

ACT 1-30 Answer Explanation

1. **The Correct Answer is A.** A comma is needed between form and from to create a series. A comma is needed between tiny and water to separate two adjectives describing the same noun.  
**Skill:** Comma use with participial phrases

2. **The Correct Answer is J.** The correct transition is however, which alerts the to a contrasting thought to the previous thought. Use of the transition word “additionally” would mean a thought is being added to the previous thought. Use of the transitional phrase “for example” would mean an example (not a new thought) is being given for the previous thought.  
**Skill:** Comma use with interrupters and proper use of transitions

3. **The Correct Answer is D.** An adjective clause MUST have a subject and a verb. Answer D is the only answer which provides a subject “they”.  
**Skill:** Dependent adjective clause

4. **The Correct Answer is H.** A sentence written in active voice must have the subject/s of the sentence performing the action. Answer H is the only answer which has the subjects (Kenneth Libbrecht and Hannah Arnold) performing an action(have discovered). The other choices provide the action first (F-has revealed, G-has been made, J-has been discovered) and the subjects receiving the action making these answers all passive voice.  
**Skill:** Use of active voice and clarity

5. **The Correct Answer is B.** This question deals with correct comma usage when combining two independent clauses. Independent clauses are two complete sentences joined as one. In this case, “Snowflakes begin to form when water in the atmosphere freezes” and “It causes the water molecules to bond into a hexagonal shape.” Each of these clauses have a subject (snowflakes and it) and a verb (begin and causes). There are two options to join these clauses correctly: 1) a comma and a coordinating conjunction, 2) a semicolon. None of the answer choices provide either of the options, therefore the second clause must be changed by having the subject removed. Only answer B removes the subject, making the sentence correct.  
**Skill:** Comma usage

6. **The Correct Answer is J.** This question requires you to choose the correct verb based on agreement with the subject and tense agreement with other verbs. The subject of the clause is “molecules” which is plural. A plural verb must accompany a plural subject, therefore answer F can be eliminated. The other verb in the sentence ( descent) is present tense. Verbs must match in tense, therefore G and H, which contain past tense verbs) can be eliminated.  
**Skill:** Subject-verb agreement/Verb Tense

7. **The Correct Answer is B.** This question requires you to utilize basic knowledge learned in science courses. Answer B contains the correct phases and acknowledges the correct order of the phases. A is incorrect because the phases of vapor and solid are not mentioned in the underlined portion. Answer C is incorrect because no adjectives are used to provide the reader with a “visual description” and because the underlined portion does not mention vapor. Answer B is incorrect because the underlined portion does not offer an explanation pertaining to reactions of molecules or to “various air temperatures”.

**Skill:** Cause and effect

8. **The Correct Answer is J.** This question requires you to choose the correct verb based on agreement with the subject and tense agreement with other verbs. The subject of the sentence, snowflakes, is plural. A plural subject must accompany a plural verb, therefore answer F can be eliminated. The verb must also agree in tense with other verbs in the sentence, in this case the verb “begin”. Since “begin” is present tense, answer G (future tense) and answer H (past tense) can be eliminated.

**Skill:** Subject-verb agreement/Verb tense

9. **The Correct Answer is C.** This question requires you to determine what if any punctuation is needed after the word process. Process of elimination is the best method for this question. Answer A is incorrect because the word dust has no function in this sentence; it cannot be left unchanged and still make sense. Answer B is incorrect because the verb “is” changes the meaning of the sentence and would imply “process” is “dust”. Answer D is incorrect because the use of semicolon requires that an independent (complete sentence) occurs on each side of the semicolon. The word “dust” does not create a complete sentence. Therefore, a semicolon cannot be used. By process of elimination the only correct answer is C. A semicolon is appropriate because an independent clause can be found before the semicolon and the word “dust” serves as an additional explanation for “one significant addition”.

**Skill:** Use of colon as identifier/ explanation

10. **The Correct Answer is J.** Process of elimination is the best method for this question. A comma is not required for this sentence, therefore answers F, G, and H can be eliminated. Answer J is the best choice because, once the article “the” is eliminated from the sentence, the meaning of the sentence becomes clear.

**Skill:** Clear subject/ comma use

11. **The Correct Answer is B.** The word “quick” is meant to modify the verb form and therefore, must be an adverb. Adverbs usually end in an “ly”; therefore, answers A and D can be eliminated. Answer C is incorrect because the adjective “most” implies the greatest amount and is typically preceded by the article “the” and followed by a noun. Answer B is the best choice because “quickly” is an adverb and because the adverb “more” implies a comparison, which makes sense in the sentence due to various wind pressure.

**Skill:** Parts of Speech

12. **The Correct Answer is G.** This question requires you to choose the best punctuation for an introductory clause. Answer G is the best choice because, "Although these snowflakes appear to have a triangular shape.." is an introductory clause and must be connect to an independent sentence by a comma. Answer F is incorrect because hyphens are used to indicated a grammatical link within a sentence or a combined meaning. Answer H is incorrect because a semicolon must have an independent clause (complete sentences) on each side. J is incorrect because a semicolon must be preceded by an independent clause (complete sentence).

**Skill:** Dependent/ independent clause

13. **The Correct Answer is A.** The final sentence in any essay leave the reader with a final thought pertaining to the main point of the essay. Answer A is the best choice because "the basic laws of chemistry" is a reoccurring theme throughout the essay and most clearly completes the sentence. Answer B is incorrect because the word "certain" is an absolute. The essay did not infer absolutes. Answer C is incorrect because it contradicts other information given in the essay. Answer D is incorrect because the shape and size of snowflakes is not the main point of the essay.

**Skill:** Summarizes and restates clearly

14. **The Correct Answer is H.** Answer H is the best choice because the final sentence in paragraph three provides a physical description of the snowflake; the additional sentence in question four continues this physical description. Answers F and G are incorrect because paragraph one deals mainly chemical aspects of the "triangular" snowflake. Answer J is incorrect because paragraph four deals mainly with the effect of wind resistance on the edges of the snowflake.

**Skill:** Clarifies and gives example

15. **The Correct Answer is D** because, although the first paragraph states, "The rare 'triangular' snowflake, similarly, confounded scientists for years because it apparently defied the basic laws of chemistry.", the final paragraph states "..., the basic laws of chemistry still apply." Answers A and B are incorrect because the final paragraph states "..., the basic laws of chemistry still apply". Answer C is incorrect because of the explanation the answer provides. The fact scientist are struggling to determine how the snowflake is formed does not imply the laws of chemistry have changed.

**Skill:** Primary Purpose

16. **The Correct Answer is H** because the introductory clause, " Bundled up in wool sweaters and thick coats" must be joined to the independent clause by a comma. Answer F is incorrect a coordinating conjunction (for, and, not, yet, but, yet, nor) are not used to join an introductory and dependent clause. Answers F and J are incorrect because the subject of the independant (we) is eliminated causing the sentence to become a fragment. **Skill:** Participial phrase

17. **The Correct Answer is B.** This question requires you to determine the tense of other verbs used in the sentence and match that tense to the answer choices. "Hiked" is another verb used in the sentence and is past tense, therefore would need is the correct tense to use. Answer A is incorrect because "would have needed" is future perfect tense and does not match. Answer C is incorrect because "will need" is future tense and does not match. Answer D is incorrect because "need" is present tense and does not match.

**Skill:** Shift in tense

18. **The Correct Answer is J** is the correct answer because it completes the sentence without using any redundancy (stating the same idea that has already been stated in the paragraph). Answer F is incorrect because "we were slipping on" is redundant of "slipped". Answer G is incorrect because "even though we used our walking sticks" is redundant of "we tried to steady ourselves with our walking sticks." Answer H is incorrect because "despite any efforts to remain steady is redundant of "We tried to steady ourselves."

**Skill:** Redundancy

19. **The Correct Answer is C.** This question requires you to determine both correct preposition and correct verb tense. Answer C is the best choice because "piled" is past tense which matches the other verbs in the sentence "unsettled and reassured" and used the correct preposition "with". Answer A is incorrect because the roof was not located on the rocks. Answer B is incorrect because "piling" is present tense and does not match the other verbs in the sentence. Answer D is incorrect because "piling" is present tense and does not match the other verbs in the sentence and because the roof was not "on" the rocks.

**Skill:** Correct preposition/Verb tense

20. **The Correct Answer is H.** Process of elimination is the best strategy for this questions. Answer A is incorrect because "sticks which it was proof of" contains the subject "it". In order for the sentence to be correct the word which would need to be removed and a semicolon or comma and coordinating conjunction would need to be added. G is incorrect because "sticks, it was proof of" creates a compound sentence with two independant clauses. In order for the sentence to be written correctly a coordinating conjunction would need to be added to the comma. Answer D is incorrect because "proved" is past tense.

**Skill:** Adjective phrase

21. **The Correct Answer is A** because the correct because most is used when comparing quantities or amounts. Since we are talking about the length of the route, most is the best choice. Answer B is incorrect because "the most part" is used as a superlative adjective. Answer C is incorrect because the article "the" would need to be added in front of "majority". Answer D is incorrect because the sentence does not make a full comparison. Ex (thinly spread across the mountain for **more of the route than** they were last year)

**Skill:** Comparative/ Superlative adjective

22. **The Correct Answer is F.** The best strategy for answering this question is thru the process of elimination. Answer G, H, and J are incorrect because they would each make a compound sentence. In order to have a correct sentence a semicolon or coordinating conjunction would need to be added in place of or with the comma.

**Skill:** Participial phrase

23. **The Correct Answer is B** is correct because “a few steps at a time” show the group was moving slowly and the answer does not imply the groups choose to go slowly. Answer A is incorrect because “Progressing along the trail” does not indicate the speed at which the group was going. Answer C is incorrect because it does not indicate the speed at which the group was going. Answer D is incorrect because it only indicates the the direction the group is going not the speed.

**Skill:** Clarity

24. **The Correct Answer is H** correct because a comma is needed to separate the introductory clause from the independent clause. Answer F is incorrect because a semicolon can only follow an independent clause. Answer G is incorrect because hyphens are used between words that have a combined meaning. Answer J is incorrect because a semicolon comes between two independent clauses, not between an introductory clause and an independent clause.

**Skill:** Comma use in prepositional phrases

25. **The Correct Answer is C** because “cliffs’ “ indicates both plural and possessive. Since the cliffs do not have ownership, there is no need for the apostrophe after the word. Also, crater’s is correct because there is only one crater and the crater possess the edge. Answer A is incorrect because “cliffs” should not show ownership. Answer B is incorrect because “craters” should not be plural and possessive. Answer D is incorrect because “craters” should be possessive not plural.

**Skill:** Possessives

26. **The Correct Answer is F.** Answer F is the best choice because the word “waited” is used twice, implying a feeling of anticipation. Answer G is incorrect because the idea of waiting was introduced before this paragraph and it is not the focus of the entire paragraph. Answer H is incorrect because the sentence does not contradict any previous sentences. Answer J is incorrect because a “clear image” is not presented. A “clear image” would be more descriptive containing adjectives and sensory details.

**Skill:** Editing

27. **The Correct Answer is D.** Answer D is the best choice because the transition “Finally” implies that what comes next has been anticipated. Since the group, “waited and waited” as stated the previous sentence, finally is the best choice. Answer A is incorrect because “generally” means usually or most of the time which does not work in this instance. Answer B is incorrect because the word “Furthermore” means in addition to. The sentence is not adding to the sentence before it, therefore this would not be the best choice. Answer C is incorrect because “once again” means something is taking place that has already happened before. This is not the case in this sentence.

**Skill:** Transitions

28. **The Correct Answer is G** because “shattered” implies the sun broke or forced its way through to the “gray volcanic rock”. Answer F is incorrect because because of the word “out”. This would imply the sun removed the “gray volcanic rock” which would be impossible. Answer H is incorrect because the word “smothered” is not as **dramatic** as the word “shattered”. Answer J is incorrect because “went over” would not emphasize the ruggedness of the landscape.

**Skill:** Use of appropriate diction

29. **The Correct Answer is A.** Answer A is the best choice because the sentence adds detail to the beginning of the trip, including preparations that were made. Answers B, C, D would not be logical placing for the sentence and would result in events being placed out of chronological order.

**Skill:** Logical sequencing

30. **The Correct Answer is F** because the paragraph repeatedly describes the difficult terrain, the need to travel in the dark, and the required gear needed for navigating the trail. Answer G is incorrect because the primary focus of the essay is not the need for walking sticks and tools. Answer H is incorrect because the essay does describe the hike as challenging. Answer J is incorrect because the primary focus of the paragraph is not on the landscape.

**Skill:** Clearly supporting details

31. **The Correct Answer is B.** Since the sentence includes the word “named” the boy’s specific name “Juan Quezada” is not an appositive and is required for the sentence to make sense; therefore, no commas are needed. Answers A, C, and D do not follow the comma rules since all the information is essential to the sentences and would result in a comma splice.

**Skill:** Comma usage

32. **The Correct Answer is H** because parenthesis are used to interrupt with non-essential information and do not need a comma before parenthesis interruption. Answer F is incorrect

because hyphens can be used to offset information that is non-essential, but relative, to the subject matter of the sentence. Answer G is incorrect because commas can be used to offset non-essential, but relative, information in a sentence. Answer J is incorrect because parenthesis can be used to offset information that is non-essential, but relative, information in a sentence.

**Skill:** Proper use of Punctuation

33. **The Correct Answer is B** because a comma is not needed before a dependent clause at the end of a sentence. "If" is a subordinating conjunction, therefore creating a dependent clause. Answer A is incorrect because the comma placed before "if" is not needed and because the question mark at the end of the sentence is not need since the sentence is declarative not interrogative. Answer C is incorrect because a comma is not need before a dependent clause at the end of a sentence. Answer D is incorrect because the sentence is not interrogative, so it does not need a question mark.

**Skill:** Proper use of Punctuation

34. **The Correct Answer is H** because paragraph two begins by describing the process of preparing the clay. The sentence being added talks about the where the clay comes from, so it is a logical choice. Answer F is incorrect because the size and location of the streets are irrelevant in the paragraph. Answers G and J would be later appropriate in the paragraph but would not be appropriate as the beginning sentence of the paragraph.

**Skill:** Editing

35. **The Correct Answer is A** because the verb tense aligns with the other verb "was" in the sentence. Answers B and C contain no verb and would result in making this sentence a fragment. Answer B because "has taught" is prefect present tense and would imply Quezada is still teaching.

**Skill:** Verb Tense

36. **The Correct Answer is F.** The best strategy for this question is process of elimination. Answers G and H are incorrect because paragraph two explains the complex method of creating the pots and the complex artistic designs Quezada used to create his pots. Since both of these answer imply the pots were not complex, these answers would be incorrect. Answer J is incorrect because the word "outmoded" means out-of-date and no longer appealing to people.

**Skill:** Purpose

37. **The Correct Answer is A** because the word "led" is past tense, so it corresponds to the other parts of the passage. Also, "him" is the correct pronoun for his. Answer B is incorrect because "lead" is present tense and would not correspond with the other verbs in the passage.

Also, "himself" is a reflexive pronoun and would not be appropriate since the pronoun him was not previously used in the sentence. Answer C is incorrect because, although "led" is the correct verb, "himself" is a reflexive pronoun and is not appropriate since the pronoun him was not previously used in the sentence. Answer D is incorrect because the verb "lead" would not correspond with the verbs used elsewhere in the passage even though the pronoun "him" is correct.

**Skill:** Verb Tense/Pronoun-antecedent agreement

38. **The Correct Answer is F** because the adverb "eventual" implies a wait. Since the questions ask which adverb suggest the partnership took time, F is the best choice. Answer G is incorrect because "circumstantial" means implied, without clear evidence. Answer H is incorrect because "momentary" implies a short, brief amount of time. Answer J is incorrect because "Timely" suggests perfect timing without having to wait.

**Skill:** Correct Diction

39. **The Correct Answer is C**, because it is concise, clear, grammatical correct and not redundant. Answer A is not the best choice because it is redundant. The "United States" and "the places" are the same. Answer B is not the best choice because it is wordy making the meaning unclear. Answer D is not the best choice because if you delete the underlined portion you would be left with an independent clause which would require a semicolon.

**Skill:** Editing

40. **The Correct Answer is J** the best strategy for this question is process of elimination. Answer F is incorrect because the coordination conjunction "so" is not needed since an independent clause does not follow. Answer G is incorrect because it is wordy and "then" should be "than" since a comparison is being made. Answer H incorrect because of the word "of". The word "for" should be in the answer instead.

**Skill:** Sentence Clarity

41. **The Correct Answer is C** is correct because stating the exact location makes the information in the sentence both clearer and relevant to the essay. Answer A is incorrect because the word "around" is too vague. Answer B is incorrect because it is redundant. Since the sentence already says "Today" there is no need to add "now". Answer D is incorrect because the reader would not know what there was four hundred of making the sentence too vague.

**Skill:** Sentence Clarity

42. **The Correct Answer is G** because the pronoun "whom" refers to people and is a relative pronoun. Answer F is incorrect because "which" is not used when referring to people. Answer H is incorrect because the pronoun "them" is used when describing the object of a sentence.



Answer J is incorrect because the pronoun “who” is used when talking about the subject of a sentence.

**Skill:** Pronoun usage

43. **The Correct Answer is D** because the antecedent of the pronoun is **Each**. Each is singular and must be used with a singular pronoun. Answer A is incorrect because “they’re” is a contraction meaning they are. Answer B is incorrect because, although his is the correct pronoun, her selves is a reflexive, plural pronoun and does not correspond with the antecedent “Each”. Answer C is incorrect because, although his is the correct pronoun, hers is plural and does not match the antecedent.

44. **The Correct Answer is J** because sentence two introduce the idea of people making their own pots and sentence three expands on the amount of people who are now artist in the area. Between the two sentence is the most logical place to add the information because it connects sentence two and three together. Answer F is not the best choice because sentence four is a better ending to the essay. Answer G and H are not the best choice because the author has not yet introduced the concept of multiple artist in the area.

**Skill:** Sequencing Information

45. **The Correct Answer is C** because, although the author tells us there are more artist in Mata ortiz making pots, the thesis and main points of the essay focus only on one person, Juan Quezada. Answer A is not correct because, although the facts in the answer are accurate, the primary purpose of the essay is not to compare and contrast the pottery. Answer B is incorrect because although the essay does mention the quality of the pottery, it is not the primary purpose of the essay. Answer D is incorrect because the focus of the paragraph is not the Casas Grandes culture.

**Skill:** Author’s Purpose

46. **The Correct Answer is J (its)**. It’s is a contraction for it is, which wouldn’t make sense in this sentence. In this case, you need the possessive form (its) to refer to the height of the building. Also, this is a singular building, so neither of the plural answers would make sense.

**Skill:** Contractions/Possessives

47. **The Correct Answer is D**. No comma is needed eliminating B and C. Verb tense must match the remaining paragraph - attend and admire.

**Skill:** Verb Tense

48. **The Correct Answer is H** because you need a word that shows contrast in this situation. Consequently shows a cause and effect relationship, whereas both in fact and for example show examples. **Skill:** Transitions

49. **The Correct Answer is B**. Parallel structure within the sentence. It matches the previous independent clause (sentence) “to attend”.

**Skill:** Parallel Structure

50. **The Correct Answer is F.** Semicolons are used to separate two complete sentences that are related. The J answer is a comma splice. G and H both use vague pronoun references.

**Skill:** Punctuation (Semicolons, Commas)

51. **The Correct Answer is D.** The information is not a continuous focus of the essay.

**Skill:** Editing/Relevance

52. **The Correct Answer is J.** All of the answers other than J restate information already provided in the previous sentence.

**Skill:** Redundancy

53. **The Correct Answer is A** - no change. The part following the vocabulary word is a definition enclosed in commas. B creates a fragment in the second sentence. C causes a subject/verb agreement problem. D creates a comma splice.

**Skill:** Punctuation (Periods/Commas)/Appositives

54. **The Correct Answer is F.** G and H try to use an adverb (elegantly) to describe a noun. J uses incorrect subject-verb agreement.

**Skill:** Subject-Verb Agreement

55. **The Correct Answer is B.** This is formal style using poetic/descriptive structure. C does not follow the same positive tone or connotation. D is too simplified (the question says "elaborate style").

**Skill:** Style (Tone)

56. **The Correct Answer is G.** The sentence simply describes the Lyceum Theatre. It doesn't do anything else suggested in the other answers.

**Skill:** Editing

57. **The Correct Answer is C.** With letter "C" the interior is being described while in the previous part the exterior is being described.

**Skill:** Editing

58. **The Correct Answer is F.** All other answers have transitions, but they are not actually transitioning to or from a new idea.

**Skill:** Transitions

59. **The Correct Answer is D.** Both words mean the same thing, so the simplest answer would be "enhancing". No repetition.

**Skill:** Wordiness

60. **The Correct Answer is G.** This essay describes the features of the Lyceum that fit the Beaux Arts architectural style. It does not discuss other theaters, so the answer is not F.

**Skill:** Editing

61. **The Correct Answer is C.** Adjectives can only be used to describe nouns, and adverbs can only be used to describe verbs, adjectives, or other adverbs. A is using an adjective to describe an adjective, and B uses an adverb to describe a noun. D is incorrect because an object of the preposition is required after with, and inaccurate is an adjective.

**Skill:** Adjectives/Adverbs

62. **The Correct Answer is G.** The answer is not H because there would not be an independent clause on each side of the semicolon. J looks like it sets up a list, but it does not. If left alone, it would be a comma splice. Colons can be used when the second part of a sentence explains the first.

**Skill:** Punctuation (Colons/Semicolons/Commas)

63. **The Correct Answer is D.** Untruths (the subject) must be matched to the verb "matter" (the verb). Ignore the interrupting phrase separated by dashes.

**Skill:** Subject-Verb Agreement

64. **The Correct Answer is F.** In this sentence, the word for acts as a conjunction. J would create a comma splice.

**Skill:** Punctuation (Colons/Semicolons/Commas)

65. **The Correct Answer is C.** The sentence is a contrast to the information and it gives the specific information leading to the remainder of the essay. D - Instead is not as specific an indication.

**Skill:** Transitions

66. **The Correct Answer is H.** In F and G, advocates is written as if it is possessive, but it is not. Movement has to be made possessive, so the answer would not be J.

**Skill:** Possessives

67. **The Correct Answer is D.** Herself is a reflexive pronoun reflecting back to "She". It does not require commas eliminating all of the other choices.

**Skill:** Punctuation (Commas)

68. **The Correct Answer is G.** The addition would, in fact, add details about the types of changes Jones made to create her public persona. It wouldn't be F because it doesn't show contrast. It wouldn't be H because the details are related.

**Skill:** Editing

69. **The Correct Answer is D.** Two independent clauses (sentence) referring to the same subject matter are separated by a semicolon. A is a comma splice; B should have a semicolon in front of in fact.

**Skill:** Punctuation (Semicolons, Commas)

70. **The Correct Answer is J.** The quote supports the claim that Jones redefined the boundaries of home by showing that home is a state of mind, not a physical address.

**Skill:** Editing

71. **The Correct Answer is A.** It completes the metaphor that compares Jones to the head of the family. Both C and D do not follow the line of thinking. B specifically says Jones cares more about family relatives and the story says workers.

**Skill:** Editing

72. **The Correct Answer is F** because the second part of the sentence explains the first. G sets up a list, but then does not list anything. H and J do not use an independent clause before the colon, which is required.

**Skill:** Punctuation (Commas/Colons)

73. **The Correct Answer is B.** "Because of" gives an explanation. Eliminate the other choices, since they do not fit the meaning of the sentence.

**Skill:** Transitions

74. **The Correct Answer is H.** The possessive form their should be used. There refers to a place, and they're is a contraction of they are.

**Skill:** Word Choice

75. **The Correct Answer is D.** The writer's goal is to summarize women's contributions. Since the passage discusses only one specific character, it does not match the focus.

**Skill:** Editing

\* Any Alg 1 problem could be considered Pre-Alg. As well.

ACT Math Practice Test (60 pts)

Correct	Type	Bubbles	Points	Standards
1. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input checked="" type="radio"/> D <input type="radio"/> E	Multiple Choice	ABCDE	1	1
<p>MA.AII.S-CP.1 <b>Alg 2 Probability</b> Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").</p>				
2. <input type="radio"/> F <input type="radio"/> G <input checked="" type="radio"/> H <input type="radio"/> J <input type="radio"/> K	Multiple Choice	FGHJK	1	1
<p>MA.AI.S-ID.2 <b>Alg 1</b> Use statistics appropriate to the shape of the data distribution to compare center (median, <u>mean</u>) and spread (interquartile range, standard deviation) of two or more different data sets.</p>				
3. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input checked="" type="radio"/> E	Multiple Choice	ABCDE	1	1
<p>MA.G.G-SRT.2 <b>Geo Use cross products</b> Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.</p>				
4. <input checked="" type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E	Multiple Choice	FGHJK	1	1
<p>MA.AI.A-CED.4 <b>Alg 1</b> Rearrange formulas to highlight a quantity of interest, using the same reasoning as in <u>solving equations</u>.</p>				
5. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input checked="" type="radio"/> E	Multiple Choice	ABCDE	1	1
<p>MA.AI.F-IF.2 <b>Alg 1</b> Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.</p>				
6. <input type="radio"/> F <input type="radio"/> G <input checked="" type="radio"/> H <input type="radio"/> J <input type="radio"/> K	Multiple Choice	FGHJK	1	1
<p>MA.AI.A-CED.1 <b>Alg 1</b> Create equations and inequalities in one variable and use them to solve problems.</p>				
7. <input type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input checked="" type="radio"/> E	Multiple Choice	ABCDE	1	2
<p>MA.AAT.F-IF.3 <b>Alg 2</b> Identify the real zeros of a function and explain the relationship between the real zeros and the x-intercepts of the graph of a function (polynomial, rational, exponential, logarithmic, and trigonometric).</p>				
<p>MA.AII.F-LE.2 Construct linear and exponential functions, including arithmetic and <u>geometric sequences</u>, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).</p>				
8. <input type="radio"/> F <input type="radio"/> G <input checked="" type="radio"/> H <input type="radio"/> J <input type="radio"/> K	Multiple Choice	FGHJK	1	1
<p>MA.AI.F-BF.1 <b>Alg 1</b> Write a function that describes a relationship between two quantities.</p>				
9. <input checked="" type="radio"/> A <input type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E	Multiple Choice	ABCDE	1	1
<p>MA.AI.F-BF.1 <b>Alg 1</b> Write a function that describes a relationship between two quantities.</p>				
10. <input type="radio"/> F <input type="radio"/> G <input type="radio"/> H <input type="radio"/> J <input checked="" type="radio"/> K	Multiple Choice	FGHJK	1	1
<p>MA.AI.S-ID.2 <b>Alg 1</b> Use statistics appropriate to the shape of the data distribution to compare center (<u>median</u>, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p>				
11. <input type="radio"/> A <input type="radio"/> B <input checked="" type="radio"/> C <input type="radio"/> D <input type="radio"/> E	Multiple Choice	ABCDE	1	1
<p>MA.AI.F-BF.1 <b>Alg 1</b> Write a function that describes a relationship between two quantities.</p>				
12. <input type="radio"/> F <input type="radio"/> G <input type="radio"/> H <input type="radio"/> J <input checked="" type="radio"/> K	Multiple Choice	FGHJK	1	1
<p>MA.G.G-MG.2 <b>Geo Area &amp; Perimeter</b> Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).</p>				

- 13.  A  B  C  D  E **Geo Vertical angle** Multiple Choice ABCDE 1 1  
 MA.G.G-CO.9 **Angle sum theorem**  
 Prove theorems about lines and angles.
- 14.  F  G  H  J  K **Geo Central angles** Multiple Choice FGHIK 1 1  
 MA.G.G-C.2 Identify and describe relationships among inscribed angles, radii, and chords.
- 15.  A  B  C  D  E **Alg 1 Write a system of equations +** Multiple Choice ABCDE 1 1  
 MA.AI.A-CED.1 Create equations and inequalities in one variable and use them to solve problems.
- 16.  F  G  H  J  K **Alg 1 Find slope** Multiple Choice FGHIK 1 1  
 MA.AI.F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
- 17.  A  B  C  D  E **Geo Linear pair of angles** Multiple Choice ABCDE 1 1  
 MA.G.G-CO.9 Prove theorems about lines and angles.
- 18.  G  H  J  K **Alg 1 ordering fractions** Multiple Choice FGHIK 1 1  
 MA.AI.N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- 19.  A  B  C  D  E **Alg 1 scientific notation** Multiple Choice ABCDE 1 1  
 MA.AI.N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- 20.  G  H  J  K **Geo Trapezoids** Multiple Choice FGHIK 1 1  
 MA.G.G-CO.11 Prove theorems about parallelograms.
- 21.  A  B  C  D  E **Alg 2** Multiple Choice ABCDE 1 1  
 MA.AII.S-CP.3 Understand the conditional probability of A given B as  $P(A \text{ and } B)/P(B)$ , and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
- 22.  F  G  H  J  K **Alg 2 exponent rules** Multiple Choice FGHIK 1 1  
 MA.AII.F-LE.4 For exponential models, express as a logarithm the solution to  $ab^{ct} = d$  where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.
- 23.  B  C  D  E **Alg 1 distributive property + simplify** Multiple Choice ABCDE 1 1  
 MA.AI.A-SSE.2 Use the structure of an expression to identify ways to rewrite it.
- 24.  F  G  H  J  K **Alg 1 Factor, zero product property, + solve** Multiple Choice FGHIK 1 1  
 MA.AI.A-REI.4.b Solve quadratic equations by inspection (e.g., for  $x^2 = 49$ ), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as  $a \pm bi$  for real numbers a and b.
- 25.  A  B  C  D  E **Alg 1 percentages** Multiple Choice ABCDE 1 1  
 MA.AI.S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

26.  F  H  J  K **Geo Angle addition postulate** Multiple Choice FGHIK 1 1  
 MA.G.G-CO.9 Prove theorems about lines and angles.
27.  A  B  C  D  E **Geo special right triangles** Multiple Choice ABCDE 1 1  
 MA.G.G-SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.
28.  F  G  J  K **Alg 2 x-intercepts** Multiple Choice FGHIK 1 1  
 MA.AII.A-REI.4.b Solve quadratic equations by inspection (e.g., for  $x^2 = 49$ ), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as  $a \pm bi$  for real numbers  $a$  and  $b$ .
29.  A  B  D  E **Alg 2 multiply complex numbers** Multiple Choice ABCDE 1 1  
 MA.AII.N-CN.2 Use the relation  $i^2 = -1$  and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
30.  F  H  J  K **Geo Trig Ratios** Multiple Choice FGHIK 1 1  
 MA.G.G-SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.
31.  A  B  C  E **Alg 2 simple probability** Multiple Choice ABCDE 1 1  
 MA.AII.S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
32.  F  G  H  J  K **Alg 1 mean** Multiple Choice FGHIK 1 1  
 MA.AI.S-ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
33.  A  C  D  E **Geo Proportions** Multiple Choice ABCDE 1 1  
 MA.G.G-SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor.
34.  F  G  J  K **Geo Area** Multiple Choice FGHIK 1 1  
 MA.G.G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
35.  A  B  C  E **Geo Solving Linear equations in context** Multiple Choice ABCDE 1 1  
 MA.G.G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
36.  F  G  H  K **Alg 1 systems of inequalities** Multiple Choice FGHIK 1 1  
 MA.AI.A-REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
37.  B  C  D  E **Alg 1 find & compare mean & median** Multiple Choice ABCDE 1 1  
 MA.AI.S-ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
38.  G  H  J  K **Alg 2 Quadratic + Linear systems** Multiple Choice FGHIK 1 1  
 MA.AII.A-REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.



39.  A  B  C  D  E **Geo slope** Multiple Choice ABCDE 1 1  
 MA.G.G-GPE.5  
 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
40.  G  H  J  K **Geo reflection** Multiple Choice FGHJK 1 1  
 MA.G.G-GPE.4  
 Use coordinates to prove simple geometric theorems algebraically.
41.  A  B  C  D  E **Geo midpoint + area of a trapezoid** Multiple Choice ABCDE 1 1  
 MA.G.G-GPE.7  
 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
42.  F  G  H  J  K **Alg 2 Composition** Multiple Choice FGHJK 1 1  
 MA.AII.F-BF.1  
 Write a function that describes a relationship between two quantities.
43.  A  B  C  D  E **Alg 2 ratio comparison / scale factor** Multiple Choice ABCDE 1 1  
 MA.AII.A-REI.1  
 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
44.  F  G  H  J  K **Geo Directed line segment proportions** Multiple Choice FGHJK 1 1  
 MA.G.G-CO.5  
 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.
45.  A  B  C  D  E **Pre-Cal Matrix Operations** Multiple Choice ABCDE 1 1  
 MA.PC.N-VM.7  
 Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
46.  F  G  H  J  K **Geo one step equation (real world application)** Multiple Choice FGHJK 1 1  
 MA.G.G-MG.2  
 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
47.  A  B  C  D  E **Alg 2 Comparing equivalent ratios** Multiple Choice ABCDE 1 1  
 MA.AII.S-IC.4  
 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
48.  F  G  H  J  K **Alg 2 simplify radical expressions** Multiple Choice FGHJK 1 1  
 MA.AII.A-REI.2  
 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
49.  B  C  D  E **Alg 2 solving systems of inequalities** Multiple Choice ABCDE 1 1  
 MA.AII.A-REI.6  
 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.
50.  G  H  J  K **Geo volume + subtraction** Multiple Choice FGHJK 1 1  
 MA.G.G-MG.2  
 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
51.  A  B  C  D  E **Alg 1 Comparing Ratios** Multiple Choice ABCDE 1 1  
 MA.BM.M-SV.3  
 Write ratios, proportions, and solve proportions in a contextual setting for an unknown value.



52.  F  G  J  K **Alg 1 Solving Compound Inequalities** Multiple Choice FGHIJK 1 1  
 MA.A1.A-CED.1 Create equations and inequalities in one variable and use them to solve problems.
53.  A  C  D  E **Geo Surface area** Multiple Choice ABCDE 1 1  
 MA.G.G-MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
54.  F  G  H  J  K **Alg 1 Rate of change / proportional reasoning** Multiple Choice FGHIJK 1 1  
 MA.A1.F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
55.  A  B  C  D  E **Alg 2 conditional probability using a 2-way table** Multiple Choice ABCDE 1 1  
 MA.A11.S-CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.
56.  F  G  H  J  K **Geo Comparing & analyzing area(s)** Multiple Choice FGHIJK 1 1  
 MA.G.G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.
57.  B  C  D  E **Alg 2 Trig. transformation** Multiple Choice ABCDE 1 1  
 MA.A11.F-TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
58.  F  G  H  J  K **Alg 2 Absolute value inequalities** Multiple Choice FGHIJK 1 2  
 MA.A11.A-CED.1 Create equations and inequalities in one variable and use them to solve problems.  
 MA.AAT.A-REI.3 Solve nonlinear inequalities (quadratic, trigonometric, conic, exponential, logarithmic, and rational) by graphing (solutions in interval notation if one-variable), by hand and with appropriate technology.
59.  A  B  C  D  E **Alg 2 Multiplication of independent events** Multiple Choice ABCDE 1 1  
 MA.A11.S-CP.3 Understand the conditional probability of A given B as  $P(A \text{ and } B)/P(B)$ , and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
60.  F  G  H  K **Pre-Cal Law of Sines** Multiple Choice FGHIJK 1 1  
 MA.PC.G-AT.6 Understand and apply the Law of Sines (including the ambiguous case) and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).



# 2



# 2

# Overall Key (not specified by course)

## MATHEMATICS TEST

60 Minutes—60 Questions

**DIRECTIONS:** Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

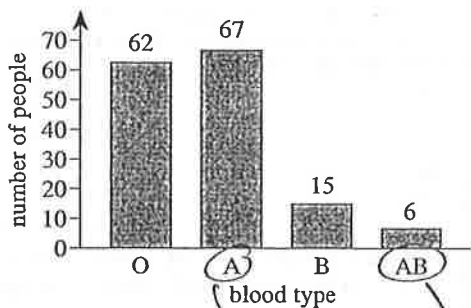
You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

1. The blood types of 150 people were determined for a study as shown in the figure below.



If 1 person from this study is randomly selected, what is the probability that this person has either Type A or Type AB blood?

- A.  $\frac{62}{150}$   
 B.  $\frac{66}{150}$   
 C.  $\frac{68}{150}$   
 D.  $\frac{73}{150}$   
 E.  $\frac{84}{150}$

What you want =  $\frac{67 + 6}{150}$   
 What is possible =  $\frac{67 + 6}{150}$

2. The monthly fees for single rooms at 5 colleges are \$370, \$310, \$380, \$340, and \$310, respectively. What is the mean of these monthly fees?

- F. \$310  
 G. \$340  
 H. \$342  
 J. \$350  
 K. \$380

$$\frac{370 + 310 + 380 + 340 + 310}{5}$$

3. On a particular road map,  $\frac{1}{2}$  inch represents 18 miles. About how many miles apart are 2 towns that are  $2\frac{1}{2}$  inches apart on this map?

- A. 18  
 B.  $22\frac{1}{2}$   
 C. 36  
 D. 45  
 E. 90

Proportion

$$\frac{\frac{1}{2}}{18} = \frac{2\frac{1}{2}}{x}$$

cross multiply

$$\frac{1}{2}x = 45.2$$

$$x = 90$$

4. Given  $f = cd^3$ ,  $f = 450$ , and  $d = 10$ , what is  $c$ ?

- F. 0.45  
 G. 4.5  
 H. 15  
 J. 45  
 K. 150

plug-in

$$450 = c \cdot 10^3$$

$$450 = c \cdot 1000$$

$$\frac{450}{1000} = c$$

$$0.45 = c$$

5. If  $f(x) = (3x + 7)^2$ , then  $f(1) = ?$

- A. 10  
 B. 16  
 C. 58  
 D. 79  
 E. 100

$$(3(1) + 7)^2 = (3 + 7)^2 = 10^2$$

6. Jorge's current hourly wage for working at Denti Smiles is \$12.00. Jorge was told that at the beginning of next month, his new hourly wage will be an increase of 6% of his current hourly wage. What will be Jorge's new hourly wage?

- F. \$12.06  
 G. \$12.60  
 H. \$12.72  
 J. \$18.00  
 K. \$19.20

$$12(1 + 0.06)$$

$$12(1.06)$$

$$12.72$$



7. The first term is 1 in the geometric sequence 1, -3, 9, -27, ... What is the SEVENTH term of the geometric sequence?

- A. -243
- B. -30
- C. 81
- D. 189
- E. 729**

1, -3, 9, -27 ... 81, -243, 729  
 mult. by -3 every time

8. The shipping rate for customers of Ship Quick consists of a fee per box and a price per pound for each box. The table below gives the fee and the price per pound for customers shipping boxes of various weights.

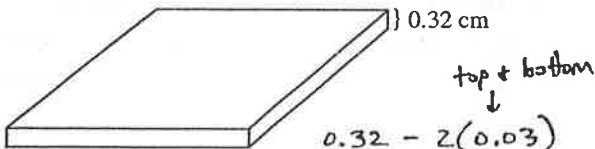
Weight of box (pounds)	Fee	Price per pound
Less than 10	\$ 5.00	\$1.00
10-25	\$10.00	\$0.65
More than 25	\$20.00	\$0.30

Gregg wants Ship Quick to ship 1 box that weighs 15 pounds. What is the shipping rate for this box?

- F. \$ 9.75
- G. \$16.50
- H. \$19.75**
- J. \$20.00
- K. \$24.50

10 + 15 (0.65) =  
 ↑ pounds ↑ price per pound

9. A computer chip 0.32 cm thick is made up of layers of silicon. If the top and bottom layers are each 0.03 cm thick and the inner layers are each 0.02 cm thick, how many inner layers are there?



- A. 13**
- B. 15
- C. 16
- D. 52
- E. 64

10. The table below shows the number of cars Jing sold each month last year. What is the median of the data in the table?

Month	Number of cars sold
January	25
February	15
March	22
April	19
May	16
June	13
July	19
August	25
September	26
October	27
November	28
December	29

- F. 13
- G. 16
- H. 19
- J. 20.5
- K. 23.5**

13, 15, 16, 19, 19, 22, 25, 25, 26, 27, 28, 29  
 middle  
 V average of 2  
 23.5

11. Students studying motion observed a cart rolling at a constant rate along a straight line. The table below gives the distance,  $d$  feet, the cart was from a reference point at 1-second intervals from  $t=0$  seconds to  $t=5$  seconds.

$x$	$t$	0	1	2	3	4	5
$y$	$d$	14	20	26	32	38	44

Which of the following equations represents this relationship between  $d$  and  $t$ ?

- A.  $d = t + 14$
- B.  $d = 6t + 8$
- C.  $d = 6t + 14$**
- D.  $d = 14t + 6$
- E.  $d = 34t$

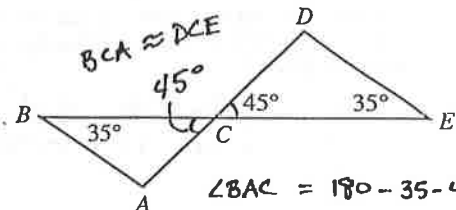
slope =  $\frac{\text{rise}}{\text{run}} = \frac{+6}{+1} = 6$   
 $b = 14$  (when  $x = 0$ )

12. The length of a rectangle with area 54 square centimeters is 9 centimeters. What is the perimeter of the rectangle, in centimeters?

- F. 6
- G. 12
- H. 15
- I. 24
- K. 30**

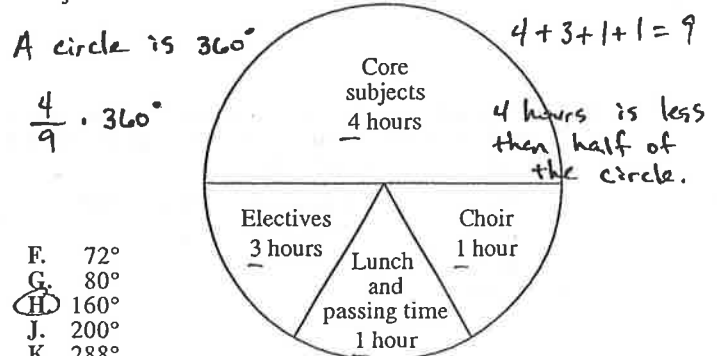
$A = l \cdot w$   
 $54 = 9 \cdot w$   
 $\frac{54}{9} = w$   
 $6 = w$   
 $P = w + w + l + l$   
 $P = 6 + 6 + 9 + 9$   
 $P = 30$

13. In the figure below,  $C$  is the intersection of  $\overline{AD}$  and  $\overline{BE}$ . If it can be determined, what is the measure of  $\angle BAC$ ?



- A. 80°
- B. 100°**
- C. 110°
- D. 115°
- E. Cannot be determined from the given information

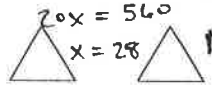
14. Antwan drew the circle graph below describing his time spent at school in 1 day. His teacher said that the numbers of hours listed were correct, but that the central angle measures for the sectors were not correct. What should be the central angle measure for the Core subjects sector?



- F. 72°
- G. 80°
- H. 160°**
- J. 200°
- K. 288°

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2



2

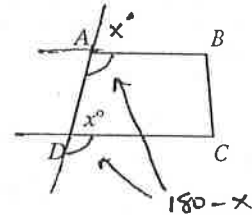
15. This month, Kami sold 70 figurines in 2 sizes. The large figurines sold for \$12 each, and the small figurines sold for \$8 each. The amount of money he received from the sales of the large figurines was equal to the amount of money he received from the sales of the small figurines. How many large figurines did Kami sell this month?

- A. 20
- B. 28**
- C. 35
- D. 42
- E. 50

$x = \text{large}$   
 $x + y = 70$   
 $y = 70 - x$   
 $12x = 8y$   
 plug in

20. For trapezoid ABCD shown below,  $\overline{AB} \parallel \overline{DC}$ , the measures of the interior angles are distinct, and the measure of  $\angle D$  is  $x^\circ$ . What is the degree measure of  $\angle A$  in terms of  $x$ ?

- F.  $(180 - x)^\circ$**
- G.  $(180 - 0.5x)^\circ$
- H.  $(180 + 0.5x)^\circ$
- J.  $(180 + x)^\circ$
- K.  $x^\circ$



16. A car accelerated from 88 feet per second (fps) to 220 fps in exactly 3 seconds. Assuming the acceleration was constant, what was the car's acceleration, in feet per second per second, from 88 fps to 220 fps?

- F.  $\frac{1}{44}$
- G.  $29\frac{1}{3}$
- H. 44**
- J.  $75\frac{1}{3}$
- K.  $102\frac{2}{3}$

$\frac{220 - 88 \text{ fps}}{3 \text{ seconds}} = \frac{132}{3} = 44 \text{ fps/s}$

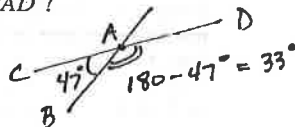
21. To get a driver's license, an applicant must pass a written test and a driving test. Past records show that 80% of the applicants pass the written test and 60% of those who have passed the written test pass the driving test. Based on these figures, how many applicants in a random group of 1,000 applicants would you expect to get driver's licenses?

- A. 200
- B. 480**
- C. 600
- D. 750
- E. 800

$80\% \text{ of } 1000 = 0.8(1000) = 800$   
 $60\% \text{ of test passers} = 0.6(800) = 480$

17. In a plane, the distinct lines  $\overleftrightarrow{AB}$  and  $\overleftrightarrow{CD}$  intersect at A, where A is between C and D. The measure of  $\angle BAC$  is  $47^\circ$ . What is the measure of  $\angle BAD$ ?

- A.  $43^\circ$
- B.  $47^\circ$
- C.  $94^\circ$
- D.  $133^\circ$**
- E.  $137^\circ$



22. If  $a$ ,  $b$ , and  $c$  are positive integers such that  $a^b = x$  and  $c^b = y$ , then  $xy = ?$

- F.  $ac^b$
- G.  $ac^{2b}$
- H.  $(ac)^b$**
- J.  $(ac)^{2b}$
- K.  $(ac)^{b^2}$

$x \cdot y$   
 $a^b \cdot c^b$   
 $(ac)^b$  exp. rule is mult. exponents

18. In which of the following are  $\frac{1}{2}$ ,  $\frac{5}{6}$ , and  $\frac{5}{8}$  arranged in ascending order?

- F.  $\frac{1}{2} < \frac{5}{8} < \frac{5}{6}$**
- G.  $\frac{5}{6} < \frac{1}{2} < \frac{5}{8}$
- H.  $\frac{5}{6} < \frac{5}{8} < \frac{1}{2}$
- J.  $\frac{5}{8} < \frac{1}{2} < \frac{5}{6}$
- K.  $\frac{5}{8} < \frac{5}{6} < \frac{1}{2}$

Get common denominator of 24:  
 $\frac{12}{24}, \frac{20}{24}, \frac{15}{24}$   
 1st, 3rd, 2nd  
 or  
 Change to decimals:  
 0.5, 0.83, 0.625  
 1st, 3rd, 2nd

23. Which of the following expressions is equivalent to  $\frac{1}{2}y^2(6x + 2y + 12x - 2y)$ ?

- A.  $9xy^2$**
- B.  $18xy$
- C.  $3xy^2 + 12x$
- D.  $9xy^2 - 2y^3$
- E.  $3xy^2 + 12x - y^3 - 2y$

Add like terms  
 $\frac{1}{2}y^2(18x)$   
 $9xy^2$

19. In scientific notation,  $670,000,000 + 700,000,000 = ?$

- A.  $1.37 \times 10^{-9}$
- B.  $1.37 \times 10^7$
- C.  $1.37 \times 10^8$
- D.  $1.37 \times 10^9$**
- E.  $137 \times 10^{15}$

$670,000,000 + 700,000,000 = 1,370,000,000$   
 move decimal 9 places

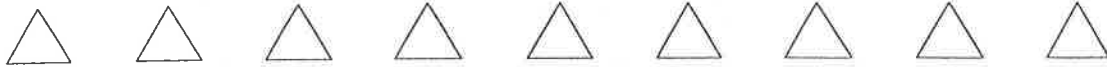
24. An artist makes a profit of  $(500p - p^2)$  dollars from selling  $p$  paintings. What is the fewest number of paintings the artist can sell to make a profit of at least  $(\geq)$  \$60,000?

- F. 100
- G. 150
- H. 200**
- J. 300
- K. 600

$500p - p^2 \geq 60000$   
 $0 \geq p^2 - 500p + 60000$   
 $0 = (p - 300)(p - 200)$   
 $p = 300, 200$

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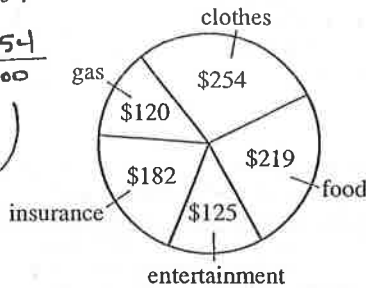
Also, you can graph  $f(x) = x^2 - 500x + 60000$  and look where it crosses the x-axis



25. Last month, Lucie had total expenditures of \$900. The pie chart below breaks down these expenditures by category. The category in which Lucie's expenditures were greatest is what percent of her total expenditures, to the nearest 1%?

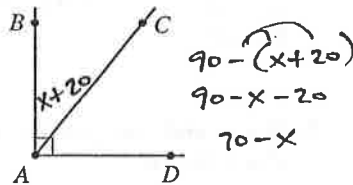
$$\frac{\text{want}}{\text{possible}} = \frac{254}{900}$$

- A. 24%
- B. 28%**
- C. 32%
- D. 34%
- E. 39%



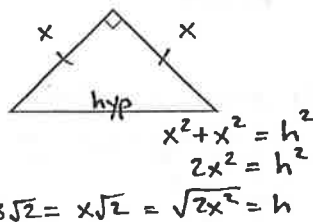
26. In the figure shown below, the measure of  $\angle BAC$  is  $(x + 20)^\circ$  and the measure of  $\angle BAD$  is  $90^\circ$ . What is the measure of  $\angle CAD$ ?

- F.  $(x - 70)^\circ$
- G.  $(70 - x)^\circ$**
- H.  $(70 + x)^\circ$
- J.  $(160 - x)^\circ$
- K.  $(160 + x)^\circ$

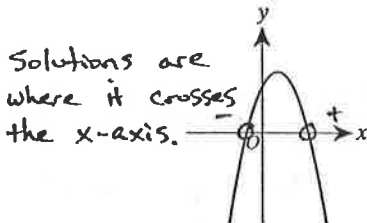


27. What is the perimeter, in inches, of the isosceles right triangle shown below, whose hypotenuse is  $8\sqrt{2}$  inches long?

- A. 8
- B.  $8 + 8\sqrt{2}$
- C.  $8 + 16\sqrt{2}$
- D. 16
- E.  $16 + 8\sqrt{2}$**



28. The equation  $y = ax^2 + bx + c$  is graphed in the standard  $(x, y)$  coordinate plane below for real values of  $a, b,$  and  $c$ . When  $y = 0$ , which of the following best describes the solutions for  $x$ ?



- F. 2 distinct positive real solutions
- G. 2 distinct negative real solutions
- H. 1 positive real solution and 1 negative real solution**
- J. 2 real solutions that are not distinct
- K. 2 distinct solutions that are not real

29. What is the product of the complex numbers  $(-3i + 4)$  and  $(3i + 4)$ ?

- A. 1
- B. 7
- C. 25**
- D.  $-7 + 24i$
- E.  $7 + 24i$

FOIL

$$(-3i + 4)(3i + 4)$$

$$-9i^2 - 12i + 12i + 16$$

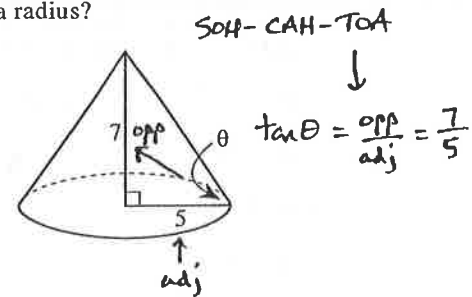
$$-9i^2 + 16$$

$i^2 = -1$

$$9 + 16 = 25$$

30. The radius of the base of the right circular cone shown below is 5 inches, and the height of the cone is 7 inches. Solving which of the following equations gives the measure,  $\theta$ , of the angle formed by a slant height of the cone and a radius?

- F.  $\tan \theta = \frac{5}{7}$
- G.  $\tan \theta = \frac{7}{5}$**
- H.  $\sin \theta = \frac{5}{7}$
- J.  $\sin \theta = \frac{7}{5}$
- K.  $\cos \theta = \frac{7}{5}$



31. To make a 750-piece jigsaw puzzle more challenging, a puzzle company includes 5 extra pieces in the box along with the 750 pieces, and those 5 extra pieces do not fit anywhere in the puzzle. If you buy such a puzzle box, break the seal on the box, and immediately select 1 piece at random, what is the probability that it will be 1 of the extra pieces?

- A.  $\frac{1}{5}$
- B.  $\frac{1}{755}$
- C.  $\frac{1}{750}$
- D.  $\frac{5}{755}$**
- E.  $\frac{5}{750}$

$$\frac{\text{want}}{\text{possible}} = \frac{5 \text{ extras}}{750 + 5} = \frac{5}{755}$$

32. What fraction lies exactly halfway between  $\frac{2}{3}$  and  $\frac{3}{4}$ ?

- F.  $\frac{3}{5}$
- G.  $\frac{5}{6}$
- H.  $\frac{7}{12}$
- J.  $\frac{9}{16}$
- K.  $\frac{17}{24}$**

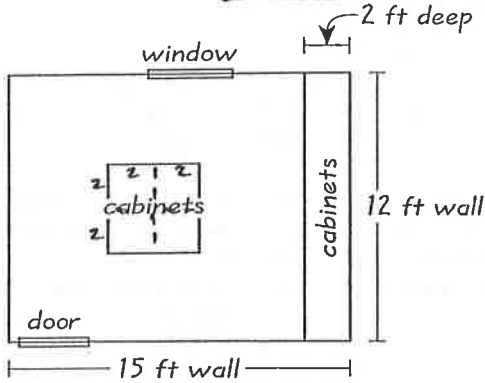
Average

$$\frac{\frac{2}{3} + \frac{3}{4}}{2} = \frac{\frac{17}{12}}{2} = \frac{17}{24}$$



Use the following information to answer questions 33–35.

Gianna is converting a 12-foot-by-15-foot room in her house to a craft room. Gianna will install tile herself but will have CC Installations build and install the cabinets. The scale drawing shown below displays the location of the cabinets in the craft room (0.25 inch represents 2 feet). **SCALE**



Cabinets will be installed along one of the 12-foot walls from floor to ceiling, and 4 cabinets that are each 3 feet tall will be installed in the middle of the room. These are the only cabinets that will be installed, and each of them will be 2 feet wide and 2 feet deep. CC Installations has given Gianna an estimate of \$2,150.00 for building and installing the cabinets.

33. A 15-foot wall is how many (inches long) in the scale drawing?
- A. 1.5  
 B. 1.875  
 C. 3  
 D. 3.375  
 E. 3.75

$$\begin{aligned} \text{Scale} &= \frac{x}{15} \\ 0.25 &= \frac{x}{15} \quad \text{cross multiply} \\ 2x &= 3.75 \\ x &= 1.875 \end{aligned}$$

34. Gianna will install tile on the portion of the floor that will NOT be covered by cabinets. What is the area, in square feet, of the portion of the floor that will NOT be covered by cabinets?
- F. 72  
 G. 90  
 H. 140  
 J. 156  
 K. 164

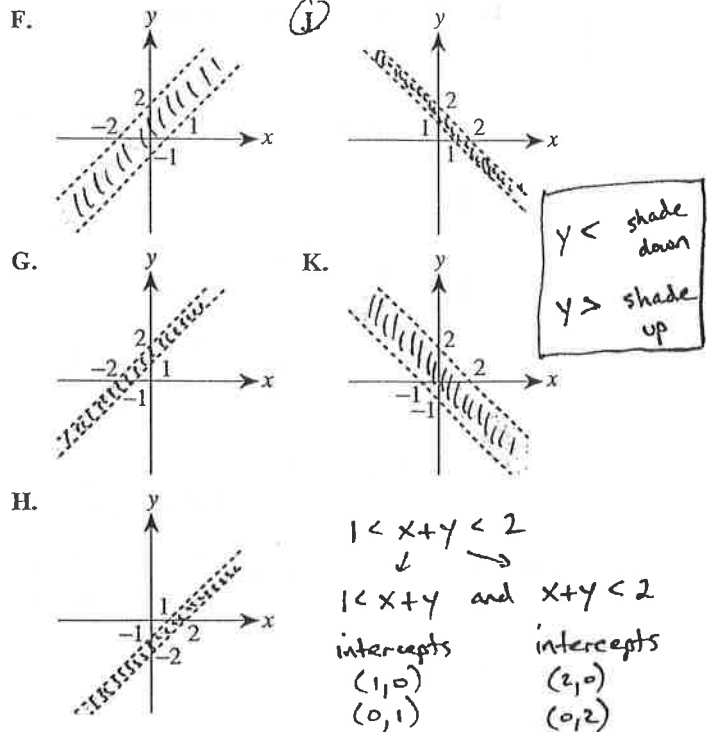
A large left rect. - A small sq.

$$(13 \times 12) - (4 \times 4) = 156 - 16 = 140$$

35. CC Installations' estimate consists of a \$650.00 charge for labor, plus a fixed charge per cabinet. The labor charge and the charge per cabinet remain the same for any number of cabinets built and installed. CC Installations would give Gianna what estimate if the craft room were to have twice as many cabinets as Gianna is planning to have?
- A. \$2,800.00  
 B. \$3,000.00  
 C. \$3,450.00  
 D. \$3,650.00  
 E. \$4,300.00

$$\begin{aligned} &\$2150 \text{ Estimate} \\ &\quad - 650 \text{ Labor} \\ &\hline &1500 \text{ Cabinets} \\ &2150 + 1500 = \$3650 \\ &\quad \uparrow \\ &\text{more cabinets} \\ &\text{(no additional labor cost)} \end{aligned}$$

36. Which of the following is the graph of the region  $1 < x + y < 2$  in the standard  $(x, y)$  coordinate plane?



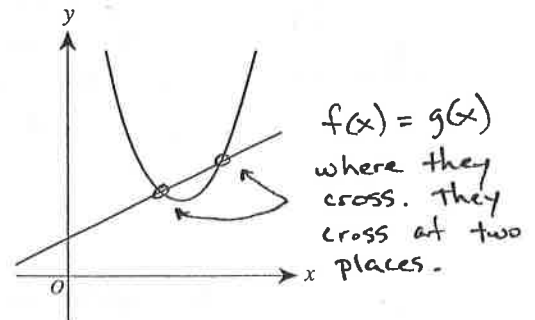
37. What is the difference between the mean and the median of the set  $\{3, 8, 10, 15\}$ ?

A. 0  
 B. 1  
 C. 4  
 D. 9  
 E. 12

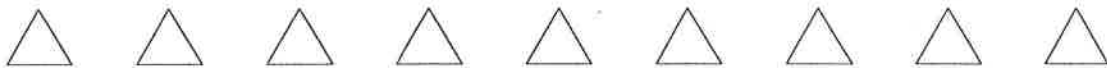
$$\text{mean} = \frac{3+8+10+15}{4} = 9$$

$$\text{median} = \frac{8+10}{2} = 9$$

38. Which of the following describes a true relationship between the functions  $f(x) = (x - 3)^2 + 2$  and  $g(x) = \frac{1}{2}x + 1$  graphed below in the standard  $(x, y)$  coordinate plane?

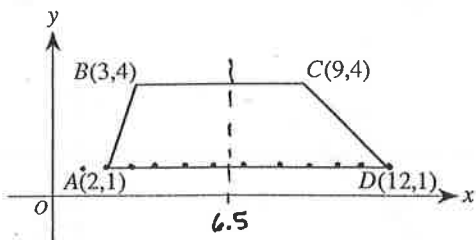


- F.  $f(x) = g(x)$  for exactly 2 values of  $x$   
 G.  $f(x) = g(x)$  for exactly 1 value of  $x$   
 H.  $f(x) < g(x)$  for all  $x$   
 J.  $f(x) > g(x)$  for all  $x$   
 K.  $f(x)$  is the inverse of  $g(x)$



Use the following information to answer questions 39–41.

Trapezoid  $ABCD$  is graphed in the standard  $(x,y)$  coordinate plane below.



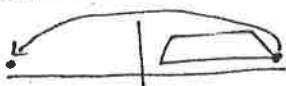
39. What is the slope of  $\overline{CD}$ ?

- A. -3
- B. -1**
- C. 1
- D.  $\frac{5}{21}$
- E.  $\frac{3}{2}$

$(9,4)(12,1)$   
 $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 1}{9 - 12} = \frac{3}{-3} = -1$

40. When  $ABCD$  is reflected over the  $y$ -axis to  $A'B'C'D'$ , what are the coordinates of  $D'$ ?

- F. (-12, 1)**
- G. (-12, -1)
- H. (12, -1)
- J. (1, 12)
- K. (1, -12)



41. Which of the following vertical lines cuts  $ABCD$  into 2 trapezoids with equal areas?

- A.  $x = 2.5$
- B.  $x = 3.5$
- C.  $x = 4.5$
- D.  $x = 5.5$
- E.  $x = 6.5$**

Look closer at graph.  
 Draw vertical lines at the bigger  $x$  values.  
 $x = 6.5$  visually looks like half.

42. Given  $f(x) = x - \frac{1}{x}$  and  $g(x) = \frac{1}{x}$ , what is  $f(g(\frac{1}{2}))$ ?

- F. -3
- G.  $-\frac{3}{2}$
- H.  $-\frac{2}{3}$
- J. 0
- K.  $\frac{3}{2}$**

Do  $g(\frac{1}{2})$  first:  
 $g(\frac{1}{2}) = \frac{1}{\frac{1}{2}} = 2$   
 Now do  $f(2)$ :  
 $f(2) = 2 - \frac{1}{2} = 1\frac{1}{2}$

43. A formula to estimate the monthly payment,  $p$  dollars, on a short-term loan is

$$p = \frac{(\frac{1}{2}ary + a)^2}{12y}$$

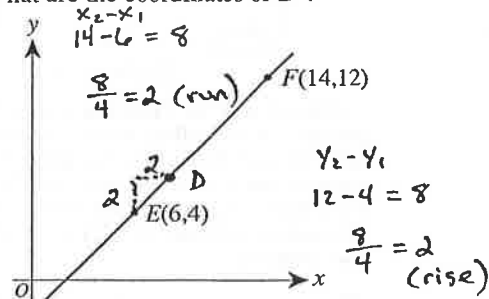
where  $a$  dollars is the amount of the loan,  $r$  is the annual interest rate expressed as a decimal, and  $y$  years is the length of the loan. When  $a$  is multiplied by 2, what is the effect on  $p$ ?

- A.  $p$  is divided by 6
- B.  $p$  is divided by 2
- C.  $p$  does not change
- D.  $p$  is multiplied by 2**
- E.  $p$  is multiplied by 4

If you multiply one side, you must multiply the other.

44. The points  $E(6,4)$  and  $F(14,12)$  lie in the standard  $(x,y)$  coordinate plane shown below. Point  $D$  lies on  $\overline{EF}$  between  $E$  and  $F$  such that the length of  $\overline{EF}$  is 4 times the length of  $\overline{DE}$ . What are the coordinates of  $D$ ?

- F. (7, 5)
- G. (8, 6)**
- H. (8, 8)
- J. (10, 8)
- K. (12, 10)



45. Given that  $a \begin{bmatrix} 2 & 6 \\ 1 & 4 \end{bmatrix} = \begin{bmatrix} x & 27 \\ y & z \end{bmatrix}$  for some real number  $a$ , what is  $x + z$ ?

- A.  $\frac{4}{3}$
- B.  $\frac{27}{2}$
- C. 26
- D. 27**
- E. 48

$$\begin{bmatrix} 2a & 6a \\ 1a & 4a \end{bmatrix} = \begin{bmatrix} x & 27 \\ y & z \end{bmatrix}$$

$6a = 27$   
 $a = \frac{27}{6}$   
 $x = 2a = 2(\frac{27}{6})$   
 $z = 4a = 4(\frac{27}{6})$   
 $\frac{81}{3} = 27$

46. A container is  $\frac{1}{8}$  full of water. After 10 cups of water are added, the container is  $\frac{3}{4}$  full. What is the volume of the container, in cups?

- F.  $13\frac{1}{3}$
- G.  $13\frac{1}{2}$
- H. 15
- J. 16**
- K. 40

$$\frac{3}{4} - \frac{1}{8} = \frac{5}{8} \rightarrow 10 \text{ cups}$$

SCALE

$$\frac{5}{8} = \frac{1 \text{ (full container)}}{x}$$

$$\frac{5}{8}x = 10$$

GO ON TO THE NEXT PAGE.

$$x = 16$$



47. Only tenth-, eleventh-, and twelfth-grade students attend Washington High School. The ratio of tenth graders to the school's total student population is 86:255, and the ratio of eleventh graders to the school's total student population is 18:51. If 1 student is chosen at random from the entire school, which grade is that student most likely to be in?

$$\frac{18}{51} = \frac{90}{255}$$

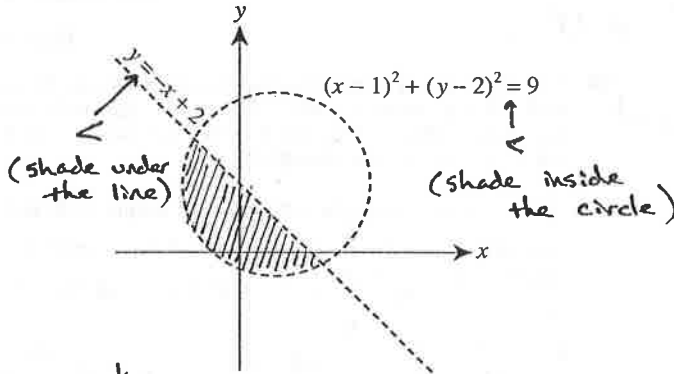
- A. Tenth  
 B. Eleventh  
 C. Twelfth  
 D. All grades are equally likely.  
 E. Cannot be determined from the given information
- Tenth 86    Eleventh 90    Twelfth 79  
 255 - 86 - 90 = 79

48.  $\frac{4}{\sqrt{2}} + \frac{2}{\sqrt{3}} = ?$

- F.  $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{5}}$   
 G.  $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{6}}$   
 H.  $\frac{6}{\sqrt{2} + \sqrt{3}}$   
 J.  $\frac{6}{\sqrt{5}}$   
 K.  $\frac{8}{\sqrt{6}}$

Add fractions:  
 $\sqrt{3} \cdot \frac{4}{\sqrt{2}} + \frac{2}{\sqrt{3}} \cdot \sqrt{3}$  get common denom.  
 $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{6}}$   
 $\sqrt{3} \cdot \sqrt{2} = \sqrt{6}$

49. The shaded region in the graph below represents the solution set to which of the following systems of inequalities?



- A.  $\begin{cases} y < -x + 2 \\ (x-1)^2 + (y-2)^2 < 9 \end{cases}$   
 B.  $\begin{cases} y > -x + 2 \\ (x-1)^2 + (y-2)^2 < 9 \end{cases}$   
 C.  $\begin{cases} y > -x + 2 \\ (x-1)^2 + (y-2)^2 > 9 \end{cases}$   
 D.  $\begin{cases} y < -x + 2 \\ (x-1)^2 + (y-2)^2 > 9 \end{cases}$   
 E.  $\begin{cases} (y-2) < 3 \\ (x-1) > 3 \end{cases}$

50. You can find the volume of an irregularly shaped solid object by completely submerging it in water and calculating the volume of water the object displaces. You completely submerge a solid object in a rectangular tank that has a base 40 centimeters by 30 centimeters and is filled with water to a depth of 20 centimeters. The object sinks to the bottom, and the water level goes up 0.25 centimeters. What is the volume, in cubic centimeters, of the object?

F. 300  
 G. 240  
 H. 200  
 J. 150  
 K. 75

Volume  
 $40 \times 30 \times 20$   
 $\sqrt{= 24000}$   
 $40 \times 30 \times 20.25$   
 $\sqrt{= 24300}$

Difference is 300.

51. If  $x:y = 5:2$  and  $y:z = 3:2$ , what is the ratio of  $x:z$ ?  
 A. 3:1  
 B. 3:5  
 C. 5:3  
 D. 8:4  
 E. 15:4

Get y's to be equal.  
 $3 \cdot 5 : 2 \cdot 3 \quad 2 \cdot 3 : 2 \cdot 2$   
 $15 : 6 \quad 6 : 4$   
 $\rightarrow 15 : 4$

52. Which of the following is the solution statement for the inequality shown below?

$-5 < 1 - 3x < 10$  Solve  
 F.  $-5 < x < 10$     -1    -1    -1    Subtract 1  
 G.  $-3 < x$   
 H.  $-3 < x < 2$      $-6 < -3x < 9$     Divide -3  
 J.  $-2 < x < 3$      $-2 > x > -3$     \* symbols flip  
 K.  $x < -3$  or  $x > 2$

53. A formula for the surface area (A) of the rectangular solid shown below is  $A = 2lw + 2lh + 2wh$  where  $l$  represents length;  $w$ , width; and  $h$ , height. By doubling each of the dimensions ( $l$ ,  $w$ , and  $h$ ), the surface area will be multiplied by what factor?

A. 2  
 B. 4  
 C. 6  
 D. 8  
 E. 12

$A = 2lw + 2lh + 2wh$   
 $4A = 4(2lw + 2lh + 2wh)$   
 If you multiply one side by 4, multiply the other.

54. A dog eats 7 cans of food in 3 days. At this rate, how many cans of food does the dog eat in  $3 + d$  days?

F.  $\frac{7}{3} + d$   
 G.  $\frac{7}{3} + \frac{d}{3}$   
 H.  $\frac{7}{3} + \frac{7}{3d}$   
 J.  $7 + \frac{d}{3}$   
 K.  $7 + \frac{7d}{3}$

SCALE  
 $\frac{7 \text{ cans}}{3 \text{ days}} = \frac{x \text{ cans}}{3+d \text{ days}}$   
 cross multiply  
 $7(3+d) = 3x$   
 $7 + \frac{7d}{3} = \frac{21 + 7d}{3} = x$  ← Divide  
 (simplify)



55. Kelly asked 120 students questions about skiing. The results of the poll are shown in the table below.

Question	Yes	No
1. Have you skied either cross-country or downhill?	65	55
2. If you answered Yes to Question 1, did you ski downhill?	28	37
3. If you answered Yes to Question 1, did you ski cross-country?	45	20

57

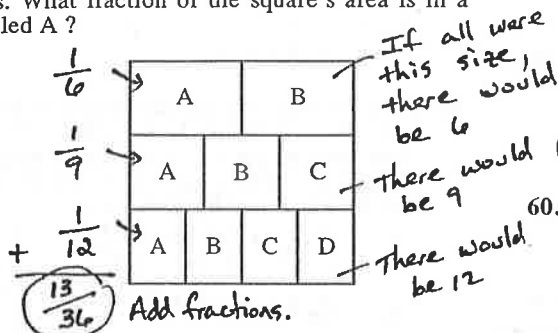
After completing the poll, Kelly wondered how many of the students polled had skied both cross-country and downhill. How many of the students polled indicated that they had skied both cross-country and downhill?

- A. 73
- B. 65
- C. 47
- D. 18
- E. 8

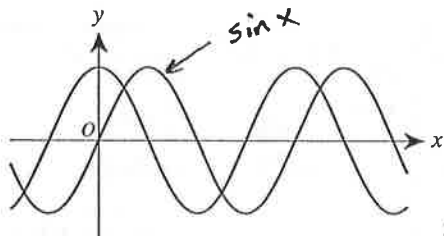
$65 - 57 = 8$   
 ↑                    ↑  
 Yes to            No to  
 one                    the other

56. The square below is divided into 3 rows of equal area. In the top row, the region labeled A has the same area as the region labeled B. In the middle row, the 3 regions have equal areas. In the bottom row, the 4 regions have equal areas. What fraction of the square's area is in a region labeled A?

- F.  $\frac{1}{9}$
- G.  $\frac{3}{9}$
- H.  $\frac{6}{9}$
- J.  $\frac{13}{12}$
- K.  $\frac{13}{36}$



57. The functions  $y = \sin x$  and  $y = \sin(x + a) + b$ , for constants  $a$  and  $b$ , are graphed in the standard  $(x, y)$  coordinate plane below. The functions have the same maximum value. One of the following statements about the values of  $a$  and  $b$  is true. Which statement is it?



- A.  $a < 0$  and  $b = 0$
- B.  $a < 0$  and  $b > 0$
- C.  $a = 0$  and  $b > 0$
- D.  $a > 0$  and  $b < 0$
- E.  $a > 0$  and  $b > 0$

There is no vertical shift, so  $b = 0$

For  $(x+a)$ ,  $+a$  means there is a horizontal shift in the negative direction.

58. Which of the following number line graphs shows the solution set to the inequality  $|x - 5| < -1$ ?

- F.
- G.
- H.
- J.
- K.

↑  
This means absolute value is negative. It can't be negative by definition.

59. As part of a probability experiment, Elliott is to answer 4 multiple-choice questions. For each question, there are 3 possible answers, only 1 of which is correct. If Elliott randomly and independently answers each question, what is the probability that he will answer the 4 questions correctly?

- A.  $\frac{27}{81}$
- B.  $\frac{12}{81}$
- C.  $\frac{4}{81}$
- D.  $\frac{3}{81}$
- E.  $\frac{1}{81}$

Multiple events means you will multiply probabilities:

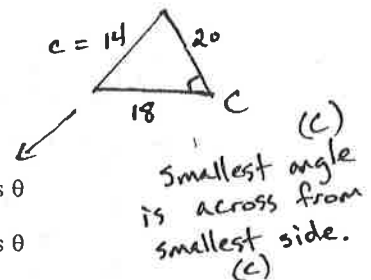
$P(\text{one correct}) = \frac{1}{3}$   
 $P(\text{four correct}) = \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} = \frac{1}{81}$   
 four events

60. The sides of an acute triangle measure 14 cm, 18 cm, and 20 cm, respectively. Which of the following equations, when solved for  $\theta$ , gives the measure of the smallest angle of the triangle?

(Note: For any triangle with sides of length  $a$ ,  $b$ , and  $c$  that are opposite angles  $A$ ,  $B$ , and  $C$ , respectively,  $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$  and  $c^2 = a^2 + b^2 - 2ab \cos C$ .)

- F.  $\frac{\sin \theta}{14} = \frac{1}{18}$
- G.  $\frac{\sin \theta}{14} = \frac{1}{20}$
- H.  $\frac{\sin \theta}{20} = \frac{1}{14}$
- J.  $14^2 = 18^2 + 20^2 - 2(18)(20)\cos \theta$
- K.  $20^2 = 14^2 + 18^2 - 2(14)(18)\cos \theta$

Need an angle to use this.



END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.

# Alg. 1. Analysis Only

2



2

## MATHEMATICS TEST

60 Minutes—60 Questions

**DIRECTIONS:** Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

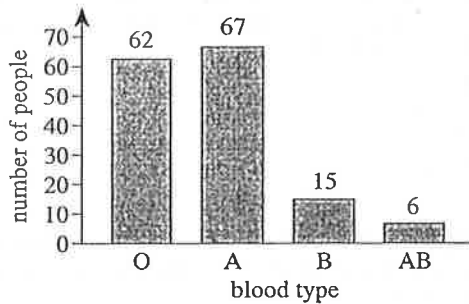
You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

1. The blood types of 150 people were determined for a study as shown in the figure below.



If 1 person from this study is randomly selected, what is the probability that this person has either Type A or Type AB blood?

- A.  $\frac{62}{150}$
- B.  $\frac{66}{150}$
- C.  $\frac{68}{150}$
- D.  $\frac{73}{150}$
- E.  $\frac{84}{150}$

- A | 2. The monthly fees for single rooms at 5 colleges are \$370, \$310, \$380, \$340, and \$310, respectively. What is the mean of these monthly fees?

- F. \$310
  - G. \$340
  - H. \$342**
  - J. \$350
  - K. \$380
- Skill: Finding the mean  

$$\frac{\text{add the values}}{\text{number of values}} = \frac{370+310+380+340+310}{5}$$

3. On a particular road map,  $\frac{1}{2}$  inch represents 18 miles. About how many miles apart are 2 towns that are  $2\frac{1}{2}$  inches apart on this map?

- A. 18
- B.  $22\frac{1}{2}$
- C. 36
- D. 45
- E. 90

4. Given  $f = cd^3$ ,  $f = 450$ , and  $d = 10$ , what is  $c$ ?

- F. 0.45**
  - G. 4.5
  - H. 15
  - J. 45
  - K. 150
- Skill: Substitute and Solve  

$$f = cd^3$$

$$450 = c(10)^3$$

$$\frac{450}{1000} = \frac{c(1000)}{1000}$$

$$.45 = c$$

5. If  $f(x) = (3x + 7)^2$ , then  $f(1) = ?$

- A. 10
  - B. 16
  - C. 58
  - D. 79
  - E. 100**
- Skill: Substitute and Simplify  

$$f(1) = (3(1) + 7)^2$$

$$f(1) = (3 + 7)^2$$

$$f(1) = (10)^2$$

$$f(1) = 100$$

6. Jorge's current hourly wage for working at Denti Smiles is \$12.00. Jorge was told that at the beginning of next month, his new hourly wage will be an increase of 6% of his current hourly wage. What will be Jorge's new hourly wage?

- F. \$12.06
  - G. \$12.60
  - H. \$12.72**
  - J. \$18.00
  - K. \$19.20
- Skill: exponential growth/decay  

$$y = A(1 \pm r)^t$$

$$y = 12.00(1 + .06)^1$$

$$y = 12.00(1.06)^1$$

$$y = 12.72$$



7. The first term is 1 in the geometric sequence 1, -3, 9, -27, ... What is the SEVENTH term of the geometric sequence?

- A. -243
- B. -30
- C. 81
- D. 189
- E. 729

8. The shipping rate for customers of Ship Quick consists of a fee per box and a price per pound for each box. The table below gives the fee and the price per pound for customers shipping boxes of various weights.

Weight of box (pounds)	Fee	Price per pound
Less than 10	\$ 5.00	\$1.00
10-25	\$10.00	\$0.65
More than 25	\$20.00	\$0.30

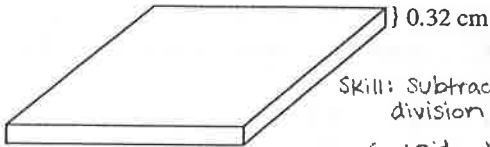
Gregg wants Ship Quick to ship 1 box that weighs 15 pounds. What is the shipping rate for this box?

- F. \$ 9.75
- G. \$16.50
- H. \$19.75
- J. \$20.00
- K. \$24.50

Skill: write and solve a function (piecewise)

$10 + \$0.65(15) = 19.75$

9. A computer chip 0.32 cm thick is made up of layers of silicon. If the top and bottom layers are each 0.03 cm thick and the inner layers are each 0.02 cm thick, how many inner layers are there?



Skill: Subtraction & division (outside layers)

$0.32 - (0.06) = 0.26$   
 $\frac{0.26}{0.02} = 13$

- A. 13
- B. 15
- C. 16
- D. 52
- E. 64

10. The table below shows the number of cars Jing sold each month last year. What is the median of the data in the table?

Skill: median

\* put numbers in order least to greatest!

Month	Number of cars sold
January	25
February	15
March	22
April	19
May	16
June	13
July	19
August	25
September	26
October	27
November	28
December	29

- F. 13
- G. 16
- H. 19
- J. 20.5
- K. 23.5

13, 15, 16, 19, 19, 22, 22, 25, 25, 26, 27, 27, 28, 29  
 $\frac{22+25}{2} = 23.5$

11. Students studying motion observed a cart rolling at a constant rate along a straight line. The table below gives the distance,  $d$  feet, the cart was from a reference point at 1-second intervals from  $t=0$  seconds to  $t=5$  seconds.

$t$	0	1	2	3	4	5
$d$	14	20	26	32	38	44

Which of the following equations represents this relationship between  $d$  and  $t$ ? Skill: Writing slope-intercept form.

- A.  $d = t + 14$
- B.  $d = 6t + 8$
- C.  $d = 6t + 14$
- D.  $d = 14t + 6$
- E.  $d = 34t$

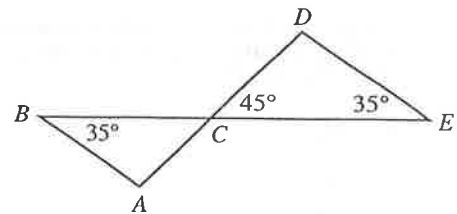
Slope =  $\frac{\text{change } y}{\text{change } x} = \frac{6}{1} = 6$   
 y-int =  $(0, 14)$

$y = 6x + 14$

12. The length of a rectangle with area 54 square centimeters is 9 centimeters. What is the perimeter of the rectangle, in centimeters?

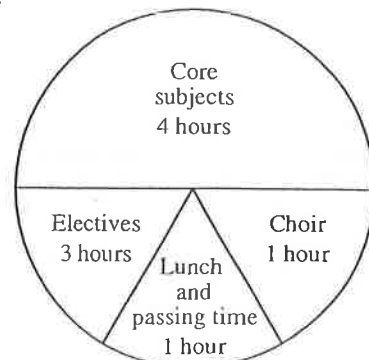
- F. 6
- G. 12
- H. 15
- J. 24
- K. 30

13. In the figure below,  $C$  is the intersection of  $\overline{AD}$  and  $\overline{BE}$ . If it can be determined, what is the measure of  $\angle BAC$ ?



- A. 80°
- B. 100°
- C. 110°
- D. 115°
- E. Cannot be determined from the given information

14. Antwan drew the circle graph below describing his time spent at school in 1 day. His teacher said that the numbers of hours listed were correct, but that the central angle measures for the sectors were not correct. What should be the central angle measure for the Core subjects sector?



- F. 72°
- G. 80°
- H. 160°
- J. 200°
- K. 288°



15. This month, Kami sold 70 figurines in 2 sizes. The large figurines sold for \$12 each, and the small figurines sold for \$8 each. The amount of money he received from the sales of the large figurines was equal to the amount of money he received from the sales of the small figurines. How many large figurines did Kami sell this month?

- A. 20
- B. 28**
- C. 35
- D. 42
- E. 50

skills: solving linear systems

$$\begin{cases} L+S=70 \\ 12L=8S \end{cases} \rightarrow \begin{cases} L+S=70 \\ -L+S=76 \end{cases}$$

$$\begin{matrix} L+S=70 \\ -L+S=76 \\ \hline 2S=146 \\ S=73-L \end{matrix}$$

\* make sure to solve for variable from question

$$12L=8(70-L)$$

$$12L=560-8L$$

$$20L=560$$

$$L=28$$

16. A car accelerated from 88 feet per second (fps) to 220 fps in exactly 3 seconds. Assuming the acceleration was constant, what was the car's acceleration, in feet per second per second, from 88 fps to 220 fps?

- F.  $\frac{1}{44}$
- G.  $29\frac{1}{3}$
- H. 44**
- J.  $75\frac{1}{3}$
- K.  $102\frac{2}{3}$

Skill: slope

$$\text{Slope} = \frac{\text{change } y}{\text{change } x} = \frac{220-88}{3-0} = \frac{132}{3} = 44$$

17. In a plane, the distinct lines  $\overleftrightarrow{AB}$  and  $\overleftrightarrow{CD}$  intersect at A, where A is between C and D. The measure of  $\angle BAC$  is  $47^\circ$ . What is the measure of  $\angle BAD$ ?

- A.  $43^\circ$
- B.  $47^\circ$
- C.  $94^\circ$
- D.  $133^\circ$
- E.  $137^\circ$

18. In which of the following are  $\frac{1}{2}$ ,  $\frac{5}{6}$ , and  $\frac{5}{8}$  arranged in ascending order?

- F.  $\frac{1}{2} < \frac{5}{8} < \frac{5}{6}$
- G.  $\frac{5}{6} < \frac{1}{2} < \frac{5}{8}$
- H.  $\frac{5}{6} < \frac{5}{8} < \frac{1}{2}$
- J.  $\frac{5}{8} < \frac{1}{2} < \frac{5}{6}$
- K.  $\frac{5}{8} < \frac{5}{6} < \frac{1}{2}$

Skill: ordering fractions

$$\frac{1}{2} \times \frac{12}{12} = \frac{12}{24}$$

$$\frac{5}{6} \times \frac{4}{4} = \frac{20}{24}$$

$$\frac{5}{8} \times \frac{3}{3} = \frac{15}{24}$$

$$\frac{12}{24}, \frac{15}{24}, \frac{20}{24}$$

$$\frac{1}{2}, \frac{5}{8}, \frac{5}{6}$$

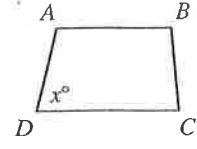
19. In scientific notation,  $670,000,000 + 700,000,000 = ?$

- A.  $1.37 \times 10^{-9}$
- B.  $1.37 \times 10^7$
- C.  $1.37 \times 10^8$
- D.  $1.37 \times 10^9$
- E.  $137 \times 10^{15}$

Skill:

$$\begin{array}{r} 670,000,000 \\ + 700,000,000 \\ \hline 1,370,000,000 \\ \downarrow \\ 1.37 \times 10^9 \end{array}$$

20. For trapezoid  $ABCD$  shown below,  $\overline{AB} \parallel \overline{DC}$ , the measures of the interior angles are distinct, and the measure of  $\angle D$  is  $x^\circ$ . What is the degree measure of  $\angle A$  in terms of  $x$ ?



- F.  $(180 - x)^\circ$
- G.  $(180 - 0.5x)^\circ$
- H.  $(180 + 0.5x)^\circ$
- J.  $(180 + x)^\circ$
- K.  $x^\circ$

21. To get a driver's license, an applicant must pass a written test and a driving test. Past records show that 80% of the applicants pass the written test and 60% of those who have passed the written test pass the driving test. Based on these figures, how many applicants in a random group of 1,000 applicants would you expect to get driver's licenses?

- A. 200
- B. 480
- C. 600
- D. 750
- E. 800

22. If  $a$ ,  $b$ , and  $c$  are positive integers such that  $a^b = x$  and  $c^b = y$ , then  $xy = ?$

- F.  $ac^b$
- G.  $ac^{2b}$
- H.  $(ac)^b$
- J.  $(ac)^{2b}$
- K.  $(ac)^{b^2}$

23. Which of the following expressions is equivalent to  $\frac{1}{2}y^2(6x + 2y + 12x - 2y)$ ? Skill: distribute and simplify

- A.  $9xy^2$
- B.  $18xy$
- C.  $3xy^2 + 12x$
- D.  $9xy^2 - 2y^3$
- E.  $3xy^2 + 12x - y^3 - 2y$

Option 1

$$\frac{1}{2}y^2(6x + 2y + 12x - 2y)$$

$$\frac{1}{2}y^2(18x)$$

$$9xy^2$$

Option 2

$$\frac{1}{2}y^2(6x + 2y + 12x - 2y)$$

$$3xy^2 + y^3 + 6xy^2 - y^3$$

$$9xy^2$$

24. An artist makes a profit of  $(500p - p^2)$  dollars from selling  $p$  paintings. What is the fewest number of paintings the artist can sell to make a profit of at least \$60,000?

- F. 100
- G. 150
- H. 200**
- J. 300
- K. 600

Skill: Solving quadratics

$$(500p - p^2) \geq 60,000$$

$$-500p + p^2 \geq -500p + 60,000$$

$$0 \geq p^2 - 500p + 60,000$$

$$0 \geq (p - 200)(p - 300)$$

$$0 \geq p - 200 \quad 0 \geq p - 300$$

$$200 \geq p \quad 300 \geq p$$

fewest

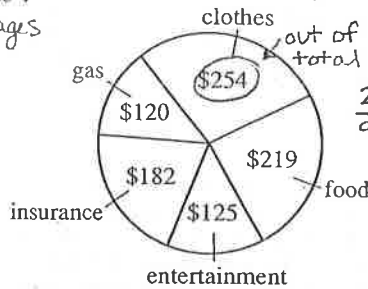
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200 ≥ p



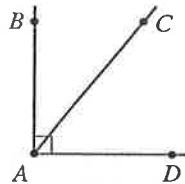
25. Last month, Lucie had total expenditures of \$900. The pie chart below breaks down these expenditures by category. The category in which Lucie's expenditures were greatest is what percent of her total expenditures, to the nearest 1%?

Skill: percentages



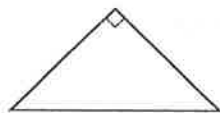
- A. 24%
- B. 28%**
- C. 32%
- D. 34%
- E. 39%

26. In the figure shown below, the measure of  $\angle BAC$  is  $(x + 20)^\circ$  and the measure of  $\angle BAD$  is  $90^\circ$ . What is the measure of  $\angle CAD$ ?



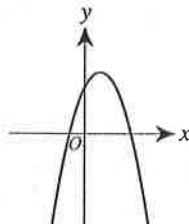
- F.  $(x - 70)^\circ$
- G.  $(70 - x)^\circ$
- H.  $(70 + x)^\circ$
- J.  $(160 - x)^\circ$
- K.  $(160 + x)^\circ$

27. What is the perimeter, in inches, of the isosceles right triangle shown below, whose hypotenuse is  $8\sqrt{2}$  inches long?



- A. 8
- B.  $8 + 8\sqrt{2}$
- C.  $8 + 16\sqrt{2}$
- D. 16
- E.  $16 + 8\sqrt{2}$

28. The equation  $y = ax^2 + bx + c$  is graphed in the standard  $(x, y)$  coordinate plane below for real values of  $a$ ,  $b$ , and  $c$ . When  $y = 0$ , which of the following best describes the solutions for  $x$ ?

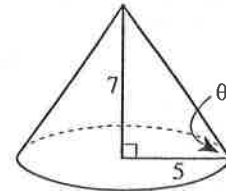


- F. 2 distinct positive real solutions
- G. 2 distinct negative real solutions
- H. 1 positive real solution and 1 negative real solution
- J. 2 real solutions that are not distinct
- K. 2 distinct solutions that are not real

29. What is the product of the complex numbers  $(-3i + 4)$  and  $(3i + 4)$ ?

- A. 1
- B. 7
- C. 25
- D.  $-7 + 24i$
- E.  $7 + 24i$

30. The radius of the base of the right circular cone shown below is 5 inches, and the height of the cone is 7 inches. Solving which of the following equations gives the measure,  $\theta$ , of the angle formed by a slant height of the cone and a radius?



- F.  $\tan \theta = \frac{5}{7}$
- G.  $\tan \theta = \frac{7}{5}$
- H.  $\sin \theta = \frac{5}{7}$
- J.  $\sin \theta = \frac{7}{5}$
- K.  $\cos \theta = \frac{7}{5}$

31. To make a 750-piece jigsaw puzzle more challenging, a puzzle company includes 5 extra pieces in the box along with the 750 pieces, and those 5 extra pieces do not fit anywhere in the puzzle. If you buy such a puzzle box, break the seal on the box, and immediately select 1 piece at random, what is the probability that it will be 1 of the extra pieces?

- A.  $\frac{1}{5}$
- B.  $\frac{1}{755}$
- C.  $\frac{1}{750}$
- D.  $\frac{5}{755}$
- E.  $\frac{5}{750}$

32. What fraction lies exactly halfway between  $\frac{2}{3}$  and  $\frac{3}{4}$ ?

Skill: mean

Handwritten calculation:  $\frac{\frac{2}{3} + \frac{3}{4}}{2} = \frac{\frac{17}{12}}{2} = \frac{17}{24}$

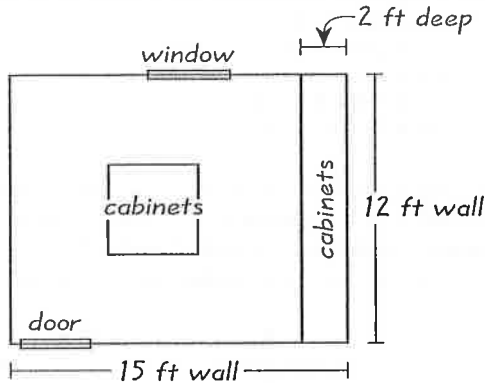
- F.  $\frac{3}{5}$
- G.  $\frac{5}{6}$
- H.  $\frac{7}{12}$
- J.  $\frac{9}{16}$
- K.  $\frac{17}{24}$**

Handwritten calculation:  $\frac{\frac{2}{3} + \frac{3}{4}}{2} = \frac{\frac{8}{12} + \frac{9}{12}}{2} = \frac{17}{24}$



Use the following information to answer questions 33–35.

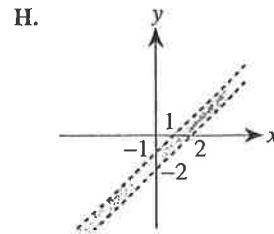
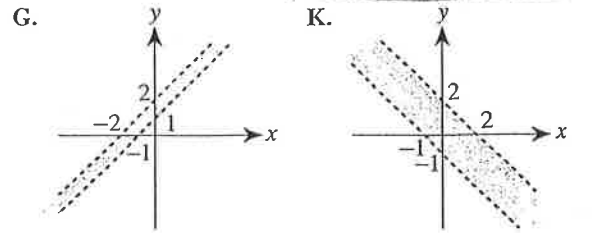
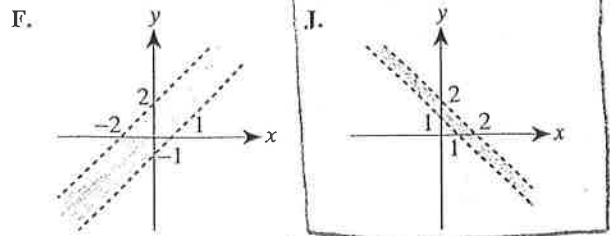
Gianna is converting a 12-foot-by-15-foot room in her house to a craft room. Gianna will install tile herself but will have CC Installations build and install the cabinets. The scale drawing shown below displays the location of the cabinets in the craft room (0.25 inch represents 2 feet).



Cabinets will be installed along one of the 12-foot walls from floor to ceiling, and 4 cabinets that are each 3 feet tall will be installed in the middle of the room. These are the only cabinets that will be installed, and each of them will be 2 feet wide and 2 feet deep. CC Installations has given Gianna an estimate of \$2,150.00 for building and installing the cabinets.

33. A 15-foot wall is how many inches long in the scale drawing?
- A. 1.5
  - B. 1.875
  - C. 3
  - D. 3.375
  - E. 3.75
34. Gianna will install tile on the portion of the floor that will NOT be covered by cabinets. What is the area, in square feet, of the portion of the floor that will NOT be covered by cabinets?
- F. 72
  - G. 90
  - H. 140
  - J. 156
  - K. 164
35. CC Installations' estimate consists of a \$650.00 charge for labor, plus a fixed charge per cabinet. The labor charge and the charge per cabinet remain the same for any number of cabinets built and installed. CC Installations would give Gianna what estimate if the craft room were to have twice as many cabinets as Gianna is planning to have?
- A. \$2,800.00
  - B. \$3,000.00
  - C. \$3,450.00
  - D. \$3,650.00
  - E. \$4,300.00

36. Which of the following is the graph of the region  $1 < x + y < 2$  in the standard  $(x, y)$  coordinate plane?



Skill: systems of inequalities

$$1 < x + y < 2$$

$$\downarrow$$

$$1 < x + y$$

$$\begin{matrix} -x & -x \\ \hline -x + 1 < y \end{matrix}$$

$$y > -x + 1$$

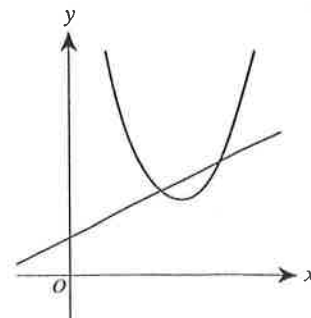
$$x + y < 2$$

$$\begin{matrix} -x & -x \\ \hline y < -x + 2 \end{matrix}$$

37. What is the difference between the mean and the median of the set  $\{3, 8, 10, 15\}$ ?

- A. 0
  - B. 1
  - C. 4
  - D. 9
  - E. 12
- Skill: mean, median, subtraction
- mean = 9      median = 9
- $9 - 9 = 0$

38. Which of the following describes a true relationship between the functions  $f(x) = (x - 3)^2 + 2$  and  $g(x) = \frac{1}{2}x + 1$  graphed below in the standard  $(x, y)$  coordinate plane?

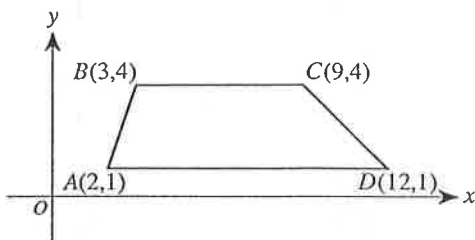


- F.  $f(x) = g(x)$  for exactly 2 values of  $x$
- G.  $f(x) = g(x)$  for exactly 1 value of  $x$
- H.  $f(x) < g(x)$  for all  $x$
- J.  $f(x) > g(x)$  for all  $x$
- K.  $f(x)$  is the inverse of  $g(x)$



Use the following information to answer questions 39–41.

Trapezoid  $ABCD$  is graphed in the standard  $(x,y)$  coordinate plane below.



39. What is the slope of  $\overline{CD}$ ?

- A.  $-3$
- B.  $-1$
- C.  $1$
- D.  $\frac{5}{21}$
- E.  $\frac{3}{2}$

40. When  $ABCD$  is reflected over the  $y$ -axis to  $A'B'C'D'$ , what are the coordinates of  $D'$ ?

- F.  $(-12, 1)$
- G.  $(-12, -1)$
- H.  $(12, -1)$
- J.  $(1, 12)$
- K.  $(1, -12)$

41. Which of the following vertical lines cuts  $ABCD$  into 2 trapezoids with equal areas?

- A.  $x = 2.5$
- B.  $x = 3.5$
- C.  $x = 4.5$
- D.  $x = 5.5$
- E.  $x = 6.5$

42. Given  $f(x) = x - \frac{1}{x}$  and  $g(x) = \frac{1}{x}$ , what is  $f\left(g\left(\frac{1}{2}\right)\right)$ ?

- F.  $-3$
- G.  $-\frac{3}{2}$
- H.  $-\frac{2}{3}$
- J.  $0$
- K.  $\frac{3}{2}$

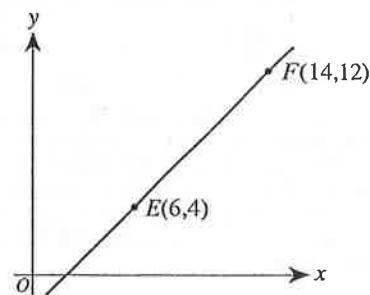
43. A formula to estimate the monthly payment,  $p$  dollars, on a short-term loan is

$$p = \frac{\frac{1}{2}ary + a}{12y}$$

where  $a$  dollars is the amount of the loan,  $r$  is the annual interest rate expressed as a decimal, and  $y$  years is the length of the loan. When  $a$  is multiplied by 2, what is the effect on  $p$ ?

- A.  $p$  is divided by 6
- B.  $p$  is divided by 2
- C.  $p$  does not change
- D.  $p$  is multiplied by 2
- E.  $p$  is multiplied by 4

44. The points  $E(6,4)$  and  $F(14,12)$  lie in the standard  $(x,y)$  coordinate plane shown below. Point  $D$  lies on  $\overline{EF}$  between  $E$  and  $F$  such that the length of  $\overline{EF}$  is 4 times the length of  $\overline{DE}$ . What are the coordinates of  $D$ ?



- F.  $(7, 5)$
- G.  $(8, 6)$
- H.  $(8, 8)$
- J.  $(10, 8)$
- K.  $(12, 10)$

45. Given that  $a \begin{bmatrix} 2 & 6 \\ 1 & 4 \end{bmatrix} = \begin{bmatrix} x & 27 \\ y & z \end{bmatrix}$  for some real number  $a$ , what is  $x + z$ ?

- A.  $\frac{4}{3}$
- B.  $\frac{27}{2}$
- C.  $26$
- D.  $27$
- E.  $48$

46. A container is  $\frac{1}{8}$  full of water. After 10 cups of water are added, the container is  $\frac{3}{4}$  full. What is the volume of the container, in cups?

- F.  $13\frac{1}{3}$
- G.  $13\frac{1}{2}$
- H.  $15$
- J.  $16$
- K.  $40$



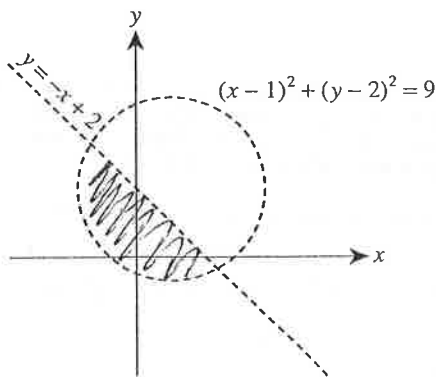


47. Only tenth-, eleventh-, and twelfth-grade students attend Washington High School. The ratio of tenth graders to the school's total student population is 86:255, and the ratio of eleventh graders to the school's total student population is 18:51. If 1 student is chosen at random from the entire school, which grade is that student most likely to be in?
- A. Tenth
  - B. Eleventh
  - C. Twelfth
  - D. All grades are equally likely.
  - E. Cannot be determined from the given information

48.  $\frac{4}{\sqrt{2}} + \frac{2}{\sqrt{3}} = ?$

- F.  $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{5}}$
- G.  $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{6}}$
- H.  $\frac{6}{\sqrt{2} + \sqrt{3}}$
- J.  $\frac{6}{\sqrt{5}}$
- K.  $\frac{8}{\sqrt{6}}$

49. The shaded region in the graph below represents the solution set to which of the following systems of inequalities?



- A.  $\begin{cases} y < -x + 2 \\ (x - 1)^2 + (y - 2)^2 < 9 \end{cases}$
- B.  $\begin{cases} y > -x + 2 \\ (x - 1)^2 + (y - 2)^2 < 9 \end{cases}$
- C.  $\begin{cases} y > -x + 2 \\ (x - 1)^2 + (y - 2)^2 > 9 \end{cases}$
- D.  $\begin{cases} y < -x + 2 \\ (x - 1)^2 + (y - 2)^2 > 9 \end{cases}$
- E.  $\begin{cases} (y - 2) < 3 \\ (x - 1) > 3 \end{cases}$

50. You can find the volume of an irregularly shaped solid object by completely submerging it in water and calculating the volume of water the object displaces. You completely submerge a solid object in a rectangular tank that has a base 40 centimeters by 30 centimeters and is filled with water to a depth of 20 centimeters. The object sinks to the bottom, and the water level goes up 0.25 centimeters. What is the volume, in cubic centimeters, of the object?

- F. 300
- G. 240
- H. 200
- J. 150
- K. 75

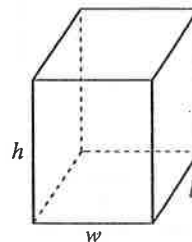
51. If  $x:y = 5:2$  and  $y:z = 3:2$ , what is the ratio of  $x:z$ ?

- A. 3:1 Skill: comparing ratios
  - B. 3:5
  - C. 5:3 \*to compare, y must be the same
  - D. 8:4
  - E. 15:4
- |       |       |       |
|-------|-------|-------|
| $x:y$ | $y:z$ | $x:z$ |
| 5:2   | 3:2   | 15:4  |
| 15:6  | 6:4   |       |

52. Which of the following is the solution statement for the inequality shown below? Skill: inequalities

- $-5 < 1 - 3x < 10$
- |                        |   |                     |
|------------------------|---|---------------------|
| F. $-5 < x < 10$       | $-1 \quad -1 \quad -1$                          |                     |
| G. $-3 < x$            | $-\frac{6}{-3} < \frac{-3x}{-3} < \frac{9}{-3}$ | *multiply by a neg. |
| H. $-3 < x < 2$        | $2 > x > -3$                                    | flip inequality     |
| J. $-2 < x < 3$        | $-3 < x < 2$                                    |                     |
| K. $x < -3$ or $x > 2$ |   |                     |

53. A formula for the surface area ( $A$ ) of the rectangular solid shown below is  $A = 2lw + 2lh + 2wh$  where  $l$  represents length;  $w$ , width; and  $h$ , height. By doubling each of the dimensions ( $l$ ,  $w$ , and  $h$ ), the surface area will be multiplied by what factor?



- A. 2
- B. 4
- C. 6
- D. 8
- E. 12

54. A dog eats 7 cans of food in 3 days. At this rate, how many cans of food does the dog eat in  $3 + d$  days?

- F.  $\frac{7}{3} + d$
  - G.  $\frac{7}{3} + \frac{d}{3}$
  - H.  $\frac{7}{3} + \frac{7}{3d}$
  - J.  $7 + \frac{d}{3}$
  - K.  $7 + \frac{7d}{3}$
- Skill: proportional reasoning or slope
- cans per day  $\downarrow$  days  $\downarrow$
- $\frac{7}{3} (3+d)$
- $7 + \frac{7d}{3}$



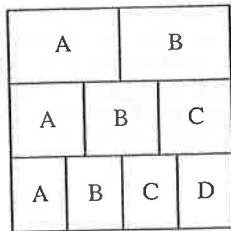
55. Kelly asked 120 students questions about skiing. The results of the poll are shown in the table below.

Question	Yes	No
1. Have you skied either cross-country or downhill?	65	55
2. If you answered Yes to Question 1, did you ski downhill?	28	37
3. If you answered Yes to Question 1, did you ski cross-country?	45	20

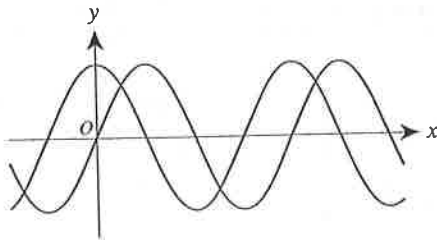
After completing the poll, Kelly wondered how many of the students polled had skied both cross-country and downhill. How many of the students polled indicated that they had skied both cross-country and downhill?

- A. 73  
 B. 65  
 C. 47  
 D. 18  
 E. 8
56. The square below is divided into 3 rows of equal area. In the top row, the region labeled A has the same area as the region labeled B. In the middle row, the 3 regions have equal areas. In the bottom row, the 4 regions have equal areas. What fraction of the square's area is in a region labeled A?

- F.  $\frac{1}{9}$   
 G.  $\frac{3}{9}$   
 H.  $\frac{6}{9}$   
 J.  $\frac{13}{12}$   
 K.  $\frac{13}{36}$

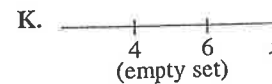
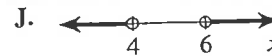
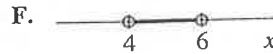


57. The functions  $y = \sin x$  and  $y = \sin(x + a) + b$ , for constants  $a$  and  $b$ , are graphed in the standard  $(x, y)$  coordinate plane below. The functions have the same maximum value. One of the following statements about the values of  $a$  and  $b$  is true. Which statement is it?



- A.  $a < 0$  and  $b = 0$   
 B.  $a < 0$  and  $b > 0$   
 C.  $a = 0$  and  $b > 0$   
 D.  $a > 0$  and  $b < 0$   
 E.  $a > 0$  and  $b > 0$

58. Which of the following number line graphs shows the solution set to the inequality  $|x - 5| < -1$ ?



59. As part of a probability experiment, Elliott is to answer 4 multiple-choice questions. For each question, there are 3 possible answers, only 1 of which is correct. If Elliott randomly and independently answers each question, what is the probability that he will answer the 4 questions correctly?

- A.  $\frac{27}{81}$   
 B.  $\frac{12}{81}$   
 C.  $\frac{4}{81}$   
 D.  $\frac{3}{81}$   
 E.  $\frac{1}{81}$

60. The sides of an acute triangle measure 14 cm, 18 cm, and 20 cm, respectively. Which of the following equations, when solved for  $\theta$ , gives the measure of the smallest angle of the triangle?

(Note: For any triangle with sides of length  $a$ ,  $b$ , and  $c$  that are opposite angles  $A$ ,  $B$ , and  $C$ , respectively,  $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$  and  $c^2 = a^2 + b^2 - 2ab \cos C$ .)

F.  $\frac{\sin \theta}{14} = \frac{1}{18}$

G.  $\frac{\sin \theta}{14} = \frac{1}{20}$

H.  $\frac{\sin \theta}{20} = \frac{1}{14}$

J.  $14^2 = 18^2 + 20^2 - 2(18)(20)\cos \theta$

K.  $20^2 = 14^2 + 18^2 - 2(14)(18)\cos \theta$

END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.



## Geo Analysis only

## MATHEMATICS TEST

60 Minutes—60 Questions

**DIRECTIONS:** Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

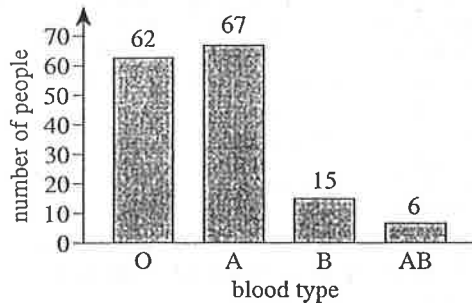
You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

1. The blood types of 150 people were determined for a study as shown in the figure below.



If 1 person from this study is randomly selected, what is the probability that this person has either Type A or Type AB blood?

- A.  $\frac{62}{150}$
  - B.  $\frac{66}{150}$
  - C.  $\frac{68}{150}$
  - D.  $\frac{73}{150}$
  - E.  $\frac{84}{150}$
2. The monthly fees for single rooms at 5 colleges are \$370, \$310, \$380, \$340, and \$310, respectively. What is the mean of these monthly fees?
- F. \$310
  - G. \$340
  - H. \$342
  - J. \$350
  - K. \$380

3. On a particular road map,  $\frac{1}{2}$  inch represents 18 miles. About how many miles apart are 2 towns that are  $2\frac{1}{2}$  inches apart on this map? "PROPORTIONS"

- A. 18
- B.  $22\frac{1}{2}$
- C. 36
- D. 45
- E. 90

SET UP RATIO, USE UNITS

THEN MAKE A PROPORTION

$$\frac{\frac{1}{2} \text{ IN}}{18 \text{ MI}}$$

$$\frac{\frac{1}{2} \text{ IN}}{18 \text{ MI}} = \frac{2\frac{1}{2} \text{ IN}}{X \text{ MI}}$$

USE CROSS PRODUCTS

$$\frac{1}{2} \cdot X = 18 \cdot 2\frac{1}{2} \quad \frac{1}{2} X = 45$$

$$X = 90$$

4. Given  $f = cd^3$ ,  $f = 450$ , and  $d = 10$ , what is  $c$ ?

- F. 0.45
- G. 4.5
- H. 15
- J. 45
- K. 150

5. If  $f(x) = (3x + 7)^2$ , then  $f(1) = ?$

- A. 10
- B. 16
- C. 58
- D. 79
- E. 100

6. Jorge's current hourly wage for working at Denti Smiles is \$12.00. Jorge was told that at the beginning of next month, his new hourly wage will be an increase of 6% of his current hourly wage. What will be Jorge's new hourly wage?

- F. \$12.06
- G. \$12.60
- H. \$12.72
- J. \$18.00
- K. \$19.20



7. The first term is 1 in the geometric sequence 1, -3, 9, -27, ... What is the SEVENTH term of the geometric sequence?
- A. -243
  - B. -30
  - C. 81
  - D. 189
  - E. 729

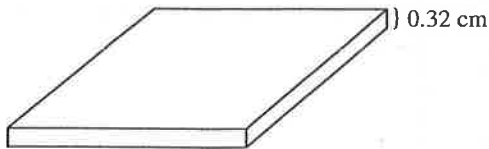
8. The shipping rate for customers of Ship Quick consists of a fee per box and a price per pound for each box. The table below gives the fee and the price per pound for customers shipping boxes of various weights.

Weight of box (pounds)	Fee	Price per pound
Less than 10	\$ 5.00	\$1.00
10-25	\$10.00	\$0.65
More than 25	\$20.00	\$0.30

Gregg wants Ship Quick to ship 1 box that weighs // 15 pounds. What is the shipping rate for this box?

- F. \$ 9.75
- G. \$16.50
- H. \$19.75
- J. \$20.00
- K. \$24.50

9. A computer chip 0.32 cm thick is made up of layers of silicon. If the top and bottom layers are each 0.03 cm thick and the inner layers are each 0.02 cm thick, how many inner layers are there?



- A. 13
- B. 15
- C. 16
- D. 52
- E. 64

10. The table below shows the number of cars Jing sold each month last year. What is the median of the data in the table?

Month	Number of cars sold
January	25
February	15
March	22
April	19
May	16
June	13
July	19
August	25
September	26
October	27
November	28
December	29

- F. 13
- G. 16
- H. 19
- J. 20.5
- K. 23.5

11. Students studying motion observed a cart rolling at a constant rate along a straight line. The table below gives the distance,  $d$  feet, the cart was from a reference point at 1-second intervals from  $t = 0$  seconds to  $t = 5$  seconds.

$t$	0	1	2	3	4	5
$d$	14	20	26	32	38	44

Which of the following equations represents this relationship between  $d$  and  $t$ ?

- A.  $d = t + 14$
- B.  $d = 6t + 8$
- C.  $d = 6t + 14$
- D.  $d = 14t + 6$
- E.  $d = 34t$

12. The length of a rectangle with area 54 square centimeters is 9 centimeters. What is the perimeter of the rectangle, in centimeters?

**"AREA"**  
 $A = L \times W$   
 $54 = 9 \cdot W$   
 $6 = W$

**"PERIMETER ="**  
 $2 \cdot \text{LENGTH} + 2 \cdot \text{WIDTH}$   
 $P = 2 \cdot 9\text{cm} + 2 \cdot 6\text{cm}$   
 $P = 18\text{cm} + 12\text{cm}$

**"AREA"**  
 $A = L \times W$   
 $54 = 9 \cdot W$   
 $6 = W$

**"PERIMETER ="**  
 $2 \cdot \text{LENGTH} + 2 \cdot \text{WIDTH}$   
 $P = 2 \cdot 9\text{cm} + 2 \cdot 6\text{cm}$   
 $P = 18\text{cm} + 12\text{cm}$

13. In the figure below,  $C$  is the intersection of  $\overline{AD}$  and  $\overline{BE}$ . If it can be determined, what is the measure of  $\angle BAC$ ?

**"VERTICAL ANGLES"**  
**"ANGLE SUM THEOREM"**

IF  $m\angle ECD = 45^\circ$ , THEN  
 $m\angle BCA = 45^\circ$

$m\angle A = 180^\circ - (35^\circ + 45^\circ)$

- A.  $80^\circ$
- B.  $100^\circ$**
- C.  $110^\circ$
- D.  $115^\circ$
- E. Cannot be determined from the given information

14. Antwan drew the circle graph below describing his time spent at school in 1 day. His teacher said that the numbers of hours listed were correct, but that the central angle measures for the sectors were not correct. What should be the central angle measure for the Core subjects sector?

**"CENTRAL ANGLES"**  
**"NOT 1/2"**

**CORE HOURS =**  $\frac{4}{9} (360^\circ)$   
**TOTAL HOURS =** 9  
 $= 160^\circ$   
**NOT 180°**

F.  $72^\circ$   
**G.  $80^\circ$**   
**H.  $160^\circ$**   
 J.  $200^\circ$   
 K.  $288^\circ$

2



2

15. This month, Kami sold 70 figurines in 2 sizes. The large figurines sold for \$12 each, and the small figurines sold for \$8 each. The amount of money he received from the sales of the large figurines was equal to the amount of money he received from the sales of the small figurines. How many large figurines did Kami sell this month?

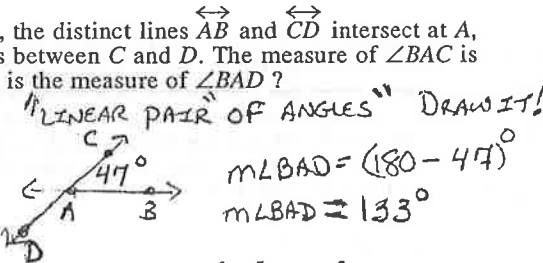
A. 20  
B. 28  
C. 35  
D. 42  
E. 50

16. A car accelerated from 88 feet per second (fps) to 220 fps in exactly 3 seconds. Assuming the acceleration was constant, what was the car's acceleration, in feet per second per second, from 88 fps to 220 fps?

F.  $\frac{1}{44}$   
G.  $29\frac{1}{3}$   
H. 44  
J.  $75\frac{1}{3}$   
K.  $102\frac{2}{3}$

17. In a plane, the distinct lines  $\overleftrightarrow{AB}$  and  $\overleftrightarrow{CD}$  intersect at A, where A is between C and D. The measure of  $\angle BAC$  is  $47^\circ$ . What is the measure of  $\angle BAD$ ?

A.  $43^\circ$   
B.  $47^\circ$   
C.  $94^\circ$   
D.  $133^\circ$   
E.  $137^\circ$



18. In which of the following are  $\frac{1}{2}$ ,  $\frac{5}{6}$ , and  $\frac{5}{8}$  arranged in ascending order?

F.  $\frac{1}{2} < \frac{5}{8} < \frac{5}{6}$   
G.  $\frac{5}{6} < \frac{1}{2} < \frac{5}{8}$   
H.  $\frac{5}{6} < \frac{5}{8} < \frac{1}{2}$   
J.  $\frac{5}{8} < \frac{1}{2} < \frac{5}{6}$   
K.  $\frac{5}{8} < \frac{5}{6} < \frac{1}{2}$

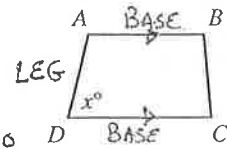
19. In scientific notation,  $670,000,000 + 700,000,000 = ?$

A.  $1.37 \times 10^{-9}$   
B.  $1.37 \times 10^7$   
C.  $1.37 \times 10^8$   
D.  $1.37 \times 10^9$   
E.  $137 \times 10^{15}$

20. For trapezoid  $ABCD$  shown below,  $\overline{AB} \parallel \overline{DC}$ , the measures of the interior angles are distinct, and the measure of  $\angle D$  is  $x^\circ$ . What is the degree measure of  $\angle A$  in terms of  $x$ ?

F.  $(180 - x)^\circ$   
G.  $(180 - 0.5x)^\circ$   
H.  $(180 + 0.5x)^\circ$   
J.  $(180 + x)^\circ$   
K.  $x^\circ$

$$m\angle A = (180 - x)$$



"TRAPEZOID'S" CONSECUTIVE "LEG" ANGLES OF A TRAPEZOID ARE SUPPLEMENTARY

21. To get a driver's license, an applicant must pass a written test and a driving test. Past records show that 80% of the applicants pass the written test and 60% of those who have passed the written test pass the driving test. Based on these figures, how many applicants in a random group of 1,000 applicants would you expect to get driver's licenses?

A. 200  
B. 480  
C. 600  
D. 750  
E. 800

22. If  $a$ ,  $b$ , and  $c$  are positive integers such that  $a^b = x$  and  $c^b = y$ , then  $xy = ?$

F.  $ac^b$   
G.  $ac^{2b}$   
H.  $(ac)^b$   
J.  $(ac)^{2b}$   
K.  $(ac)^{b^2}$

23. Which of the following expressions is equivalent to  $\frac{1}{2}y^2(6x + 2y + 12x - 2y)$ ?

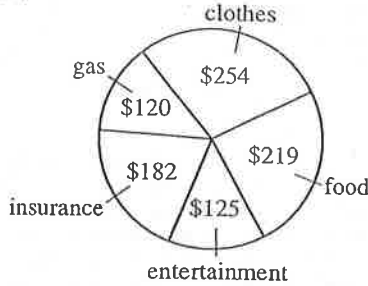
A.  $9xy^2$   
B.  $18xy$   
C.  $3xy^2 + 12x$   
D.  $9xy^2 - 2y^3$   
E.  $3xy^2 + 12x - y^3 - 2y$

24. An artist makes a profit of  $(500p - p^2)$  dollars from selling  $p$  paintings. What is the fewest number of paintings the artist can sell to make a profit of at least \$60,000?

F. 100  
G. 150  
H. 200  
J. 300  
K. 600

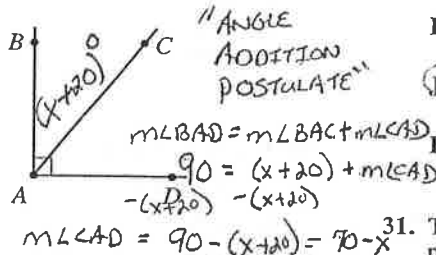


25. Last month, Lucie had total expenditures of \$900. The pie chart below breaks down these expenditures by category. The category in which Lucie's expenditures were greatest is what percent of her total expenditures, to the nearest 1%?



- A. 24%  
B. 28%  
C. 32%  
D. 34%  
E. 39%

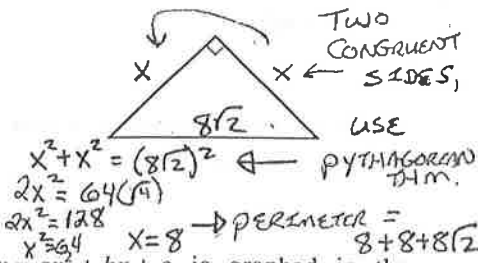
26. In the figure shown below, the measure of  $\angle BAC$  is  $(x + 20)^\circ$  and the measure of  $\angle BAD$  is  $90^\circ$ . What is the measure of  $\angle CAD$ ?



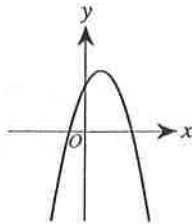
- F.  $(x - 70)^\circ$   
G.  $(70 - x)^\circ$   
H.  $(70 + x)^\circ$   
J.  $(160 - x)^\circ$   
K.  $(160 + x)^\circ$

27. What is the perimeter, in inches, of the isosceles right triangle shown below, whose hypotenuse is  $8\sqrt{2}$  inches long?

- A. 8  
B.  $8 + 8\sqrt{2}$   
C.  $8 + 16\sqrt{2}$   
D. 16  
E.  $16 + 8\sqrt{2}$



28. The equation  $y = ax^2 + bx + c$  is graphed in the standard  $(x, y)$  coordinate plane below for real values of  $a$ ,  $b$ , and  $c$ . When  $y = 0$ , which of the following best describes the solutions for  $x$ ?



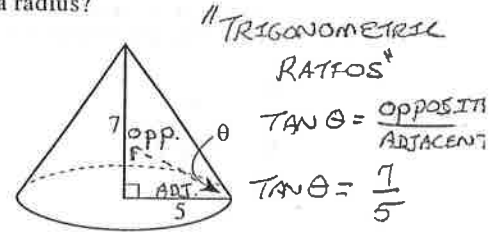
- F. 2 distinct positive real solutions  
G. 2 distinct negative real solutions  
H. 1 positive real solution and 1 negative real solution  
J. 2 real solutions that are not distinct  
K. 2 distinct solutions that are not real

29. What is the product of the complex numbers  $(-3i + 4)$  and  $(3i + 4)$ ?

- A. 1  
B. 7  
C. 25  
D.  $-7 + 24i$   
E.  $7 + 24i$

30. The radius of the base of the right circular cone shown below is 5 inches, and the height of the cone is 7 inches. Solving which of the following equations gives the measure,  $\theta$ , of the angle formed by a slant height of the cone and a radius?

- F.  $\tan \theta = \frac{5}{7}$   
G.  $\tan \theta = \frac{7}{5}$   
H.  $\sin \theta = \frac{5}{7}$   
J.  $\sin \theta = \frac{7}{5}$   
K.  $\cos \theta = \frac{7}{5}$



31. To make a 750-piece jigsaw puzzle more challenging, a puzzle company includes 5 extra pieces in the box along with the 750 pieces, and those 5 extra pieces do not fit anywhere in the puzzle. If you buy such a puzzle box, break the seal on the box, and immediately select 1 piece at random, what is the probability that it will be 1 of the extra pieces?

- A.  $\frac{1}{5}$   
B.  $\frac{1}{755}$   
C.  $\frac{1}{750}$   
D.  $\frac{5}{755}$   
E.  $\frac{5}{750}$

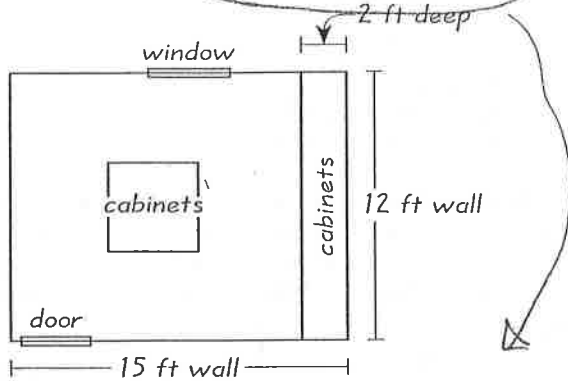
32. What fraction lies exactly halfway between  $\frac{2}{3}$  and  $\frac{3}{4}$ ?

- F.  $\frac{3}{5}$   
G.  $\frac{5}{6}$   
H.  $\frac{7}{12}$   
J.  $\frac{9}{16}$   
K.  $\frac{17}{24}$



Use the following information to answer questions 33-35.

Gianna is converting a 12-foot-by-15-foot room in her house to a craft room. Gianna will install tile herself but will have CC Installations build and install the cabinets. The scale drawing shown below displays the location of the cabinets in the craft room (0.25 inch represents 2 feet).



Cabinets will be installed along one of the 12-foot walls from floor to ceiling, and 4 cabinets that are each 3 feet tall will be installed in the middle of the room. These are the only cabinets that will be installed, and each of them will be 2 feet wide and 2 feet deep. CC Installations has given Gianna an estimate of \$2,150.00 for building and installing the cabinets.

"proportions"

33. A 15-foot wall is how many inches long in the scale drawing?

- A. 1.5
- B. 1.875**
- C. 3
- D. 3.375
- E. 3.75

USE CONVERSION, SET UP A PROPORTION, USE UNITS!  
 $\frac{0.25 \text{ IN}}{2 \text{ FT}} = \frac{x \text{ IN}}{15 \text{ FT}} \quad 2x = 3.75$   
 $x = 1.875 \text{ IN}$

"AREA"

34. Gianna will install tile on the portion of the floor that will NOT be covered by cabinets. What is the area, in square feet, of the portion of the floor that will NOT be covered by cabinets?

- F. 72
- G. 90
- H. 140**
- J. 156
- K. 164

TOTAL AREA MINUS CABINET AREA  
 $\text{TOTAL } (15-2) \cdot 12 \text{ FT} = \text{CABINET } (4 \cdot 4 \text{ FT})$   
 $13 \cdot 12 = 4 \cdot 4$   
 $156 - 16 = 140 \text{ FT}^2$

"SOLVING LINEAR EQUATIONS IN CONTEXT"

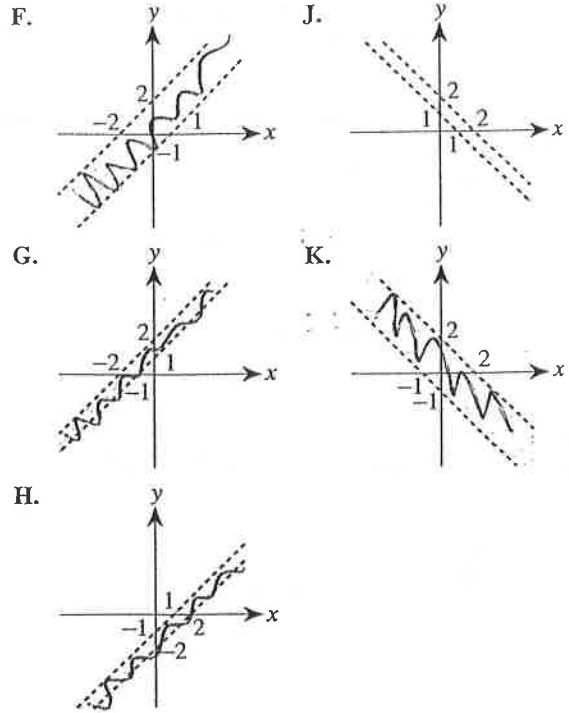
35. CC Installations' estimate consists of a \$650.00 charge for labor, plus a fixed charge per cabinet. The labor charge and the charge per cabinet remain the same for any number of cabinets built and installed. CC Installations would give Gianna what estimate if the craft room were to have twice as many cabinets as Gianna is planning to have?

- A. \$2,800.00
- B. \$3,000.00
- C. \$3,450.00
- D. \$3,650.00**
- E. \$4,300.00

ESTIMATE = LABOR  
 $2150 - 650 = 1500$   
 COST OF CABINETS = 1500  
 TWICE CABINETS = 3000  
 PLUS INSTALLATION 650

NEW ESTIMATE = \$3650

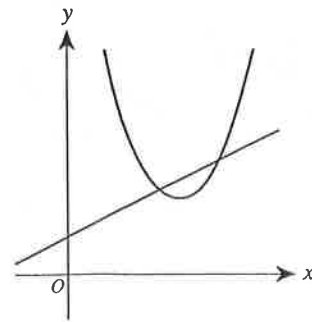
36. Which of the following is the graph of the region  $1 < x + y < 2$  in the standard  $(x,y)$  coordinate plane?



37. What is the difference between the mean and the median of the set  $\{3, 8, 10, 15\}$ ?

- A. 0
- B. 1
- C. 4
- D. 9
- E. 12

38. Which of the following describes a true relationship between the functions  $f(x) = (x - 3)^2 + 2$  and  $g(x) = \frac{1}{2}x + 1$  graphed below in the standard  $(x,y)$  coordinate plane?

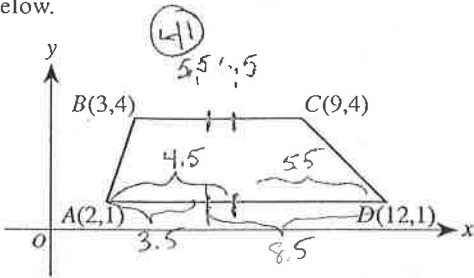


- F.  $f(x) = g(x)$  for exactly 2 values of  $x$
- G.  $f(x) = g(x)$  for exactly 1 value of  $x$
- H.  $f(x) < g(x)$  for all  $x$
- J.  $f(x) > g(x)$  for all  $x$
- K.  $f(x)$  is the inverse of  $g(x)$



Use the following information to answer questions 39–41.

Trapezoid  $ABCD$  is graphed in the standard  $(x,y)$  coordinate plane below.



39. What is the slope of  $\overline{CD}$ ?  $m = \frac{y_2 - y_1}{x_2 - x_1}$
- A. -3  
 B. -1  
 C. 1  
 D.  $\frac{5}{21}$   
 E.  $\frac{3}{2}$
- "Slope"*
- $m_{CD} = \frac{1-4}{12-9} = \frac{-3}{3} = -1$

40. When  $ABCD$  is reflected over the  $y$ -axis to  $A'B'C'D'$ , what are the coordinates of  $D'$ ? REFLECTION RULES  $(x,y) \rightarrow (-x,y)$
- A. (-12, 1)  
 B. (-12, -1)  
 C. (12, -1)  
 D. (1, 12)  
 E. (1, -12)
- "REFLECTION"*
- $D(12,1) \rightarrow D'(-12,1)$

41. Which of the following vertical lines cuts  $ABCD$  into 2 trapezoids with equal areas?
- A.  $x = 2.5$   
 B.  $x = 3.5$   
 C.  $x = 4.5$   
 D.  $x = 5.5$   
 E.  $x = 6.5$
- SEE PICTURE ABOVE*
- THE MEASUREMENTS ALONG X-AXIS ARE SO A, B, C*
- $\frac{2+12}{2} = \frac{14}{2} = 7$     $\frac{3+9}{2} = \frac{12}{2} = 6$    *NOT REASONABLE*
- TRY THESE X=5.5*    $5.5-2 = 3.5$     $5.5-9 = 3.5$     $5.5-12 = 6.5$
- $A = \frac{1}{2}(B_1 + B_2) \cdot H$     $A = \frac{1}{2}(3.5 + 6.5) \cdot H = 5H$     $A = \frac{1}{2}(2.5 + 3.5) \cdot H = 3H$
- LEFT 5H   RIGHT 3H   NOT EQUAL*

42. Given  $f(x) = x - \frac{1}{x}$  and  $g(x) = \frac{1}{x}$ , what is  $f(g(\frac{1}{2}))$ ?
- A. -3  
 B.  $-\frac{3}{2}$   
 C.  $-\frac{2}{3}$   
 D. 0  
 E.  $\frac{3}{2}$
- "ONE-STEP SOLVE"*
- REAL WORD APPLICATION*

43. A formula to estimate the monthly payment,  $p$  dollars, on a short-term loan is

$$p = \frac{\frac{1}{2}ary + a}{12y}$$

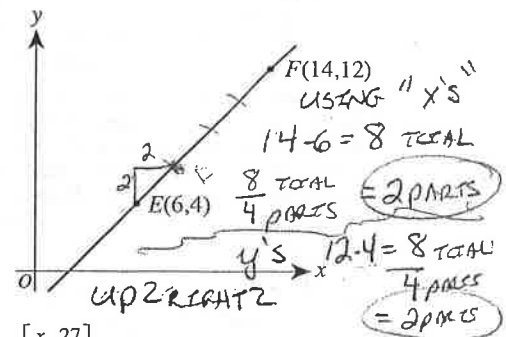
where  $a$  dollars is the amount of the loan,  $r$  is the annual interest rate expressed as a decimal, and  $y$  years is the length of the loan. When  $a$  is multiplied by 2, what is the effect on  $p$ ?

- A.  $p$  is divided by 6  
 B.  $p$  is divided by 2  
 C.  $p$  does not change  
 D.  $p$  is multiplied by 2  
 E.  $p$  is multiplied by 4

44. The points  $E(6,4)$  and  $F(14,12)$  lie in the standard  $(x,y)$  coordinate plane shown below. Point  $D$  lies on  $\overline{EF}$  between  $E$  and  $F$  such that the length of  $\overline{ED}$  is 4 times the length of  $\overline{DF}$ . What are the coordinates of  $D$ ? = 4 PARTS

*"DIRECTED LINE SEGMENT"*  
*"PROPORTIONS"*

- A. (-7, 5)  
 B. (8, 6)  
 C. (8, 8)  
 D. (10, 8)  
 E. (12, 10)



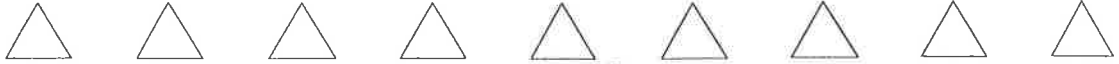
45. Given that  $a \begin{bmatrix} 2 & 6 \\ 1 & 4 \end{bmatrix} = \begin{bmatrix} x & 27 \\ y & z \end{bmatrix}$  for some real number  $a$ , what is  $x + z$ ?

- A.  $\frac{4}{3}$   
 B.  $\frac{27}{2}$   
 C. 26  
 D. 27

46. A container is  $\frac{1}{8}$  full of water. After 10 cups of water are added, the container is  $\frac{3}{4}$  full. What is the volume of the container, in cups?  $\frac{1}{8}$  PART + ADDED WATER =  $\frac{3}{4}$  FULL

- A.  $13\frac{1}{3}$   
 B.  $13\frac{1}{2}$   
 C. 15  
 D. 16  
 E. 40
- "ONE-STEP SOLVE"*
- REAL WORD APPLICATION*
- $\frac{1}{8} + x = \frac{3}{4}$   
 $x = \frac{5}{8}$  ADDED IN
- $y = \text{TOTAL ADDED}$   
 $\frac{5}{8} y = 10 \text{ CUPS} \cdot \frac{8}{5}$   
 $y = 16 \text{ CUPS TOTAL}$





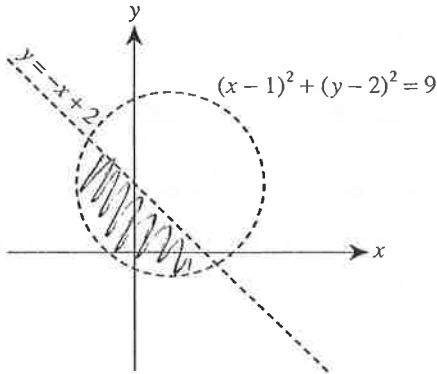
47. Only tenth-, eleventh-, and twelfth-grade students attend Washington High School. The ratio of tenth graders to the school's total student population is 86:255, and the ratio of eleventh graders to the school's total student population is 18:51. If 1 student is chosen at random from the entire school, which grade is that student most likely to be in?

- A. Tenth
- B. Eleventh
- C. Twelfth
- D. All grades are equally likely.
- E. Cannot be determined from the given information

48.  $\frac{4}{\sqrt{2}} + \frac{2}{\sqrt{3}} = ?$

- F.  $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{5}}$
- G.  $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{6}}$
- H.  $\frac{6}{\sqrt{2} + \sqrt{3}}$
- J.  $\frac{6}{\sqrt{5}}$
- K.  $\frac{8}{\sqrt{6}}$

49. The shaded region in the graph below represents the solution set to which of the following systems of inequalities?



- A.  $\begin{cases} y < -x + 2 \\ (x - 1)^2 + (y - 2)^2 < 9 \end{cases}$
- B.  $\begin{cases} y > -x + 2 \\ (x - 1)^2 + (y - 2)^2 < 9 \end{cases}$
- C.  $\begin{cases} y > -x + 2 \\ (x - 1)^2 + (y - 2)^2 > 9 \end{cases}$
- D.  $\begin{cases} y < -x + 2 \\ (x - 1)^2 + (y - 2)^2 > 9 \end{cases}$
- E.  $\begin{cases} (y - 2) < 3 \\ (x - 1) > 3 \end{cases}$

50. You can find the volume of an irregularly shaped solid object by completely submerging it in water and calculating the volume of water the object displaces. You completely submerge a solid object in a rectangular tank that has a base 40 centimeters by 30 centimeters and is filled with water to a depth of 20 centimeters. The object sinks to the bottom, and the water level goes up 0.25 centimeters. What is the volume, in cubic centimeters, of the object?

- F. 300
  - G. 240
  - H. 200
  - J. 150
  - K. 75
- TANK = 40cm x 30cm x 20cm = 24,000*  
*WITH OBJECT = 40 x 30 x 20.25 = 24,300*  
 $\frac{24,300}{-24,000} = 300\text{cm}^3$

51. If  $x:y = 5:2$  and  $y:z = 3:2$ , what is the ratio of  $x:z$ ?

- A. 3:1
- B. 3:5
- C. 5:3
- D. 8:4
- E. 15:4

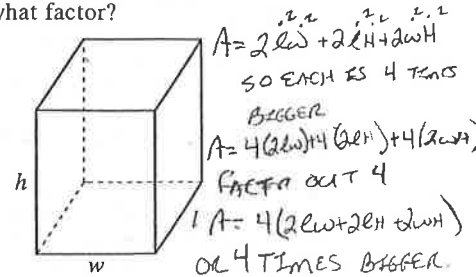
52. Which of the following is the solution statement for the inequality shown below?

$$-5 < 1 - 3x < 10$$

- F.  $-5 < x < 10$
- G.  $-3 < x$
- H.  $-3 < x < 2$
- J.  $-2 < x < 3$
- K.  $x < -3$  or  $x > 2$

53. A formula for the surface area ( $A$ ) of the rectangular solid shown below is  $A = 2lw + 2lh + 2wh$  where  $l$  represents length;  $w$ , width; and  $h$ , height. By doubling each of the dimensions ( $l$ ,  $w$ , and  $h$ ), the surface area will be multiplied by what factor?

- A. 2
- B. 4
- C. 6
- D. 8
- E. 12



54. A dog eats 7 cans of food in 3 days. At this rate, how many cans of food does the dog eat in  $3 + d$  days?

- F.  $\frac{7}{3} + d$
- G.  $\frac{7}{3} + \frac{d}{3}$
- H.  $\frac{7}{3} + \frac{7}{3d}$
- J.  $7 + \frac{d}{3}$
- K.  $7 + \frac{7d}{3}$



55. Kelly asked 120 students questions about skiing. The results of the poll are shown in the table below.

Question	Yes	No
1. Have you skied either cross-country or downhill?	65	55
2. If you answered Yes to Question 1, did you ski downhill?	28	37
3. If you answered Yes to Question 1, did you ski cross-country?	45	20

After completing the poll, Kelly wondered how many of the students polled had skied both cross-country and downhill. How many of the students polled indicated that they had skied both cross-country and downhill?

- A. 73
- B. 65
- C. 47
- D. 18
- E. 8

58. Which of the following number line graphs shows the solution set to the inequality  $|x - 5| < -1$ ?

- F.
- G.
- H.
- J.
- K.

59. As part of a probability experiment, Elliott is to answer 4 multiple-choice questions. For each question, there are 3 possible answers, only 1 of which is correct. If Elliott randomly and independently answers each question, what is the probability that he will answer the 4 questions correctly?

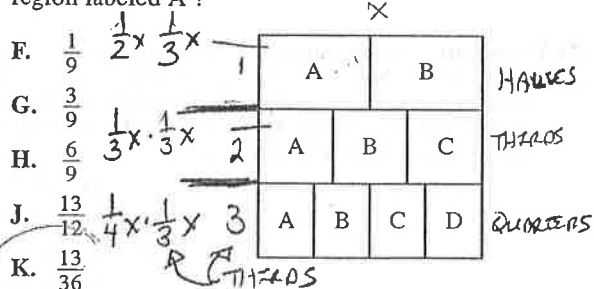
- A.  $\frac{27}{81}$
- B.  $\frac{12}{81}$
- C.  $\frac{4}{81}$
- D.  $\frac{3}{81}$
- E.  $\frac{1}{81}$

60. The sides of an acute triangle measure 14 cm, 18 cm, and 20 cm, respectively. Which of the following equations, when solved for  $\theta$ , gives the measure of the smallest angle of the triangle?

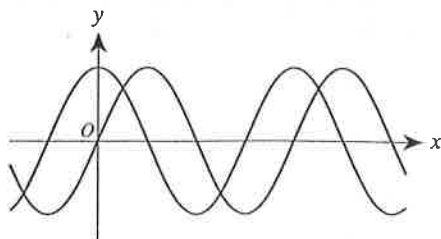
(Note: For any triangle with sides of length  $a$ ,  $b$ , and  $c$  that are opposite angles  $A$ ,  $B$ , and  $C$ , respectively,  $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$  and  $c^2 = a^2 + b^2 - 2ab \cos C$ .)

- F.  $\frac{\sin \theta}{14} = \frac{1}{18}$
- G.  $\frac{\sin \theta}{14} = \frac{1}{20}$
- H.  $\frac{\sin \theta}{20} = \frac{1}{14}$
- J.  $14^2 = 18^2 + 20^2 - 2(18)(20)\cos \theta$
- K.  $20^2 = 14^2 + 18^2 - 2(14)(18)\cos \theta$

56. The square below is divided into 3 rows of equal area. In the top row, the region labeled A has the same area as the region labeled B. In the middle row, the 3 regions have equal areas. In the bottom row, the 4 regions have equal areas. What fraction of the square's area is in a region labeled A?



57. The functions  $y = \sin x$  and  $y = \sin(x + a) + b$ , for constants  $a$  and  $b$ , are graphed in the standard  $(x, y)$  coordinate plane below. The functions have the same maximum value. One of the following statements about the values of  $a$  and  $b$  is true. Which statement is it?



- A.  $a < 0$  and  $b = 0$
- B.  $a < 0$  and  $b > 0$
- C.  $a = 0$  and  $b > 0$
- D.  $a > 0$  and  $b < 0$
- E.  $a > 0$  and  $b > 0$

END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.

# Alg 2 Analysis Only

# 2



# 2

## MATHEMATICS TEST

60 Minutes—60 Questions

**DIRECTIONS:** Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

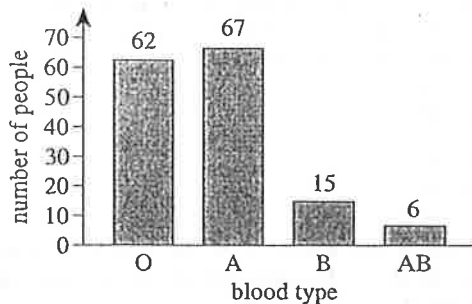
You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

1. The blood types of  $\overline{150}$  people were determined for a study as shown in the figure below.



If 1 person from this study is randomly selected, what is the probability that this person has either Type A or Type AB blood?

- A.  $\frac{62}{150}$   
 B.  $\frac{66}{150}$   
 C.  $\frac{68}{150}$   
 D.  $\frac{73}{150}$   
 E.  $\frac{84}{150}$
- $150 \text{ people}$   
 $P(1 \text{ person}) = P(A) + P(AB)$   
 $= \frac{67}{150} + \frac{6}{150}$   
 $= \frac{73}{150}$

3. On a particular road map,  $\frac{1}{2}$  inch represents 18 miles. About how many miles apart are 2 towns that are  $2\frac{1}{2}$  inches apart on this map?

- A. 18  
 B.  $22\frac{1}{2}$   
 C. 36  
 D. 45  
 E. 90

4. Given  $f = cd^3$ ,  $f = 450$ , and  $d = 10$ , what is  $c$ ?

- F. 0.45  
 G. 4.5  
 H. 15  
 J. 45  
 K. 150

5. If  $f(x) = (3x + 7)^2$ , then  $f(1) = ?$

- A. 10  
 B. 16  
 C. 58  
 D. 79  
 E. 100

2. The monthly fees for single rooms at 5 colleges are \$370, \$310, \$380, \$340, and \$310, respectively. What is the mean of these monthly fees?

- F. \$310  
 G. \$340  
 H. \$342  
 J. \$350  
 K. \$380

6. Jorge's current hourly wage for working at Denti Smiles is \$12.00. Jorge was told that at the beginning of next month, his new hourly wage will be an increase of 6% of his current hourly wage. What will be Jorge's new hourly wage?

- F. \$12.06  
 G. \$12.60  
 H. \$12.72  
 J. \$18.00  
 K. \$19.20

2



2

7. The first term is 1 in the geometric sequence 1, -3, 9, -27, ... What is the SEVENTH term of the geometric sequence?

- A. -243
- B. -30
- C. 81
- D. 189
- E. 729**

*to find the 7<sup>th</sup> term we need to find the ratio =  $\frac{2^{nd} \text{ term}}{1^{st} \text{ term}} = \frac{-3}{1} = -3$  then continue the sequence*

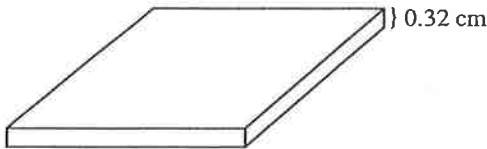
8. The shipping rate for customers of Ship Quick consists of a fee per box and a price per pound for each box. The table below gives the fee and the price per pound for customers shipping boxes of various weights.

Weight of box (pounds)	Fee	Price per pound
Less than 10	\$ 5.00	\$1.00
10-25	\$10.00	\$0.65
More than 25	\$20.00	\$0.30

Gregg wants Ship Quick to ship 1 box that weighs 15 pounds. What is the shipping rate for this box?

- F. \$ 9.75
- G. \$16.50
- H. \$19.75
- J. \$20.00
- K. \$24.50

9. A computer chip 0.32 cm thick is made up of layers of silicon. If the top and bottom layers are each 0.03 cm thick and the inner layers are each 0.02 cm thick, how many inner layers are there?



- A. 13
- B. 15
- C. 16
- D. 52
- E. 64

10. The table below shows the number of cars Jing sold each month last year. What is the median of the data in the table?

Month	Number of cars sold
January	25
February	15
March	22
April	19
May	16
June	13
July	19
August	25
September	26
October	27
November	28
December	29

- F. 13
- G. 16
- H. 19
- J. 20.5
- K. 23.5

11. Students studying motion observed a cart rolling at a constant rate along a straight line. The table below gives the distance,  $d$  feet, the cart was from a reference point at 1-second intervals from  $t=0$  seconds to  $t=5$  seconds.

$t$	0	1	2	3	4	5
$d$	14	20	26	32	38	44

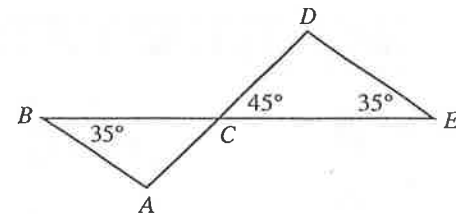
Which of the following equations represents this relationship between  $d$  and  $t$ ?

- A.  $d = t + 14$
- B.  $d = 6t + 8$
- C.  $d = 6t + 14$
- D.  $d = 14t + 6$
- E.  $d = 34t$

12. The length of a rectangle with area 54 square centimeters is 9 centimeters. What is the perimeter of the rectangle, in centimeters?

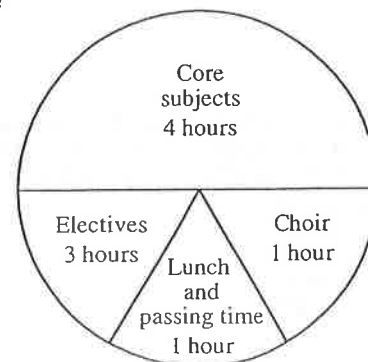
- F. 6
- G. 12
- H. 15
- J. 24
- K. 30

13. In the figure below,  $C$  is the intersection of  $\overline{AD}$  and  $\overline{BE}$ . If it can be determined, what is the measure of  $\angle BAC$ ?



- A.  $80^\circ$
- B.  $100^\circ$
- C.  $110^\circ$
- D.  $115^\circ$
- E. Cannot be determined from the given information

14. Antwan drew the circle graph below describing his time spent at school in 1 day. His teacher said that the numbers of hours listed were correct, but that the central angle measures for the sectors were not correct. What should be the central angle measure for the Core subjects sector?



- F.  $72^\circ$
- G.  $80^\circ$
- H.  $160^\circ$
- J.  $200^\circ$
- K.  $288^\circ$



15. This month, Kami sold 70 figurines in 2 sizes. The large figurines sold for \$12 each, and the small figurines sold for \$8 each. The amount of money he received from the sales of the large figurines was equal to the amount of money he received from the sales of the small figurines. How many large figurines did Kami sell this month?

- A. 20
- B. 28
- C. 35
- D. 42
- E. 50

16. A car accelerated from 88 feet per second (fps) to 220 fps in exactly 3 seconds. Assuming the acceleration was constant, what was the car's acceleration, in feet per second per second, from 88 fps to 220 fps?

- F.  $\frac{1}{44}$
- G.  $29\frac{1}{3}$
- H. 44
- J.  $75\frac{1}{3}$
- K.  $102\frac{2}{3}$

17. In a plane, the distinct lines  $\overleftrightarrow{AB}$  and  $\overleftrightarrow{CD}$  intersect at A, where A is between C and D. The measure of  $\angle BAC$  is  $47^\circ$ . What is the measure of  $\angle BAD$ ?

- A.  $43^\circ$
- B.  $47^\circ$
- C.  $94^\circ$
- D.  $133^\circ$
- E.  $137^\circ$

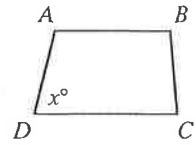
18. In which of the following are  $\frac{1}{2}$ ,  $\frac{5}{6}$ , and  $\frac{5}{8}$  arranged in ascending order?

- F.  $\frac{1}{2} < \frac{5}{8} < \frac{5}{6}$
- G.  $\frac{5}{6} < \frac{1}{2} < \frac{5}{8}$
- H.  $\frac{5}{6} < \frac{5}{8} < \frac{1}{2}$
- J.  $\frac{5}{8} < \frac{1}{2} < \frac{5}{6}$
- K.  $\frac{5}{8} < \frac{5}{6} < \frac{1}{2}$

19. In scientific notation,  $670,000,000 + 700,000,000 = ?$

- A.  $1.37 \times 10^{-9}$
- B.  $1.37 \times 10^7$
- C.  $1.37 \times 10^8$
- D.  $1.37 \times 10^9$
- E.  $137 \times 10^{15}$

20. For trapezoid  $ABCD$  shown below,  $\overline{AB} \parallel \overline{DC}$ , the measures of the interior angles are distinct, and the measure of  $\angle D$  is  $x^\circ$ . What is the degree measure of  $\angle A$  in terms of  $x$ ?



- F.  $(180 - x)^\circ$
- G.  $(180 - 0.5x)^\circ$
- H.  $(180 + 0.5x)^\circ$
- J.  $(180 + x)^\circ$
- K.  $x^\circ$

21. To get a driver's license, an applicant must pass a written test and a driving test. Past records show that 80% of the applicants pass the written test and 60% of those who have passed the written test pass the driving test. Based on these figures, how many applicants in a random group of 1,000 applicants would you expect to get driver's licenses?

- A. 200
- B. 480
- C. 600
- D. 750
- E. 800

*using conditional probability*  
 $P(A|B) = \frac{P(A \cap B)}{P(B)}$   
 $\downarrow$   
 $\frac{60}{100} = \frac{P(A \cap B)}{80/100} \Rightarrow \frac{48}{100}$   
 $\frac{48}{100} \cdot 1000 = 480$

22. If  $a$ ,  $b$ , and  $c$  are positive integers such that  $a^b = x$  and  $c^b = y$ , then  $xy = ?$

- F.  $ac^b$
- G.  $ac^{2b}$
- H.  $(ac)^b$
- J.  $(ac)^{2b}$
- K.  $(ac)^{b^2}$

$x \cdot y$   
 $a^b \cdot c^b = (ac)^b$

23. Which of the following expressions is equivalent to  $\frac{1}{2}y^2(6x + 2y + 12x - 2y)$ ?

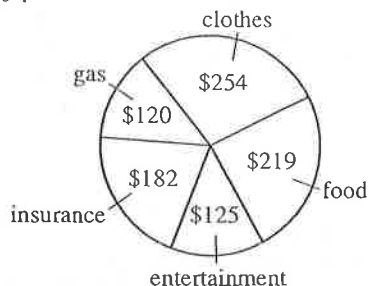
- A.  $9xy^2$
- B.  $18xy$
- C.  $3xy^2 + 12x$
- D.  $9xy^2 - 2y^3$
- E.  $3xy^2 + 12x - y^3 - 2y$

24. An artist makes a profit of  $(500p - p^2)$  dollars from selling  $p$  paintings. What is the fewest number of paintings the artist can sell to make a profit of at least \$60,000?

- F. 100
- G. 150
- H. 200
- J. 300
- K. 600

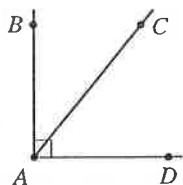


25. Last month, Lucie had total expenditures of \$900. The pie chart below breaks down these expenditures by category. The category in which Lucie's expenditures were greatest is what percent of her total expenditures, to the nearest 1%?



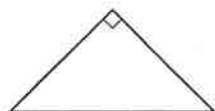
- A. 24%
- B. 28%
- C. 32%
- D. 34%
- E. 39%

26. In the figure shown below, the measure of  $\angle BAC$  is  $(x + 20)^\circ$  and the measure of  $\angle BAD$  is  $90^\circ$ . What is the measure of  $\angle CAD$ ?



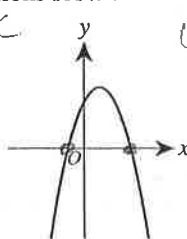
- F.  $(x - 70)^\circ$
- G.  $(70 - x)^\circ$
- H.  $(70 + x)^\circ$
- J.  $(160 - x)^\circ$
- K.  $(160 + x)^\circ$

27. What is the perimeter, in inches, of the isosceles right triangle shown below, whose hypotenuse is  $8\sqrt{2}$  inches long?



- A. 8
- B.  $8 + 8\sqrt{2}$
- C.  $8 + 16\sqrt{2}$
- D. 16
- E.  $16 + 8\sqrt{2}$

28. The equation  $y = ax^2 + bx + c$  is graphed in the standard  $(x, y)$  coordinate plane below for real values of  $a$ ,  $b$ , and  $c$ . When  $y = 0$ , which of the following best describes the solutions for  $x$ ?



- F. 2 distinct positive real solutions
- G. 2 distinct negative real solutions
- H. 1 positive real solution and 1 negative real solution
- J. 2 real solutions that are not distinct
- K. 2 distinct solutions that are not real

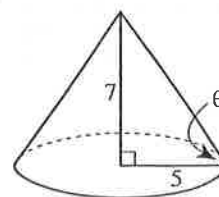
$0 = ax^2 + bx + c$   
 to find the Real Solution we need to find the x-intercepts,

Which 1 positive and 1 negative

29. What is the product of the complex numbers  $(-3i + 4)$  and  $(3i + 4)$ ?

- A. 1
- B. 7
- C. 25
- D.  $-7 + 24i$
- E.  $7 + 24i$

30. The radius of the base of the right circular cone shown below is 5 inches, and the height of the cone is 7 inches. Solving which of the following equations gives the measure,  $\theta$ , of the angle formed by a slant height of the cone and a radius?



- F.  $\tan \theta = \frac{5}{7}$
- G.  $\tan \theta = \frac{7}{5}$
- H.  $\sin \theta = \frac{5}{7}$
- J.  $\sin \theta = \frac{7}{5}$
- K.  $\cos \theta = \frac{7}{5}$

31. To make a 750-piece jigsaw puzzle more challenging, a puzzle company includes 5 extra pieces in the box along with the 750 pieces, and those 5 extra pieces do not fit anywhere in the puzzle. If you buy such a puzzle box, break the seal on the box, and immediately select 1 piece at random, what is the probability that it will be 1 of the extra pieces?

- A.  $\frac{1}{5}$
- B.  $\frac{1}{755}$
- C.  $\frac{1}{750}$
- D.  $\frac{5}{755}$
- E.  $\frac{5}{750}$

$P(1 \text{ extra piece}) = \frac{\# \text{ of extra pieces}}{\# \text{ of puzzles}} = \frac{5}{750 + 5} = \frac{5}{755}$

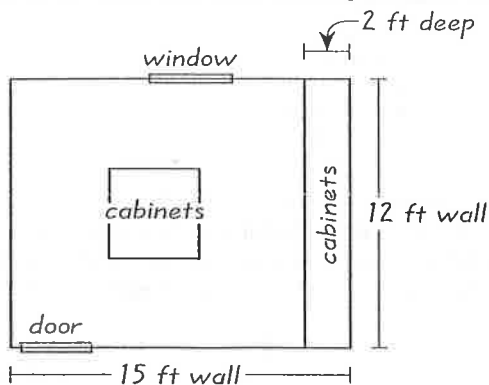
32. What fraction lies exactly halfway between  $\frac{2}{3}$  and  $\frac{3}{4}$ ?

- F.  $\frac{3}{5}$
- G.  $\frac{5}{6}$
- H.  $\frac{7}{12}$
- J.  $\frac{9}{16}$
- K.  $\frac{17}{24}$



Use the following information to answer questions 33–35.

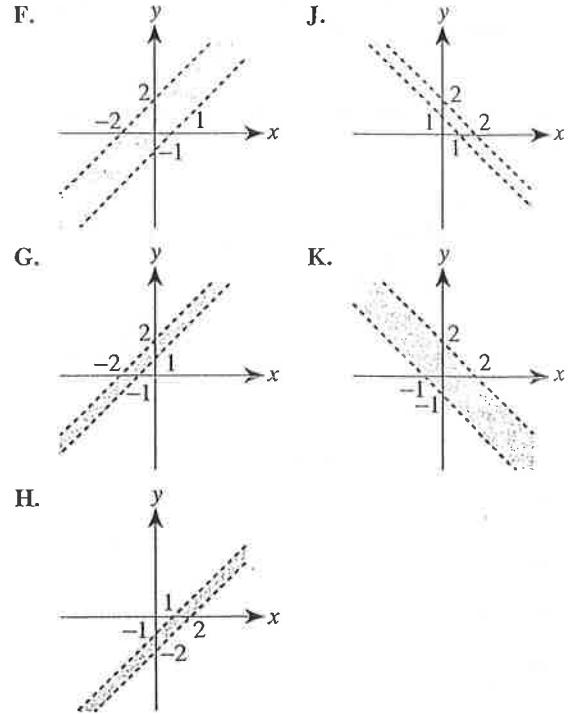
Gianna is converting a 12-foot-by-15-foot room in her house to a craft room. Gianna will install tile herself but will have CC Installations build and install the cabinets. The scale drawing shown below displays the location of the cabinets in the craft room (0.25 inch represents 2 feet).



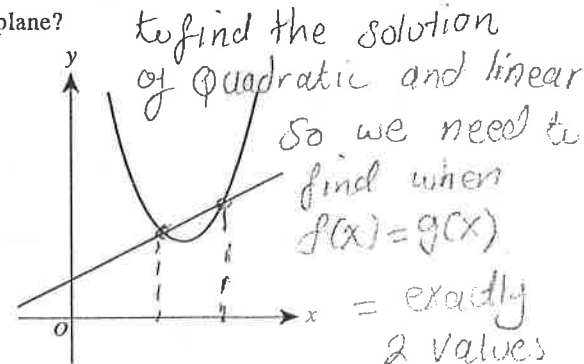
Cabinets will be installed along one of the 12-foot walls from floor to ceiling, and 4 cabinets that are each 3 feet tall will be installed in the middle of the room. These are the only cabinets that will be installed, and each of them will be 2 feet wide and 2 feet deep. CC Installations has given Gianna an estimate of \$2,150.00 for building and installing the cabinets.

33. A 15-foot wall is how many inches long in the scale drawing?
- A. 1.5  
B. 1.875  
C. 3  
D. 3.375  
E. 3.75
34. Gianna will install tile on the portion of the floor that will NOT be covered by cabinets. What is the area, in square feet, of the portion of the floor that will NOT be covered by cabinets?
- F. 72  
G. 90  
H. 140  
J. 156  
K. 164
35. CC Installations' estimate consists of a \$650.00 charge for labor, plus a fixed charge per cabinet. The labor charge and the charge per cabinet remain the same for any number of cabinets built and installed. CC Installations would give Gianna what estimate if the craft room were to have twice as many cabinets as Gianna is planning to have?
- A. \$2,800.00  
B. \$3,000.00  
C. \$3,450.00  
D. \$3,650.00  
E. \$4,300.00

36. Which of the following is the graph of the region  $1 < x + y < 2$  in the standard  $(x,y)$  coordinate plane?



37. What is the difference between the mean and the median of the set  $\{3, 8, 10, 15\}$ ?
- A. 0  
B. 1  
C. 4  
D. 9  
E. 12
38. Which of the following describes a true relationship between the functions  $f(x) = (x-3)^2 + 2$  and  $g(x) = \frac{1}{2}x + 1$  graphed below in the standard  $(x,y)$  coordinate plane?

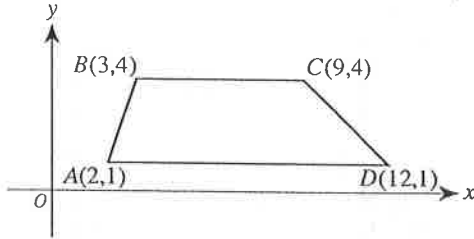


- F.  $f(x) = g(x)$  for exactly 2 values of  $x$   
G.  $f(x) = g(x)$  for exactly 1 value of  $x$   
H.  $f(x) < g(x)$  for all  $x$   
J.  $f(x) > g(x)$  for all  $x$   
K.  $f(x)$  is the inverse of  $g(x)$



Use the following information to answer questions 39–41.

Trapezoid  $ABCD$  is graphed in the standard  $(x,y)$  coordinate plane below.



39. What is the slope of  $\overline{CD}$  ?
- A.  $-3$
  - B.  $-1$
  - C.  $1$
  - D.  $\frac{5}{21}$
  - E.  $\frac{3}{2}$
40. When  $ABCD$  is reflected over the  $y$ -axis to  $A'B'C'D'$ , what are the coordinates of  $D'$  ?
- F.  $(-12, 1)$
  - G.  $(-12, -1)$
  - H.  $(12, -1)$
  - J.  $(1, 12)$
  - K.  $(1, -12)$
41. Which of the following vertical lines cuts  $ABCD$  into 2 trapezoids with equal areas?
- A.  $x = 2.5$
  - B.  $x = 3.5$
  - C.  $x = 4.5$
  - D.  $x = 5.5$
  - E.  $x = 6.5$

42. Given  $f(x) = x - \frac{1}{x}$  and  $g(x) = \frac{1}{x}$ , what is  $f\left(g\left(\frac{1}{2}\right)\right)$  ?
- $$f\left(g\left(\frac{1}{2}\right)\right) = f\left(\frac{1}{\frac{1}{2}}\right)$$

$$= f(2)$$

$$= 2 - \frac{1}{2}$$

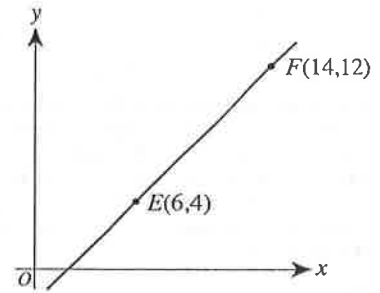
$$= 1\frac{1}{2} = \frac{3}{2}$$
- F.  $-3$
  - G.  $\frac{3}{2}$
  - H.  $-\frac{2}{3}$
  - J.  $0$
  - K.  $\frac{3}{2}$

43. A formula to estimate the monthly payment,  $p$  dollars, on a short-term loan is

$$p = \frac{\frac{1}{2}ary + a}{12y}$$

where  $a$  dollars is the amount of the loan,  $r$  is the annual interest rate expressed as a decimal, and  $y$  years is the length of the loan. When  $a$  is multiplied by 2, what is the effect on  $p$  ?

- A.  $p$  is divided by 6
  - B.  $p$  is divided by 2
  - C.  $p$  does not change
  - D.  $p$  is multiplied by 2
  - E.  $p$  is multiplied by 4
44. The points  $E(6,4)$  and  $F(14,12)$  lie in the standard  $(x,y)$  coordinate plane shown below. Point  $D$  lies on  $\overline{EF}$  between  $E$  and  $F$  such that the length of  $\overline{EF}$  is 4 times the length of  $\overline{DE}$ . What are the coordinates of  $D$  ?



- F.  $(7, 5)$
  - G.  $(8, 6)$
  - H.  $(8, 8)$
  - J.  $(10, 8)$
  - K.  $(12, 10)$
45. Given that  $a \begin{bmatrix} 2 & 6 \\ 1 & 4 \end{bmatrix} = \begin{bmatrix} x & 27 \\ y & z \end{bmatrix}$  for some real number  $a$ , what is  $x + z$  ?
- A.  $\frac{4}{3}$
  - B.  $\frac{27}{2}$
  - C.  $26$
  - D.  $27$
  - E.  $48$

46. A container is  $\frac{1}{8}$  full of water. After 10 cups of water are added, the container is  $\frac{3}{4}$  full. What is the volume of the container, in cups?
- F.  $13\frac{1}{3}$
  - G.  $13\frac{1}{2}$
  - H.  $15$
  - J.  $16$
  - K.  $40$





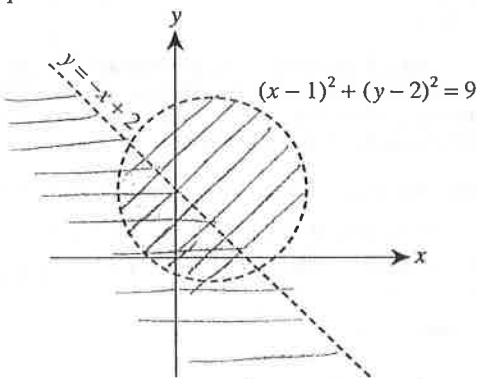
47. Only tenth-, eleventh-, and twelfth-grade students attend Washington High School. The ratio of tenth graders to the school's total student population is 86:255, and the ratio of eleventh graders to the school's total student population is 18:51. If 1 student is chosen at random from the entire school, which grade is that student most likely to be in?

- A. Tenth
  - B. Eleventh
  - C. Twelfth
  - D. All grades are equally likely.
  - E. Cannot be determined from the given information
- Handwritten notes:*  $10^{th} = \frac{86}{255}$ ,  $11^{th} = \frac{18}{51} = \frac{70}{255}$  (boxed),  $12^{th} = \frac{69}{255}$  (the biggest fraction)

48.  $\frac{4}{\sqrt{2}} + \frac{2}{\sqrt{3}} = ?$

- F.  $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{5}}$
- G.  $\frac{4\sqrt{3} + 2\sqrt{2}}{\sqrt{6}}$
- H.  $\frac{6}{\sqrt{2} + \sqrt{3}}$
- J.  $\frac{6}{\sqrt{5}}$
- K.  $\frac{8}{\sqrt{6}}$

49. The shaded region in the graph below represents the solution set to which of the following systems of inequalities?



- A.  $\begin{cases} y < -x + 2 \\ (x-1)^2 + (y-2)^2 < 9 \end{cases}$
- B.  $\begin{cases} y > -x + 2 \\ (x-1)^2 + (y-2)^2 < 9 \end{cases}$
- C.  $\begin{cases} y > -x + 2 \\ (x-1)^2 + (y-2)^2 > 9 \end{cases}$
- D.  $\begin{cases} y < -x + 2 \\ (x-1)^2 + (y-2)^2 > 9 \end{cases}$
- E.  $\begin{cases} (y-2) < 3 \\ (x-1) > 3 \end{cases}$

*Handwritten note:* this is the area that shaded two times,

50. You can find the volume of an irregularly shaped solid object by completely submerging it in water and calculating the volume of water the object displaces. You completely submerge a solid object in a rectangular tank that has a base 40 centimeters by 30 centimeters and is filled with water to a depth of 20 centimeters. The object sinks to the bottom, and the water level goes up 0.25 centimeters. What is the volume, in cubic centimeters, of the object?

- F. 300
- G. 240
- H. 200
- J. 150
- K. 75

51. If  $x:y = 5:2$  and  $y:z = 3:2$ , what is the ratio of  $x:z$ ?

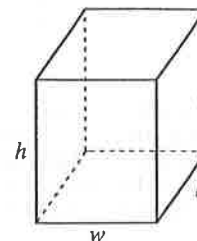
- A. 3:1
- B. 3:5
- C. 5:3
- D. 8:4
- E. 15:4

52. Which of the following is the solution statement for the inequality shown below?

$$-5 < 1 - 3x < 10$$

- F.  $-5 < x < 10$
- G.  $-3 < x$
- H.  $-3 < x < 2$
- J.  $-2 < x < 3$
- K.  $x < -3$  or  $x > 2$

53. A formula for the surface area ( $A$ ) of the rectangular solid shown below is  $A = 2lw + 2lh + 2wh$  where  $l$  represents length;  $w$ , width; and  $h$ , height. By doubling each of the dimensions ( $l$ ,  $w$ , and  $h$ ), the surface area will be multiplied by what factor?



- A. 2
- B. 4
- C. 6
- D. 8
- E. 12

54. A dog eats 7 cans of food in 3 days. At this rate, how many cans of food does the dog eat in  $3 + d$  days?

- F.  $\frac{7}{3} + d$
- G.  $\frac{7}{3} + \frac{d}{3}$
- H.  $\frac{7}{3} + \frac{7}{3d}$
- J.  $7 + \frac{d}{3}$
- K.  $7 + \frac{7d}{3}$



55. Kelly asked 120 students questions about skiing. The results of the poll are shown in the table below.

Question	Yes	No
1. Have you skied either cross-country or downhill?	65	55
2. If you answered Yes to Question 1, did you ski downhill?	28	37
3. If you answered Yes to Question 1, did you ski cross-country?	45	20

After completing the poll, Kelly wondered how many of the students polled had skied both cross-country and downhill. How many of the students polled indicated that they had skied both cross-country and downhill?

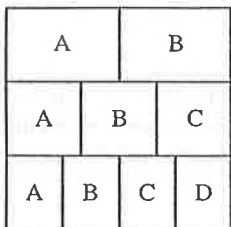
- A. 73
- B. 65
- C. 47
- D. 18
- E. 8

the number of students  
8 =

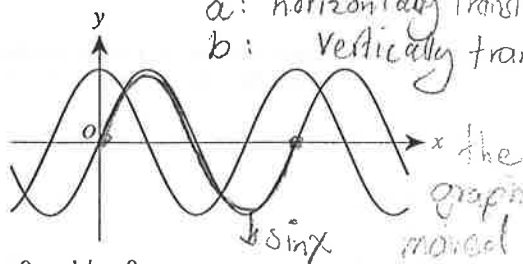
we need to find  $(A \cap B)$   
we used  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$   
 $\frac{65}{120} = \frac{28}{120} + \frac{45}{120} -$

56. The square below is divided into 3 rows of equal area. In the top row, the region labeled A has the same area as the region labeled B. In the middle row, the 3 regions have equal areas. In the bottom row, the 4 regions have equal areas. What fraction of the square's area is in a region labeled A?

- F.  $\frac{1}{9}$
- G.  $\frac{3}{9}$
- H.  $\frac{6}{9}$
- J.  $\frac{13}{12}$
- K.  $\frac{13}{36}$



57. The functions  $y = \sin x$  and  $y = \sin(x + a) + b$ , for constants  $a$  and  $b$ , are graphed in the standard  $(x, y)$  coordinate plane below. The functions have the same maximum value. One of the following statements about the values of  $a$  and  $b$  is true. Which statement is it?



- A.  $a < 0$  and  $b = 0$
- B.  $a < 0$  and  $b > 0$
- C.  $a = 0$  and  $b > 0$
- D.  $a > 0$  and  $b < 0$
- E.  $a > 0$  and  $b > 0$

58. Which of the following number line graphs shows the solution set to the inequality  $|x - 5| < -1$ ?

- F.
  - G.
  - H.
  - J.
  - K.
- (empty set)

59. As part of a probability experiment, Elliott is to answer 4 multiple-choice questions. For each question, there are 3 possible answers, only 1 of which is correct. If Elliott randomly and independently answers each question, what is the probability that he will answer the 4 questions correctly?

- A.  $\frac{27}{81}$
- B.  $\frac{12}{81}$
- C.  $\frac{4}{81}$
- D.  $\frac{3}{81}$
- E.  $\frac{1}{81}$

multiplication of independent events

$$P(1^{st} \cap 2^{nd} \cap 3^{rd} \cap 4^{th}) = P(1^{st}) \cdot P(2^{nd}) \cdot P(3^{rd}) \cdot P(4^{th})$$

$$= \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} = \frac{1}{81}$$

60. The sides of an acute triangle measure 14 cm, 18 cm, and 20 cm, respectively. Which of the following equations, when solved for  $\theta$ , gives the measure of the smallest angle of the triangle?

- F.  $\frac{\sin \theta}{14} = \frac{1}{18}$
- G.  $\frac{\sin \theta}{14} = \frac{1}{20}$
- H.  $\frac{\sin \theta}{20} = \frac{1}{14}$
- J.  $14^2 = 18^2 + 20^2 - 2(18)(20)\cos \theta$
- K.  $20^2 = 14^2 + 18^2 - 2(14)(18)\cos \theta$

(Note: For any triangle with sides of length  $a$ ,  $b$ , and  $c$  that are opposite angles  $A$ ,  $B$ , and  $C$ , respectively,  $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$  and  $c^2 = a^2 + b^2 - 2ab \cos C$ .)

END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.

# Reading

- 1. The Correct Answer is A.** The ENTIRE passage contains supporting details, which describe the relationship both the narrator and his parents had with the city of Bombay. Answer B is incorrect. Although buildings and places are mentioned in the passage descriptions are limited to specific paragraphs and cannot be found throughout the entire passage. Answer C is incorrect. The passage is a narrative concerning the narrator's personal life. The narrator is NOT making an argument for or against anything. Answer D is incorrect. Although the narrator does express emotions throughout the passage, the PRIMARY purpose of the passage is not CONCERNED about the "emotional environment".
- 2. The Correct Answer is J.** The narrator shows a desire to return to "ground level" and be among "knife grinders, water carriers, ...moneylenders, soldiers... schoolchildren and beggars." The textual evidence begins in line 61. Answer F is incorrect because the narrator does not state his dislike for the profession; instead he wants to add his own desire to take pictures from the ground line 69. Answer G is incorrect because the narrator states in line 64 these photographers showed him what he DID NOT want to do. Then in line 66 the narrator describes the sweeping panoramas of one of the photographs. Since G states the narrator WAS influenced to create grand panoramas this answer is incorrect. Answer H is incorrect because the narrator does not state any desire to have his photos added to his father's collection.
- 3. The Correct Answer is C.** Choice. The narrator uses a sarcastic tone when stating "... as if it knew it had to provide itself in finished condition by the time I was able to start paying attention to it." He then quickly rejects this information by contradicting himself saying, "no, no, I don't really think..." Answer A is incorrect. The narrator does state his parents' construction firm had been "prominent" in the making of Bombay, but he DOES NOT reject the notion later in the lines given. Answer B is incorrect. While the narrator does mention "...the time I was able to start paying attention to it...", he does not state this happened at a young age, nor does he later reject the statement. Answer D is incorrect. The narrator states Bombay had been "gigantic building site" "ten years before my own coming into the world", but he does not reject this information later in the passage

4. **The Correct Answer is H.** Answer F is incorrect because the ACT requires three words with the same beginning sound to have alliteration. Alliteration is not found in this section. Answer G is incorrect because an allusion is a reference to a well-known story or character. "Every time he speaks his nose grows." This would be an allusion to Pinocchio. J is incorrect because a simile requires two items be compared using "like" or "as". A comparison using "like" or "as" cannot be found in this section. The best response is H. Personification occurs when a non-human object is given human qualities. This occurs in the passage when the narrator refers to "Bombay" as "she", and states his parents had a "romance" with the city.
5. **The Correct Answer is B.** Beginning in line 38 the narrator directly states his parents shared parental responsibilities and describes his time with each parent. Answer A is incorrect. While the reader can infer the narrator's mother had important duties at the construction firm, there is not textual evidence to imply the narrator spent more time with the father than the mother. Answer C is incorrect. While the first section of this response is true, the narrator's father did work at his designing board, there is no mention of the narrator going with his mother to building sites. Answer D is incorrect. The narrator makes no reference to having a babysitter in the passage.
6. **The Correct Answer is J.** The passage states the "Art Deco sweep of Marine Drive". F is incorrect because the passage does not imply Art Deco and Marine Drive have any type of conflict. G is incorrect because the passage does not imply Art Deco is searching for anything on Marine Drive. H is incorrect because the passage does not infer Art Deco is removing anything from Marine Drive. By process of elimination, J is the best response because the reader can infer Art Deco could take up a broad area of/on Marine Drive.
7. **The correct answer is A.** The narrator compares important places in Bombay with those in other places by stating, "Malabar and Cumballa hills were our Capitol and Palatine, and the Brabourne Stadium was our Colosseum..." Answer B is incorrect. Although the term "Art Deco" is used the narrator does not state how the term was derived. Answer C is incorrect. The narrator states the time of his childhood WAS the golden age of Bombay. Answer D is incorrect. While the narrator does compare the significance of buildings in Bombay to those in Rome, he does not compare the "style" of the buildings.

8. **The Correct Answer is H.** F, G, and J are not the best choices because the narrator does not directly mention the emotions of joy, fear, or respect. The reader may be able to infer these emotions from the text but the narrator does not show a "STRONG SENSE" of them. H is the best response because the narrator directly states in line 32-33 "...I was insanely jealous of the city in which I was raised,"
9. **The Correct Answer is B.** Line 38 implies the parents created or made a list with parental responsibilities. The word "Prepared" most closely relates to the words create or make. Answer A is incorrect. The word extended means to continue or make longer. "My teacher extended the deadline." Answer C is incorrect. The word approach means away of dealing with or a proposal for something. "The girls approached the idea of party eagerly." D is incorrect. The word straightened means to arrange or put in order. "The boy straightened out his thoughts before writing the poem."
10. **The Correct Answer is J.** Answer F is incorrect because in the last paragraph neither the narrator, nor his father makes any reference to commercial progress or to the people of Bombay. Answer G is incorrect because neither the narrator, nor his father makes any reference to photographers Dayal and Haseler in this passage. H is incorrect because the father of the narrator makes no reference to time periods in this passage. J is the best response because the narrator's father states, " See where people lived and worked and shopped, and it becomes plain what they were like."

### Reading Passage II

11. **The Correct Answer is A.** Throughout the selection the author uses descriptive language throughout the passage to show he is awed (filled with wonder) and fascinated (to hold charm, or unusual attention) with the canyon and with the waters themselves. Words such as "grand and sweeping", "extensive, rugged, and imposing", and "eclipsing" inform the reader of the author's attitude. Answer B is incorrect. The reader can infer the author is not in disbelief due to the scientific information given and the cynicism means to doubt something is accurate or to mistrust something that is said. Answer C is incorrect because the word amusement would indicate the author finds the subject funny or entertaining and the word nostalgia means the author has an affection or longing for the past. Answer D is incorrect because the author does not have a bored attitude, nor is he suffering from indifference (lack of interest).

12. **The Correct Answer is J.** Careful reading is needed to ensure the correct response for this question. Paragraph three contains the three names given in the question but the actual identity of the land mass is not found in paragraph three. You must read further into paragraph four line 48 to determine, "Hidden beneath the waves is an immense submerged mountain range, the backbone of the sea." Scanning the passage without close reading will cause this question to be missed. Answer F is incorrect because islands are only briefly mentioned in paragraph one and are not connect with the names given in paragraph three. Answer G is incorrect because, although the transatlantic cable is mentioned in paragraph three as well, repairing the cable was the event that lead scientist to discovering the mountain range. Scanning the paragraph instead of close reading would lead to this answer being incorrectly chosen. Answer H is incorrect because, although the passage does mention a land bridge as the possible land feature for these names, if the reader continues to read, paragraph 3 specifically states," sailors repairing the transatlantic telegraph cable unknowingly produced evidence to prove otherwise." Again, scanning instead of close reading would cause this answer to be incorrectly chosen.
13. **The Correct Answer is C.** The first paragraph begins by talking about the stillness of the sea. The author is very detailed in his description of the outward appearance of the still water. The author states that the undisturbed surface "offers no hint of the grand and sweeping energies hidden below." Answer A is incorrect because at no point in the passage does the author describe the becoming rough due to high winds. Answer B is incorrect because, although paragraph one does mention oceanic islands, at no point in the text does the author mention the difficulty or ease of spotting islands. Answer D is incorrect because paragraph one specifically states, "nothing demarcates or divides the smooth expanse of water..."
14. **The Correct Answer is J.** In paragraph 6 lines 65-67 the text specifically states, "Arizona's rand Canyon, one of earth's most spectacular places, extends for about 280 miles (450 kilometers). A lesser-known canyon of similar depth but considerably greater length lies hidden in the mountains of the ridge." Answer F is incorrect because the text states "of similar depth". Depth is the measure of how deep something is. Answer G is incorrect because at no point in the text does the author compare the age of the Grand Canyon to that of the underwater mountain range. Answer H is incorrect because the author only compares the width and depth of the Grand Canyon and the underwater mountain range. He does not compare the width of the two land features.

15. **The Correct Answer is B.** In paragraph 6 lines 71 – 76 specifically discusses the “lifeless” qualities of the valley by providing words such as “bleak,” “forbidding place,” and “otherworldly setting” to describe the area. Answer A is incorrect because the results not the expectations of the first visit by scientist are being discussed. Answer C is incorrect because no statics only descriptions are given about the rift valley. Answer D is incorrect because no specific names are provided in this section. The author only tells us the names were given, “after distant, lifeless planets.” He does not tell us what those names were.
16. **The Correct Answer is H** because the whole paragraph deals with the formation of the Atlantic seafloor due to gashes in the rift valley. This answer is the best choice because it is general enough to provide an overview of the whole paragraph. Answer F is incorrect because it is a detail in the paragraph, but is not the main purpose of the paragraph. Answer G is incorrect because, according to the paragraph, the earth is still cooling. It is not cooled. Answer J is incorrect because it is another detail in the paragraph, but it is not the main purpose of the paragraph.
17. **The Correct Answer is H** because the author states in paragraph one line eleven: “Contrary to what one might guess, Atlantic’s deepest waters, like those in other oceans, are along her edges.” Since contrary to means “Different from,” which implies that people typically believe that the ocean’s waters are deepest in the middle. Answer A is incorrect because the author states in paragraph two lines 9-10, “Only one thousand miles offshore, the *Cramer* has already sailed through some of Atlantic’s deepest waters.” Answer C is incorrect because at no point in the text does the author mention the middle of the ocean being dotted with islands. Answer D is incorrect because at no point in the text does the author mention the deepest water being located in the trenches.
18. **The Correct Answer is F** because in line 19 the author describes the releasing of eight miles of hemp rope. The word “dispense” means to distribute or provide and most closely matches the description of the sailor releasing the rope. Answer G is incorrect because the word “ascertained” means to discover or find out. Although the sailor was trying to discover the depth, the word “discover” could not be substituted for the phrase “paid out” in line 19. Answer H is incorrect because the word “suggested” means to purpose or recommend. Although the sailor did suggest the ocean floor had not bottom, the word suggested cannot be substituted for the phrase “paid out” in line 19. Answer J is incorrect because even though one possible meaning of compensated can be paid out, it does not make sense in this context. This would imply that the sea is personified and expects payment for services rendered, which is not the case in line 19.

19. **The Correct Answer is D** because it states implicitly in line 51: "it covers almost as much of the earth's surface as the dry land of continents." Answer A is incorrect because the author states in line 59 the mountain range has peaks as high as Mount St. Helens but does not compare the size of the surfaces. Answer B is incorrect because the author states in line 49-51 the mountain range is more "extensive, rugged, and imposing" than the Himalayas but does not compare the size of the surfaces. Answer C is incorrect because at no point in the text does the author mention the Pacific Ocean.
20. **The Correct answer is F** because in lines 55-59, the passage states: *Its mountains are stark and black, as black as the sea itself, lit only at their peaks by a thin, patchy covering of white, the skeletal remains of tiny microscopic animals that once lived at the surface.* This provides direct textual evidence for the questions. Answers G., H., and J. are incorrect because they are unsupported by the passage.
21. **The Correct Answer is A** because Bradbury is referring to a word-association process found in line 8. Lines 38-39 also reinforce this process. Answer B is incorrect because any long- forgotten experiences have nothing to do with a word association process. Answer C is incorrect because once again "the surprise" is the word association process neither past nor current experiences. Answer D is incorrect because Bradbury discovered his word association process by himself and was not taught this method by other writers.
22. **The Correct Answer is G** because in lines 2-4 Bradbury says that beginning writers believe they can force an idea into existence. Answer F is incorrect because "the surprise" here refers to his discovery of a word-association process. Answer J is incorrect because Bradbury did not use just one word as a story catalyst, but many words to associate with personal experiences and events in his life. Answer H is incorrect because according to Bradbury most beginning writers do not experiment but attempt to write by forcing an idea into existence.
23. **The Correct Answer is B** because in line 14 Bradbury was looking for a words meaning in his own life. He was struggling to find the words meaning or significance to him. Answer A is incorrect because Bradbury wasn't looking for a word to help him understand John Huff. Answer B is incorrect because Bradbury did not reject any words as catalysts; he used any words that had meaning and significance in his own life. Answer C is incorrect because not only words that inspired fear were used by Bradbury but all words that had meaning to him in his past and present life.



24. **The Correct Answer is J** because in lines 30-32 Bradbury states “hardly a day passed when I didn’t stroll myself across recollection”. Line 36 states: “to remind him of the past”. Bradbury had a daily habit and was trying to bring his past into focus. Answer F is incorrect because Bradbury is talking about a “daily habit” over many years. Answer G is incorrect because this answer is not about a “daily habit” over many years. Answer H is incorrect because once again this answer does not address the “daily habit”. Bradbury did not drive past his grandparents’ property, he “recollected” through thought his grandparents old place in order to remind him of his past.
25. **The Correct Answer is B** because in lines 39-42 Bradbury “shipped” his friend John Huff from Arizona to Green Town so he could say goodbye to him properly. Huff was a character that Bradbury wrote about several times once he had displaced him from Arizona to Green Town. Answers A, B, D are incorrect only because choice (C) is the best answer. Since question #25 is somewhat nebulous -- a case could be made for all of the answers. But answer (C) is the best.
26. **The Correct Answer is G** because of the use of similes to highlight Douglas’s admiration of John. Answer F is incorrect because it does not exaggerate his strengths. Answer H is incorrect because Douglas was not fond of John’s recklessness. Answer J is incorrect because it is not an exaggeration.
27. **The Correct Answer is C** answers because the day, in lines 64-68, had previously been “as perfect as the flame of a candle”. In lines 74-76 the day takes a 180-degree turn and becomes cloudy and dark. Choice A is incorrect because it refers to a stormy night that causes personal sadness. Choice B is incorrect because it refers to his mood all day as being sad. This is not true, as mentioned in lines 64-68. Choice D is incorrect because the statement is not figurative.
28. **The Correct Answer J** is because both passages highlight the use of sensory details and imaginative descriptions. Lines 50-51 state this outright: “I learned to let my senses...” In passage B, Bradbury paints the scene with sounds and visual imagery. Choice F is incorrect because passage A uses 1<sup>st</sup> person and passage B uses third person. Choice G is incorrect because satire is never used. Choice H is incorrect because allegory is not used.

29. **The Correct Answer is C** because we have previously learned that Bradbury would take a word or two and then use it to let ideas coalesce into a story. Choice A is incorrect because nothing is mentioned about his taking notes while interviewing old friends. Choice B is incorrect because he did not start with two characters; he started with a word or two. Choice D is incorrect because it says he would outline; he did not do this.
30. **The Correct Answer is G** because it states all that we know from both passages. Choice F is incorrect because there is nothing in either statement that supports the answer. Choice H is incorrect because nothing about the two lines “prove” that he was pained. Choice J is incorrect because it is clearly opposite of what we know from the two passages.

#### **Passage IV Natural Science**

31. **The Correct Answer is A** because the passage as a whole pertains to the jaws of trap-jaw ants. Answer A is the best choice because it is general enough to provide an overview of the whole passage. Answer B is incorrect. Although Patek and Baio’s research and filming techniques are mentioned, they are not the primary purpose of the passage. Answer C is incorrect because the author does not compare the trap-jaw ants to other ant species. Answer D is incorrect because, while the author does talk about the trap-jaw ants performing an escape jump, it is not the primary purpose of the entire passage.
32. **The Correct Answer is G** because the phrases “bouncer defense”, “head over heels”, and “banging ones head against the ground” have a humorous and less scientific tone compared with the technical, scientific primary tone of the article. Answer F is incorrect because the author neither employs sarcasm, the use of irony to mock someone or something, nor is most of the article casual and playful. Answer H is incorrect because the author does not use a combative, ready or eager to fight, tone nor is the article primarily praising the work of two scientists. Answer J is incorrect because the article does not contain a personal anecdote, a short story about oneself, nor does the article primarily contain data.

- 33. The Correct Answer is A** because the context of lines 81-82 and the word “penetrate” help the reader infer the trap-jaw ant needs to use the stored energy in its jaws to access its prey. Therefore, the reader can infer a “well-defended prey” which needs strong jaws to “penetrate” would have a hard outer shell. Answer B is incorrect because the lines do not infer the prey has any ability to bite the ant. Answer C is incorrect because the lines do not infer the prey has any group activity. Answer D is incorrect because having strong jaws does not help the ant catch prey that moves quickly.
- 34. The Correct Answer is J** because lines 21-30 specifically state, “The key to the jaws’ speed (and their even more amazing acceleration) is that the release comes from stored energy produced by the strong but slow muscles of the jaw.” Answer F is incorrect because, although the text does mention the ease of movement of the hinge of the jaw, this is not the reason for the speed. Answer G is incorrect because, although the text does mention the continuous, steady firing of the jaw’s mandibles, this is not the reason for the speed. Answer H is incorrect because line 24-25 explains the energy is produced, NOT STORED, by the strong, slow muscles of the jaw.
- 35. The Correct Answer is D** because the analogy between popping popcorn and the trap-jaw ant in made in lines 40-41 is described in detail in lines 42-45. The author describes how the ants “bounced around” and “propelled themselves” when intruders were near. Answer A is incorrect because the analogy references “very hot popcorn” in comparison to “a painful sting” is felt when the ant bites not because the jaws themselves radiate heat. Answer B is incorrect because paragraph five, which contains the analogy, does not discuss the height of the jump escape. The jump escape is not mentioned until paragraph 6 and is no longer part of the popcorn analogy. Answer C is incorrect because the “bouncer defense” is not discussed until paragraph 7 and is no longer part of the popcorn analogy.
- 36. The Correct Answer is H** because line 84-89 specifically state, “...but the high, escape jump-with jaws aimed directly at the ground-must have arisen from a different, perhaps accidental kind of behavior.” Answer F is incorrect because the lines 83-84 specifically state, “In *Odontomachus*, the horizontal, bouncer-defense jump could have arisen out of attempts to bite intruders...” However, the text does not state the ants failed to bite the intruders as stated in the answer choice. Answer G is incorrect because lines 79-81 state, “Several lineages of trap-jaw ants have independently hit on the tactic of storing energy in their jaws to penetrate well-defended prey.” But the paragraph makes no references to the structure of the mandibles as stated in the response. Answer J is incorrect because paragraph 8 makes no reference to the ants acting in a group.

- 37. The Correct Answer is B.** Using context clues such as “biomechanics of energy storage” and both biomechanists at the University of California, Berkeley the reader can infer the word “domain” by eliminating other possible answers. Answer A is incorrect because the scientists are not living in the biomechanics of energy storage, therefore the phrase “living space” can not be substituted for the word “domain” in this instance. Answer C is incorrect because the jargon “taxonomic category” would be repetitive or conflict with the already stated category of “biomechanics of energy storage” and therefore could not be substituted for the word “domain” in this instance. Answer D is incorrect because the phrase “local jurisdiction” pertains to an actual physical area and therefore, would not be the correct substitute for the word “domain” in this instance.
- 38. The Correct Answer is J** because in lines 49-51 the text specifically states, “They also observed that mandibles started to decelerate before they meet—possibly to avoid self-inflicted damage.” Answer F is incorrect because, although the text does mention a hinge, which prevents the mandibles from snapping together forcefully, this is not referred to as a safety mechanism. Answer G is incorrect because in lines 14-16 hairs are described as “minute triggers” located on “the inner edge of the mandible”. The passage does not mention any “cushioned inner edges” as mentioned in the answer. Answer H is incorrect because in lines 12-14 a latch mechanism is described as holding the mandibles apart at “180 degrees”. The passage does not state that the “mechanism prevents the mandibles from closing completely” as mentioned in the answer.
- 39. The Correct Answer is A** because paragraph 5 lines 61-61 specifically state “Not only can theumping ant gain height and sow confusion, but it may also get to a new vantage point from which to relaunch an attack.” This quote provides textual evidence, which correlates with the answer. Answer B is incorrect because, although the text does state the escape jump confuses the predator, the portion of the answer pertaining to a “quick, and sudden sting” is not accurate. Answer C is incorrect because the passage does not mention a signal to other ants. Answer D is incorrect because paragraph 5 lines 58-60 states, “The ant doesn’t seem to go in any particular direction...”

**40. The Correct Answer is H** because paragraph 6 lines 68-70 specifically state, "If an intruder enters the ants' nest, one of the ants bangs its jaws against the intruder, which triggers the trap-jaw and propels the interloper (if small enough) in one direction, out of the nest, and the ant in the other." Also lines 73-75 state, " In the wild, gangs of defending ants team up to attack hostile strangers, sending them head over heels out of the nest." These lines provide textual evidence to prove answer H is the best answer. Answer F is incorrect because lines 68-70 state both the ant and the intruder are thrown from the nest. Answer G is incorrect because lines 68-70 and 73-75 state the intruder or "stranger" is thrown from the nest. Answer J is incorrect because lines 68-70 and lines 73-75 state the intruder and the ant are thrown from the nest.



## ACT Science Passage Explanations

### Passage I

- Evaluation of Models, Inferences and Experimental Results.* Correct answer is C. Figure 2 indicates a lifespan of fruit flies greater than or equal to 75 days with test tubes containing 5% SY medium. Figure 1 indicates the survival of fruit flies did not exceed 55 days with test tubes containing 15% SY medium. Therefore, (C) is the correct answer because it is the only answer choice that shows a fruit fly lifespan of greater than 75 days using 5% SY medium.
- Interpretation of Data.* Correct answer is G. Both Study 1 and Study 2 indicate that virgin female fruit flies less than 24 hours old were used during the experiment. It would not be answer choice (H) or (J) because the results for both Study 1 and Study 2 show an increase in death rate as the number of days increases. Since there were no male fruit flies used in either study, answer choice (F) is not correct. Therefore (G) is the correct answer.
- Interpretation of Data.* Correct answer is D. Answer choices (A) and (B) are not correct because only virgin female fruit flies were used during both studies. Study 1 contained a 15% SY medium, whereas study 2 contained a 5% SY medium. Answer choice (C) is not correct because the SY medium contained in study 1 contained a higher percent of sugar than did the SY medium in study 2. Therefore (D) is the correct answer.
- Scientific Investigation.* Correct answer is G. Answer choices (F) and (J) are not correct because the lifespan of the fruit flies decreases with increasing % SY medium. Answer choice (H) is not correct because an average lifespan of between 58.6 days and 61.6 days indicates an SY medium of between 3% and 10%. At 10% SY medium, the average fruit fly lifespan is 58.6 days. At 15% SY medium, the average fruit fly lifespan is 55.6 days. Therefore (G) is the correct answer.
- Evaluation of Models, Inferences and Experimental Results.* Correct answer is C. Strain X fruit flies lack Or83b, which is a protein required for detecting odors. The results for Study 3 indicate that the average lifespan of strain X fruit flies was longer than the average lifespan of strain N fruit flies. Therefore (C) is the correct answer.
- Scientific Investigation.* Correct answer is F. Strain X fruit flies lack Or83b, which is a protein required for detecting odor. Study 1 contained 15% SY medium, whereas study 2 contained 5% SY medium. In order to determine whether a defect in the ability to detect odors would change the lifespan of fruit flies fed with 15% SY medium when live yeast is added to the diet, study 1 would need to be repeated using strain X of fruit flies lacking Or83b. Therefore (F) is the correct answer.
- Scientific Investigation.* Correct answer is A. During study 1, no additional substance was added to tube 1. During study 2, no additional substance was added to tube 4. Additional odors from yeast and live yeast were added to the rest of the test tubes. In order to determine how a reduced calorie diet affects lifespan in the absence of live yeast and additional odors, the results from test tubes 1 and 4 should be compared. Therefore (A) is the correct answer.

### Passage II

- Evaluation of Models, Inferences and Experimental Results, EMI.* Correct answer is F.

Question: Two distinct period are stated in the Hypothesis 1 beginning sentence – from stored lipids for migration and during the overwintering period.

2<sup>nd</sup> sentence – key word **first**.

Last sentence – key word **again**.

9. *Evaluation of Models, Inferences and Experimental Results, EMI.* Correct answer is D.

Question: Storing lipids neither for migration nor during the overwintering period.

When looking at the first sentences of each of the hypotheses-

Hypothesis 1 – from stored migration AND during the overwintering period.

Hypothesis 2 – FOR migration but NOT during the overwintering period.

Hypothesis 3 – from stored lipids during the overwintering but NOT migration.

10. *Interpretation of Data, IOD.* Correct answer is J.

Question: From Hypothesis 3, which shows change in the lipid mass from beginning (B) to end (E).

Answer is found in the third sentence, "...;therefore, lipid mass **continuously increases** from the beginning of migration until the end of migration."

11. *Evaluation of Models, Inferences and Experimental Results, EMI.* Correct answer is B.

Question: "The percent of a monarch butterfly's body mass that is made up of lipids is greater at the beginning of migration than at the end of migration" is supported by which hypotheses?

Answer is found in Hypothesis 1 – lipid mass continuously **decreases**.

Answer is found in Hypothesis 2 – lipid mass continuously **decreases**.

12. *Evaluation of Models, Inferences and Experimental Results, EMI.* Correct answer is F.

Question: "A supporter of which hypothesis, if any, would be likely to claim that to ensure the butterflies can store lipids for the **overwintering period**, nectar must be present at the butterflies' **overwintering sites**?"

Answer is found in Hypothesis 1 last sentence – they must store lipids **AGAIN** before **BEGINNING** the overwintering period.

13. *Evaluation of Models, Inferences and Experimental Results, EMI.* Correct answer is B.

Question: "Which question about lipids is consistent with all 3 hypotheses?"

Hypothesis 1 - lipid mass continuously **decreases**.

Hypothesis 2 - lipid mass continuously **decreases**.

Hypothesis 3 - lipid mass continuously **increases**.



Therefore, in each hypothesis, there is change.

14. *Evaluation of Models, Inferences and Experimental Results, EMI.* Correct answer is F.

This question requires outside content knowledge to know that ATP is required for lipid breakdown.

### Passage III

15. *Interpretation of Data.* Correct answer is C. Figure 2 plots Solar Radiation Intensity (watts/m<sup>2</sup>) and Concentration of CH<sup>4</sup> in Earth's atmosphere (ppm) on the Y-axis against Thousands of Years on the X-axis. Go to the graph and note that Solar Radiation is represented by the dotted-line. 8 thousand years ago is represented on the X-axis, two spaces to the right of the 10. Go up the 8-line on the graph until you intersect with the dotted line. Then read the left side of the graph for solar radiation intensity. The Y-axis, on the left, indicates a value of approximately 500 watts/m<sup>2</sup> at 8 thousand years.

16. *Interpretation of Data.* Correct answer is F. Figure 2 plots Solar Radiation Intensity (watts/m<sup>2</sup>) and Concentration of CH<sub>4</sub> in Earth's atmosphere (ppm) on the Y-axis against Thousands of Years on the X-axis. The graph indicates that solar radiation (the dotted line) continues on a downward slope and approaches 450 ppb and less than 475 watts/m<sup>2</sup>. However, CH<sup>4</sup> turns back up, to a positive slope at 5 thousand years. The question asks what the value of CH<sup>4</sup> would be at present day if it followed the same slope as solar radiation. Simply get the value of solar radiation at present day (approximately 450 watts/m<sup>2</sup>) and look for a corresponding answer. Answer F indicates "less than 550 ppb." Every other answer is too large.

17. *Interpretation of Data.* Correct answer is B. The question asks which graph in the answers best matches the slope of the CH<sup>4</sup> in Figure 2. The slope of CH<sub>4</sub> in figure 2, represented by the solid line, *decreases then increases*. The only graph in the answers that *decreases then increases* is answer B. The object is to understand concepts such as "increases only" or "decreases only" or "increases then decreases" and then apply the same concept/slope to another graph (or in some questions, a data table).

18. *Interpretation of Data.* Correct answer is H. Figure 1 plots years on the X-axis (250,000 years ago to present day) against Solar Radiation Intensity (watts/m<sup>2</sup>) and Concentration of CH<sup>4</sup> in Earth's atmosphere (ppm) on the Y-axis. The question asks the *average solar radiation intensity for the whole graph*. You need to draw a horizontal line across the graph at the approximate midpoint between the solar radiation highs and lows (solid lines). The midpoint line would be approximately 480 watts/m<sup>2</sup>. Answer H indicates exactly 480 watts/m<sup>2</sup>. All other answers had incorrect values for solar radiation. This question requires an ability to locate the maximums and minimums in a graph and then locate an average mid-point between the maximum and minimum. You are required to be precise with your graph data for this question.

19. *Interpretation of Data.* Correct answer is B. Figure 1 plots years on the X-axis (250,000 years ago to present day) against Solar Radiation Intensity (watts/m<sup>2</sup>) and Concentration of CH<sup>4</sup> in Earth's atmosphere (ppm) on the Y-axis. You are asked how many years, *in thousands of years*, between *maximums* of solar radiation (the dotted line). Each hash mark on the X-axis indicates 10 thousand years. The gap, in thousands of years, between *any two maximums of the dotted line*, is approximately 20 thousand years. Answer B is "between 15,000 and 35,000 years." This question requires an understanding of *maximums and minimums* on a graph. You must approximate the time between *maximums* and correlate the graphical data to the numerical answers provided. The graphical data is inexact, and is an *approximate value*. Therefore the answers have a large range. The only answer offering the correct range of data is Answer B.

20. *Evaluation of Models, Inferences and Experimental Results*. Correct answer is J. This question requires you to evaluate the written passage and the graphical information. You are expected to have a basic understanding of the main concept of the passage. The main concept of the entire passage is that there is a correlation between greenhouse gasses and solar radiation intensity.  $\text{CH}_4$  is noted as a greenhouse gas in the passage. You are expected to understand that  $\text{CH}_4$  absorbs heat and warms the Earth's climate. Answer F indicates  $\text{CH}_4$  gives off light. This has nothing to do with the passage. Answer G indicates  $\text{CH}_4$  gives off ultraviolet radiation. This is a distractor. Ultraviolet radiation is a component of solar radiation, but is not released by  $\text{CH}_4$ . Answer H looks correct (a distractor) but indicates that Earth's climate *cool/s* instead of heats up. Only Answer J correctly pairs *heating* with  $\text{CH}_4$ .

#### Passage IV

21) *Scientific Investigation* Correct answer is A. Opposite force or friction force of the pull. You pull east...friction pulls west

22) *Interpretation of Data* Correct answer is F. Looking at slope of three lines and their plots along the quadrant. The steeper the slope the faster the speed/acceleration. The fastest moving block as the 2 Kg block the second fastest was the 2.5 Kg block while the slowest block was the 3 Kg block. You can compare this to a BMW racing a 18 wheeler truck. The one with the most mass will be the slowest.

23) *Interpretation of Data* Correct answer is B. The slope of the 3 Kg block is a constant acceleration of 5/meters/sec/sec. The trend will continue to 20 meters/sec/sec at the 4 second mark. The 3 Kg block has a steady non-varied slope

24) *Interpretation of Data* Correct answer is J. Slope is steady. Every second that passes by on the x axis the line rises 5 times that amount. At 1 kg the force is 5 newtons...at 2 kg the pulling force is 10 newtons...at 3 kg the force is 15 newtons...at 4 kg the force is 20 newtons

25) *Evaluation of Models, Inferences & Experimental Results* Correct answer is B. In figure 2 the more the mass increased the less steep the line becomes. The less steep the slope the slower the block is moving. The steeper the slope the faster it is moving. As more weight is added the less steep the line(s) get. Thus showing that the block is slowing down or moving at a slower pace.

26) *Evaluation of Models, Inferences & Experimental Results* Correct answer is H. As in question 24 the line has a slope of 5 newton's per 1 Kg. so the formula would be (force = 5 x Mass). If the force is 30, the formula would read  $30 = 5 \times \text{Kg}$  this is a simple formula to complete (30 divided by 5 is 6)...so the answer is 6 kg

#### Passage V

27. *Scientific Investigation* Correct answer is A. The question asks for how experiment 2 differs from 3. Choice B applies to experiment 3 only. Metaninil yellow was used for both experiments, so choice C is incorrect, as is choice D.

28. *Scientific Investigation* Correct answer is J. It would be harder to see the color change if the well was a darker color.

29. *Evaluation of Models, Inferences & Experimental Results* Correct answer is C. Curcumin remains yellow from pH 0-7. It changes to orange at pH of 8 and red at a pH 9. Answer choices A & B would be in the yellow

range. Answer choice D would change to red. Answer choice C is the only answer that would show the transition range of orange.

30. *Evaluation of Models, Inferences & Experimental Results* Correct answer is F. For this question you would need to compare colors of Indigo carmine at various pH's. Indigo carmine remains Blue from pH 0-11, therefore the correct is F.

31. *Scientific Investigation* Correct answer is B. The question refers to a range that Propyl red has a transition range of 4.6 through 6.8. Refer to the data table for the indicators and look for color change in the 4, 5, and 6 columns Resorcin blue is the only indicator that has a color change in that range. All other indicators did not change within that range.

32. *Evaluation of Models, Inferences & Experimental Results* Correct answer is G. The question refers to color change at pH of 7, out of all of indicators used Resorcin blue was the only indicator that changed color.

33. *Interpretation of Data* Correct answer is D. The question wants students to interpret color change with pH values in this case the lowest pH value belongs to Solution 5.

## Passage VI

34. *Scientific Investigation* Correct answer is J. The question asks why Albedo is measured at noon. Albedo is defined in the passage as the proportion of the total incoming solar radiation that is reflected from a surface. We know that noon is when the sun is highest in the sky - making the sunshine the most intense at that time. Thus, "most intense" is the best possible answer.

35. *Scientific Investigation* Correct answer is A. The question states that all plots have the same vegetation and density of vegetation cover, ensuring that the only variable being measured is the amount of Drilling mud (DM) being sprayed on the field. Answer C & D are the same for all 3 plots

36. *Interpretation of Data* Correct answer is H. The question directs you to look for a 3-day period on Figure 1 where the Albedo is high, then low and then high again. The date range for answers F & G do not show any change on the graph. The date for answer J also doesn't show a change. Therefore, when you look at the date range for July 26 (answer H), it's the only possible answer.

37. *Scientific Investigation* Correct answer is B. The question asks how many temperature readings were taken per minute. In the passage it states, "For each plot, the sensor recorded the soil temperature every 5 seconds over the study period." If readings are taken every 5 seconds, that means there are a total of 12 readings per minute, making B the only possible answer.

38. *Evaluation of Models, Inferences & Experimental Results* Correct answer is F. This question asks if July 20th was a cloudless day. According to paragraph 5 of the passage, albedo was only calculated for each cloudless day. When you look at Figure 1, you can see that July 20th doesn't have a plot mark, meaning that data was not collected that day. This eliminates both answers H & J. Answer G contradicts itself, making F the only possible answer.

39. *Interpretation of Data* Correct answer is D. The question first asks if a cover of DM increases or decreases albedo. Looking at Figure 1, you can see that the highest level of albedo belongs to Plot 1, the next highest belongs to plot 2, and the lowest level of albedo belongs to plot 3. According to the 4th paragraph of the

passage it states that plot 1 has no DM cover, plot 2 has the next highest amount and plot 3 has the most . This means that the more DM cover there is, the lower the albedo level. Only choices C & D have "decrease" under albedo. The second part of the question asks if the presence of DM increases or decreases the soil temperature. Figure 2 shows that the highest soil temps belong to Plot 3, which has the highest DM covering. So the presence of DM increases soil temp, making D the correct answer.

40. *Interpretation of Data* Correct answer is J. This question asks what percent of solar radiation was NOT reflected on plot 2. Figure 1 shows the percentage of solar radiation that WAS reflected. According to Figure 1 for August 3rd, plot 2 shows .20 reflected - leaving .80 unreflected. This makes the only possible answer J at 80%.

Scaled Score	Raw Score English	Raw Score Math	Raw Score Reading	Raw Score Science	Scaled Score
36	75	59-60	40	40	36
35	73-74	57-58	39	39	35
34	71-72	55-56	38	38	34
33	70	54	—	37	33
32	69	53	37	—	32
31	68	52	36	36	31
30	67	50-51	35	35	30
29	66	49	34	34	29
28	64-65	47-48	33	33	28
27	62-63	45-46	32	31-32	27
26	60-61	43-44	31	30	26
25	58-59	41-42	30	28-29	25
24	56-57	38-40	29	26-27	24
23	53-55	36-37	27-28	24-25	23
22	51-52	34-35	26	23	22
21	48-50	33	25	21-22	21
20	45-47	31-32	23-24	19-20	20
19	42-44	29-30	22	17-18	19
18	40-41	27-28	20-21	16	18
17	38-39	24-26	19	14-15	17
16	35-37	19-23	18	13	16
15	33-34	15-18	16-17	12	15
14	30-32	12-14	14-15	11	14
13	29	10-11	13	10	13
12	27-28	8-9	11-12	9	12
11	25-26	6-7	9-10	8	11
10	23-24	5	8	7	10
9	20-22	4	7	6	9
8	17-19	—	6	5	8
7	14-16	3	5	4	7
6	11-13	—	4	3	6
5	9-10	2	3	—	5
4	6-8	—	—	2	4
3	5	1	2	1	3
2	3-4	—	1	—	2
1	0-2	0	0	0	1

