EST II – Individual Subject Test

Date:

Test Center:

Room Number:

Student's Name:

National ID:

EST ID:

Subject: Math Level 1

Duration: 60 minutes

50 Multiple Choice Questions

Instructions:

- Place your answer on the answer sheet. Mark only one answer for each of the multiple choice questions.
- Avoid guessing. Your answers should reflect your overall understanding of the subject matter.
- Calculator is allowed. When a calculator is used, be aware of switching between radian mode and median mode.
- Formula sheet is available on the following page of the booklet for your reference.

THE FORMULAS BELOW MAY BE USEFUL IN ANSWERING QUESTIONS ON THIS TEST.

$S = 4\pi r^2$ is the surface area formula of a sphere with a radius of r.

$V = \frac{1}{3}\pi r^2 h$ is the volume formula of a right circular cone with a radius of r and a height of h.

$V = \frac{4}{3}\pi r^3$ is the volume formula of a sphere with a radius of r.

$V = \frac{1}{3}Bh$ is the volume formula of a pyramid with a base area of B and a height of h.

1. The third term of an arithmetic sequence is 34, and the seventh term is 86. Find the 11^{th} term of this sequence.

A. 554
B. 216
C. 164
D. 138
E. 78

2. Given the equation $3(x-4)(x+2) = (3x+7)(x+5)$. The value of x is $-\frac{a}{28}$ where a is a real number. Find the value of a.

A. 11
B. 25
C. 31
D. 45
E. 59

3. Given a geometric sequence such that one of the terms is 20, and another one is $5{,}120$. If there are 3 terms between these two, then the common ratio is:

A. 1
B. 1.5
C. 4
D. 5
E. 10

4. Given the two functions $f(x) = -x + 5$ and $g(x) = x^2 - 1$ such that their graphs are sketched only on the positive side of the x-axis. Which of the following statements is/are true?

I. If the graph of g intersects the x-axis at $(x_1, 0)$, then the graph of f intersects the x-axis at $(x_1 + 4, 0)$.
II. The graphs of the two functions intersect at $(2, 3)$.
III. When $x \in [2, +\infty)$, the graph of f is sketched above the graph of g.

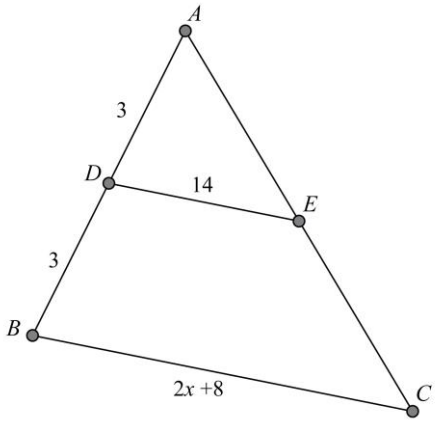
A. **I** only
B. **I** and **II**
C. **I** and **III**
D. **II** and **III**
E. **I**, **II**, and **III**

5. Given $f(x) = x^2 + 4x - 1$, and $g(x) = |x - 4| + 7$. Find $f(g(-1))$.

A. 44
B. 159
C. 177
D. 191
E. 211

6. Given the function f defined by $f(x) = 4x^2 - 10x + 1$. The equation of the axis of symmetry of f is:

A. $x = 5$
B. $x = 4$
C. $x = \frac{5}{4}$
D. $x = 1$
E. $x = -\frac{5}{4}$



7. In the figure above, $\overleftrightarrow{DE}$ and $\overleftrightarrow{BC}$ are parallel. If D and E are the midpoints of $\overline{AB}$ and $\overline{AC}$, respectively, what is the value of x?

A. 3
B. 6
C. 10
D. 14
E. 28

8. $x°$, $(4x + 12)°$, and $(2x - 7)°$ are the measures of the angles in a triangle. Find x.

A. 24
B. 25
C. 26
D. 27
E. 28

9. A virus struck a country, infecting 12 million people. The health authorities provided medication to the patients, and the number of infected people began to decrease. After t hours, the number of people still infected is represented by the function $p(t) = 12{,}000{,}000 \times (0.95)^t$. Approximately, how many people are still infected by this virus after 4 days?

A. 9,774,075
B. 3,503,868
C. 1,255,087
D. 770,665
E. 87,226

10. Given two polynomial functions $p(x)$ and $q(x)$ such that n and m are their degrees, respectively. Which of the following statements is/are always true?

I. If $f(x) = \frac{p(x)}{q(x)}$ where $q(x) \neq 0$, and $n < m$, then the graph of f has $y = 0$ as a horizontal asymptote.
II. If $g(x) = p(x) \times q(x)$, then the degree of $g(x)$ is n^m.
III. If $h(x) = p(q(x))$, then the degree of $h(x)$ is $n \times m$.

A. **I** only
B. **II** only
C. **III** only
D. **I** and **III**
E. **II** and **III**

11. An open-topped box with a square base has a volume equal to $6{,}000\ cm^3$. Suppose the side of the base is $x\ cm$, and the height of the box is $h\ cm$. At the turning point of $S(x)$, the surface area of the box, the height of the box is approximately equal to:

A. $11\ cm$
B. $23\ cm$
C. $92\ cm$
D. $133\ cm$
E. $262\ cm$

12. If the slant height of a cone is $5\ cm$, and the area of the curved surface is $62.5\pi\ cm^2$, then the surface area of this cone is:

A. $156.25\ cm^2$
B. $156.25\pi\ cm^2$
C. $218.75\pi\ cm^2$
D. $344.75\pi\ cm^2$
E. $3{,}906.25\pi\ cm^2$

13. The coefficient of the x term after dividing $3x^4 + 3x^2 + 9x - 7$ by $-3x^3$ is:

A. -1
B. 0
C. $\frac{1}{3}$
D. 1
E. 3

14. What is the length of the height of an equilateral triangle whose perimeter is $22.5\ cm$?

A. $6.1\ cm$
B. $6.5\ cm$
C. $6.9\ cm$
D. $7.3\ cm$
E. $7.5\ cm$

15. Last week, 77,000 people visited country X; 22% of them attended a conference related to the environment, 12% attended the opening of the national museum, 7,800 visited their relatives, and the rest were searching for an employment opportunity. One person was selected randomly. What is the probability that he visited country X to attend the opening of the national museum?

A. 0.06
B. 0.12
C. 0.22
D. 0.42
E. 0.51

16. Nabil has a 30 cm by 14 cm rectangular sheet of metal. He wants to form an open-top box using this sheet by cutting a square side of length $x\ cm$ from each corner, then folding up the sides. Which of the following expressions represents the surface area of the box formed?

A. $S = -4x^2 + 420$ where $x \geq 0$

B. $S = -4x^2 + 60x + 420$ where $x \geq 0$

C. $S = 4x^3 - 88x^2 + 420x$ where $x \geq 0$

D. $S = 8x^2 - 32x + 420$ where $x \geq 0$

E. $S = 8x^2 - 28x + 420$ where $x \geq 0$

17. What is the remainder when dividing $x^4 - 2x^3 + 3x - 1$ by $x - 3$?

A. 5
B. 10
C. 15
D. 25
E. 35

18. $\dfrac{\frac{2}{5} + \frac{3}{1-x}}{1 - \frac{2}{x-4}} =$

A. $\frac{2x^2-25x+68}{-5x^2+35x-30}$

B. $\frac{-2x^2-25x-68}{-5x^2-35x+30}$

C. $\frac{-2x^2-68}{-5x^2+30}$

D. $\frac{-2x^2+25x-68}{-5x^2+35x-30}$

E. $\frac{25x-68}{35x-30}$

19. A basketball club signed 11 players with an average height of 199 cm. After 2 months, they signed another player with a height of 210 cm. Calculate the new mean of the height of the 12 players.

A. 199.19 cm
B. 199.50 cm
C. 199.92 cm
D. 200.11 cm
E. 201.21 cm

20. What is the solution set of $2x^2 + x - 21 < 0$?

A. $x > 3$ only

B. $x < 3$ only

C. $x > -\frac{7}{2}$ only

D. $-\frac{7}{2} < x < 3$

E. Empty set

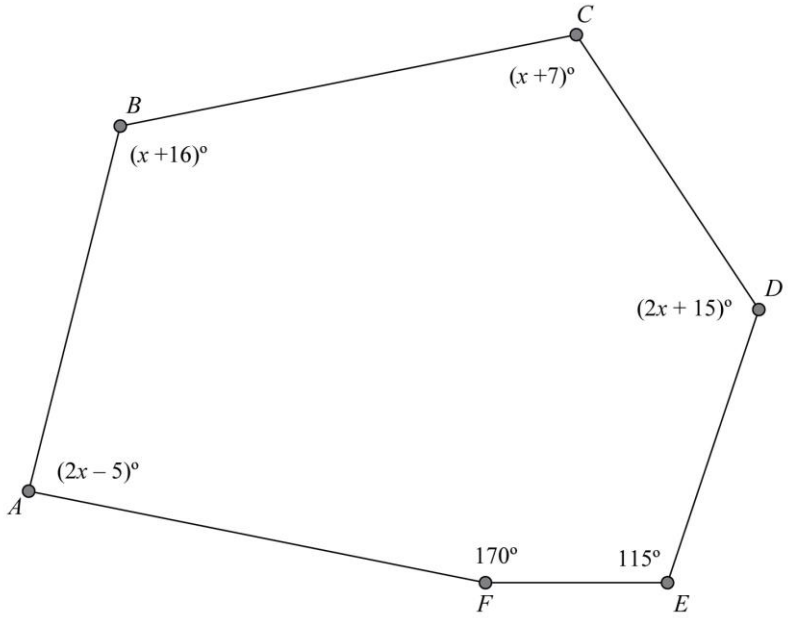
21. Given the complex number $z = \sqrt{2} + 2i$ and its conjugate $\bar{z}$. Which of the following statements is/are true?

I. $z \times \bar{z} = 6$.
II. The sum of the two complex numbers is a real number.
III. $|z| = |\bar{z}|$.

A. **I** only
B. **II** only
C. **I** and **II**
D. **II** and **III**
E. **I**, **II**, and **III**

22. Given an isosceles trapezoid $ABDG$ where $\overline{AB}$ and $\overline{GD}$ are the two bases with lengths $(x + 1)\ cm$ and $18\ cm$, respectively. If N and H are the midpoints of $\overline{AG}$ and $\overline{BD}$, respectively, and $NH = \frac{1}{3}(2x - 1)\ cm$, what is the length of $\overline{AB}$?

A. 58
B. 59
C. 60
D. 61
E. 62



23. Find $m\angle BAF$ in the figure above. (*Figure not drawn to scale*)

A. $67°$
B. $83°$
C. $95°$
D. $129°$
E. $134°$

24. The distance between the two points $A\ (3, 7)$ and $B\ (-1, c)$ is 5. Find the coordinates of N, the midpoint of $\overline{AB}$.

A. $N\ (1, 5)$
B. $N\ (1, 5.5)$
C. $N\ (4, 1.5)$
D. $N\ (4, 5.5)$
E. $N\ (1.5, 5.5)$

25. Given triangle ABC formed by the three points $A\ (4, 6)$, $B\ (2, 3)$, and $C\ (5, 1)$. Find the coordinates of A', B', and C' if triangle ABC is reflected over the y-axis, then translated 2 units up to form triangle $A'B'C'$.

A. $A'(-4, 8)$, $B'(-2, 5)$, and $C'(-5, 3)$
B. $A'(-4, 4)$, $B'(-2, 1)$, and $C'(-5, -1)$
C. $A'(-4, 6)$, $B'(-2, 3)$, and $C'(-5, 1)$
D. $A'(6, -6)$, $B'(4, -3)$, and $C'(7, -1)$
E. $A'(2, -6)$, $B'(0, -3)$, and $C'(3, -1)$

$$1, 3, 4, 5, 5, 6, 6, 8, 10$$

26. Find the 75^{th} percentile of the data set above.

A. 3.5
B. 6
C. 7
D. 8
E. 9

27. In a parallelogram $ABFV$, $m\angle VAB = (2x + 15)°$, $m\angle ABF = 71°$, $AB = 2x + y$, and $VF = 16\ cm$. Find the value of y.

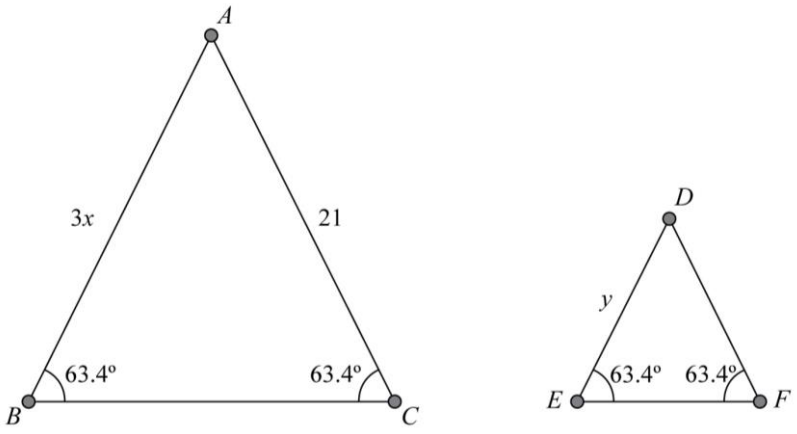
A. 78
B. 31
C. 16
D. -31
E. -78

28. Which of the following statements is never true?

A. If two angles of a triangle are congruent to two angles in another triangle, then the triangles are said to be similar.
B. In a parallelogram, diagonals always bisect each other and can sometimes be congruent.
C. If the diagonals of a rhombus are congruent, then we consider this rhombus to be a square.
D. In a convex polygon, the sum of the measures of the exterior angles is always 360°.
E. All of the above statements are false.

29. If $\angle A$ is the supplement of $\angle G$, and $m\angle A = \frac{2}{3}m\angle G$, then $m\angle G =$

A. 90°
B. 94°
C. 98°
D. 108°
E. 116°



30. Use the figure above to find the length of $\overline{DF}$ given that $y + 2x = 40$. (*Figure not drawn scale*)

A. 14
B. 21
C. 26
D. 31
E. 34

Item	Price in USD
One cup of yogurt	1.5
One piece of bread	x
Battery type AA	y

31. Salim and Layla went to the supermarket to buy some stuff. The price of the items is shown in the table above. Salim bought 2 cups of yogurt, one piece of bread, and 3 batteries of type AA, then paid an amount of \$8.5. Layla bought one cup of yogurt, 3 pieces of bread, and one battery of type AA, then paid an amount of \$4. What is the price of one piece of bread?

A. \$0.25
B. \$0.50
C. \$0.75
D. \$1.00
E. \$1.75

32. Simplify $2(x+4)^3 + 3x(2x-1)^2 + x$.

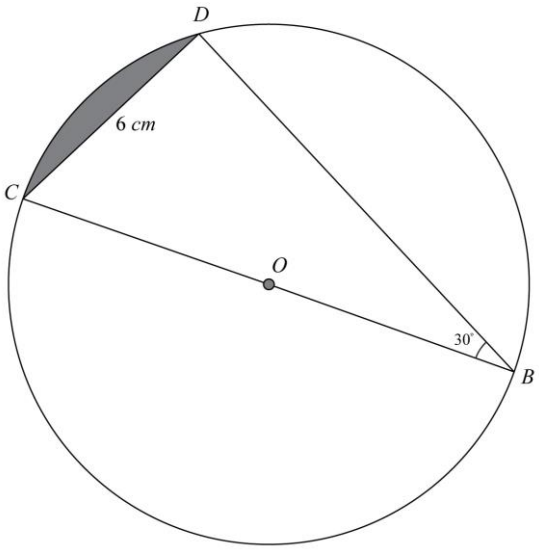
A. $14x^3 + 12x^2 + 99x + 128$
B. $14x^3 + 12x^2 + 100x + 128$
C. $12x^3 + 12x^2 + 100x + 128$
D. $12x^3 + 52x + 64$
E. $14x^3 - 12x^2 + 100x + 128$

33. $\frac{\sqrt{2}}{2}(\cos(x) - \sin(x)) =$

A. $\cos\left(x - \frac{\pi}{4}\right)$
B. $\sin\left(x + \frac{\pi}{4}\right)$
C. $\sin\left(x + \frac{\pi}{4}\right) - \cos\left(x + \frac{\pi}{4}\right)$
D. $\cos\left(x + \frac{\pi}{4}\right)$
E. $\sin\left(x - \frac{\pi}{4}\right)$

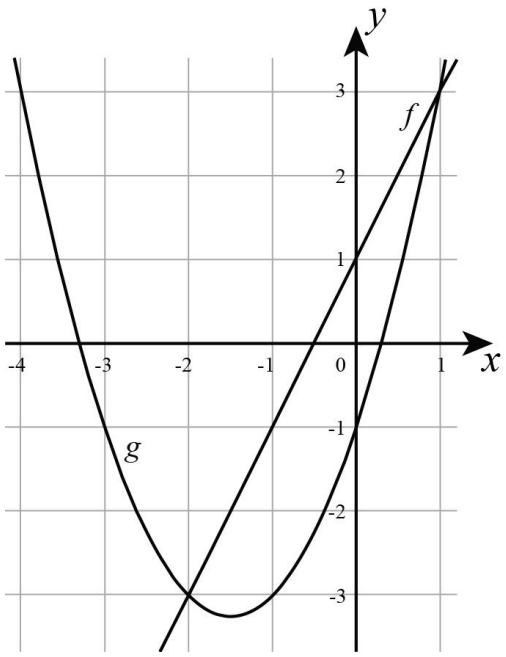
34. What is the equation of the line passing through point $E\ (9, -9)$ and perpendicular to the line whose equation $2y - 6x = 1$?

A. $y = -\frac{1}{3}x - 6$
B. $y = -3x - 6$
C. $y = -3x + 18$
D. $y = -\frac{1}{3}x - 12$
E. $y = 3x + 18$



35. In the figure above, triangle DCB is inscribed in the circle of center O such that $\overline{CB}$ is a diameter in the circle. Find the area of the shaded region. (*Figure not drawn to scale*)

A. $1.44\ cm^2$
B. $3.26\ cm^2$
C. $9.85\ cm^2$
D. $22.11\ cm^2$
E. Not enough information



36. The figure above represents two functions f (linear) and g (quadratic). Find the value of $f(g(0))$.

A. -3
B. -2
C. -1
D. 0
E. 1

37. Find the determinant of the matrix $A = \begin{pmatrix} 2 & 3 & -2 \\ 1 & 0 & -2 \\ 2 & 10 & 4 \end{pmatrix}$.

A. 4
B. 2
C. 1
D. -4
E. -10

38. Jamal bought a car for $\$13{,}000$. After 3 years, he sold it to Karim for 20% less than its original price. After doing some maintenance, Karim sold it to Jana for 7% more than the price he paid to Jamal. How much did Jana pay for the car?

A. $\$10{,}400$
B. $\$11{,}128$
C. $\$12{,}480$
D. $\$12{,}882$
E. $\$13{,}118$

39. The intersection point of the two linear functions defined by $f(x) = 2x - 1$ and $g(x) = -x + 5$ is the local minimum of a quadratic function $h(x)$, such that its y-intercept is $(0, 7)$, and it is passing through point $(3, 4)$. Find the equation of $h(x)$.

A. $y = x^2 + 4x + 7$
B. $y = x^2 + 2x + 7$
C. $y = x^2 - 4x + 7$
D. $y = -x^2 + 4x + 7$
E. $y = -x^2 - 2x + 7$

40. Consider the function f defined by $f(x) = \frac{(2x-1)^2}{x-1}$. For which values of x does the graph of f increase?

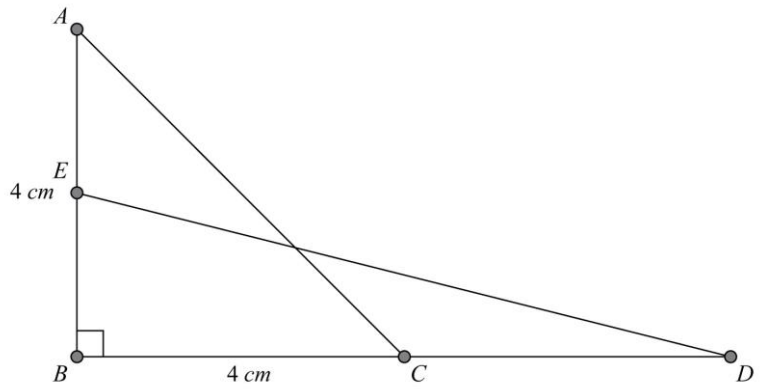
A. $x > \frac{3}{2}$ only
B. $x < \frac{1}{2}$ only
C. $\frac{1}{2} < x < \frac{3}{2}$
D. $x < \frac{1}{2}$ and $x > \frac{3}{2}$
E. None of the above

41. If $16^{2n-1} = 256$, then $4n + 3 =$

A. 1.5
B. 3
C. 5
D. 7
E. 9

42. Given the three points $A\ (-3, 1)$, $B\ (3, 3)$, and $D\ (6, 0)$. Which of the following should be the coordinates of point C so that $ABDC$ becomes a parallelogram?

A. $(0, -1)$
B. $(0, 1)$
C. $(-1, 2)$
D. $(0, -2)$
E. $(-1, -2)$



43. In the figure above, ABC is a right isosceles triangle at B. Let D be the symmetric of B with respect to C and E the midpoint of $\overline{AB}$. What is the approximate measure of $\angle AED$? (*Figure not drawn to scale*)

A. $14°$
B. $76°$
C. $94°$
D. $100°$
E. $104°$

Hours per week	$1 \leq h < 4$	$4 \leq h < 6$	$6 \leq h < 8$	$8 \leq h < 12$	$12 \leq h < 15$
Frequency	4	2	3	6	5

44. Twenty students work in 3 different restaurants to pay their tuition fees. They were surveyed about the number of hours they work per week. The results are shown in the table above. What is the approximate number of students who work less than 7 hours per week?

A. 6 students
B. 7 students
C. 9 students
D. 10 students
E. Not enough information

45. In how many ways can we arrange the letters in the word FOLLOWERS if one L should be placed in the middle?

A. 362,880 ways
B. 40,320 ways
C. 20,160 ways
D. 10,080 ways
E. 5,040 ways

46. If $\sqrt{x+a} = x - a$ where a is a real constant and $x \geq 1$, then x can be equal to:

A. $\frac{2a+1}{2}$

B. $\frac{2a+1+\sqrt{8a-1}}{2}$

C. $\frac{2a+1-\sqrt{8a-1}}{2}$

D. $\frac{2a+1+\sqrt{8a+1}}{2}$

E. $\frac{2a-1}{2}$

47. Which of the following is the expression of the surface area of a cylinder with radius $r\ cm$, a height twice the radius, and an opened top?

Given: The surface area of a cylinder is $2\pi rh + 2\pi r^2$

A. $SA = 5\pi r^2$

B. $SA = 2r^2 + rh$

C. $SA = 6\pi r^2$

D. $SA = 4\pi r^2$

E. $SA = 2\pi r^2 + 4\pi r$

48. If $i^2 = -1$, $x + 2(2i - 7y) = 3bx + 4i$, $y = 0$, and $x \neq 0$, then $b =$

A. $\frac{1}{3}$

B. $\frac{1}{7}$

C. $\frac{7}{2}$

D. 7

E. 14

49. The absolute value of the n exponent in the simplified form of $\left(\frac{9n^3p^4}{2n^{-5}p^2}\right)^{-3}$ is:

A. 3
B. 5
C. 8
D. 11
E. 24

50. If $a + b = 3$, $a - c = -6$, and $2b + c = 11$, then $c - b =$

A. 3
B. 5
C. 6
D. 7
E. 8