



EST I – Math

Student's Name _____

National ID _____

Test Center _____

Duration: 90 minutes

Test sections: I- Calculator is not required, II – Calculator is required

45 Multiple Choice Questions and 13 Short Constructive Response Questions

Instructions:

- Place your answer on the answer sheet. Mark only one answer for each of the multiple choice questions.
- Write your final result only on the answer sheet for the constructive response 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 at the end of the booklet for your reference.

Section I
Calculator is not required
(30 minutes)

Questions 1 and 2 refer to the following information.

For a point source, sound waves propagate in concentric spheres, therefore the intensity of the sound at a point A distant D from the source is given by: $I = \frac{P}{4\pi D^2}$ where:

I is the sound intensity

P is the power of the point source

D is the distance between the source and the point A where the intensity is to be found

1. Isolate **D**.

A. $D = 2\sqrt{\frac{\pi I}{P}}$

B. $D = \frac{1}{2}\sqrt{\frac{P}{\pi I}}$

C. $D = \left(\frac{P}{4\pi I}\right)^2$

D. $D = \sqrt{\frac{P}{2\pi I}}$

2. If the power of the source doubles ($P'=2P$), and the distance between the source and point A also doubles ($D'=2D$), the sound intensity becomes I' . What is the relationship between I' and I ?

A. $I' = I$

B. $I' = 4I$

C. $I' = I/2$

D. $I' = I/4$

3. The weekly salary **S** of Samantha is given by $S = 7 \cdot h \cdot d + 75$ where h is the number of hours she works every day and d is the number of working days each week. If Samantha is to be promoted with a salary increase, which of the following terms must change?

A. 7

B. h

C. d

D. None of the above

4. In the xy -plane, the equation of the line (d) passing through $A(-1,4)$ and perpendicular to line $3x-2y = 5$ is:

A. $y = \frac{3}{2}x + \frac{11}{2}$

B. $y = -\frac{3}{2}x + \frac{5}{2}$

C. $y = -\frac{2}{3}x + \frac{14}{3}$

D. $y = -\frac{2}{3}x + \frac{10}{3}$

5. A researcher selected a random sample of 25 different brands of bottled water and measured the corresponding PH. He found out that the mean PH of the sample was 7.3 with an associated margin of error of 0.25. Which of the following is the best interpretation of the researcher's findings?

A. Most water bottles in the market have a PH between 7.05 and 7.55

B. All water bottles in the market have a PH between 7.05 and 7.55

C. Any PH between 7.05 and 7.55 is a plausible value for the mean PH of the water bottles in the sample

D. Any PH between 7.05 and 7.55 is a plausible value for the mean PH of the water bottles in the market

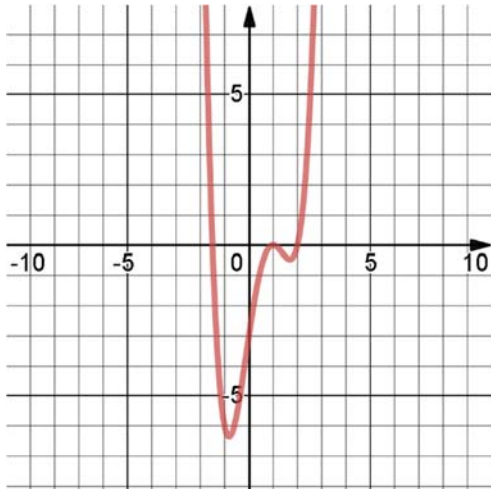
6. If $h(x) = -x^2+3x-2$ and $k(x) = -2x-5$, what is the value of $h(k(-2))$?

A. -6

B. -4

C. 0

D. 2

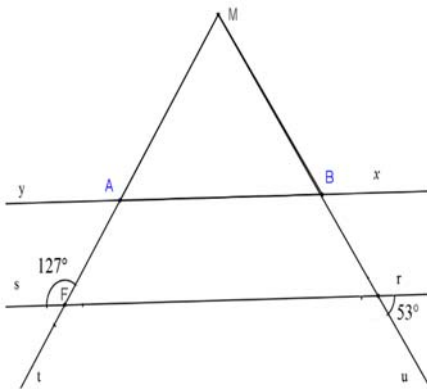


7. The graph above depicts a function $f(x)$. How many solutions does the equation $f(x) = 0$ admit?

- A. 1
- B. 2
- C. 3
- D. 4

8. Which of the following angles have the same value of $\sin 32^\circ$?

- A. $\sin(-32^\circ)$
- B. $\sin 58^\circ$
- C. $\cos(-32^\circ)$
- D. $\cos 58^\circ$



9. Knowing that lines (xy) and (rs) are parallel, what is the type of triangle ABM ? (Figure is not drawn to scale)

- A. Scalene
- B. Isosceles
- C. Equilateral
- D. Right isosceles

10. A rental car company charges its clients by the number of days d the car is rented. If the bill b of a client is given by the equation $b = 5d + 20$, what is the best interpretation of the term 5 ?

- A. The rental cost of the car per day
- B. The fixed cost of renting a car, no matter how many days it is rented
- C. The average number of days the car is rented
- D. The fees of renting a car for 7 days

The table below summarizes the grades out of 10 obtained by 4 players in a competition over a total of 5 rounds.

	Diego	Mark	Tyler	Toni
Round 1	7	3	8	10
Round 2	5	10	7	4
Round 3	8	9	6	9
Round 4	9	5	7	10
Round 5	4	8	8	7
Standard deviation	1.85	2.61	0.75	2.28

11. The winner is the player with the highest average. Who won the competition?

- A. Diego
- B. Toni
- C. Tyler
- D. Mark

12. Which player was the most consistent in terms of his grades?

- A. Mark
- B. Diego
- C. Toni
- D. Tyler

13. What is the resulting coefficient of x when $-2x + 3$ is multiplied by $-3x - 2$?

- A. -9
- B. -5
- C. 5
- D. 6

$$\frac{-6x^2 + 5x + 2}{2x + 1}$$

14. Which of the following is equivalent to the above expression?

- A. $-3x + 4 - \frac{2}{2x+1}$
- B. $-3x + 4 + \frac{2}{2x+1}$
- C. $-3x - \frac{2}{2x+1}$
- D. $-3x + 4$

15. If m and k are positive numbers, which of the following expressions is equivalent to $(16k^{12}m^4)^{\frac{1}{4}}$?

- A. $4k^3m$
- B. $2k^3$
- C. $4k^3m^2$
- D. $2k^3m$

16. If the expression $\frac{-2i-i^3}{1+3i}$ is written in the form $a+bi$ where a and b are real numbers and $i = \sqrt{-1}$, what is the value of $b - a$?

17. If $\frac{1}{2}y - \frac{3}{5}x = -6$, what is the value of $6x-5y$?

18. If $|-2b - 3| \leq 7$, how many possible integer values of b are there?

x	q(x)
-5	-7
-3	-15
-1	-15
1	-7
3	9
5	33

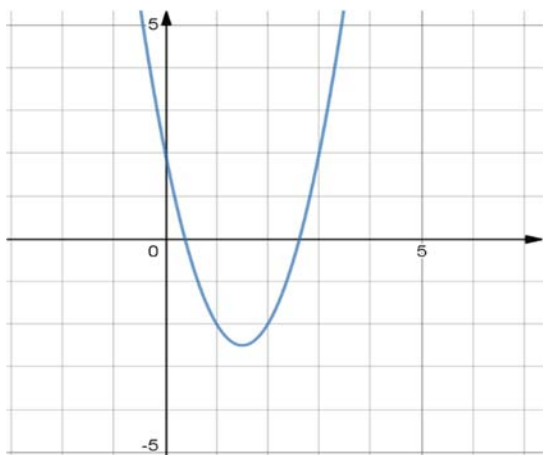
19. The table above shows several points from the graph of quadratic function $q(x)$. What is $q(-9)$?

20. If $(3^9)^{3^{12}} = 3^{3^x}$, what is the value of x ?

Section II
Calculator is required
(55 minutes)

$$\frac{6(x-1)+4}{3} - \frac{3-(5-4x)}{2} = 0$$

- What is the value of x that satisfies the equation?
 - $-\frac{2}{5}$
 - $-\frac{3}{7}$
 - There is no value of x for which the equation is true.
 - There are infinitely many values of x for which the equation is true.
- If $-\frac{4}{5}x + 3 \geq 2 - \frac{1}{5}x$, what is the highest value of $\frac{3}{2}x + 4$?
 - 3.5
 - 4.5
 - 5.5
 - 6.5



- If $g(x) = ax^2 + bx + c$ represents the quadratic function whose graph is shown above, which of the following statements is not true?
 - $a > 0$
 - $b > 0$
 - $c > 0$
 - $3a + b = 0$

Questions 4 and 5 refer to the following information.

A survey is done on 80 families from two cities **A** and **B**, separated into groups based on the number of cars they own. The results are shown in the table below.

Number of cars	City A	City B
1	25	20
2	31	19
3	14	23
4	8	12
5	2	6

- What is the mean number of cars owned by citizens in both cities **A** & **B** combined?
 - Between 1 and 2
 - Between 2 and 3
 - Between 3 and 4
 - Between 4 and 5
- Which measure of center is unchanged in both cities?
 - Mode
 - Mean
 - Median
 - None of the above
- If $f(x) = -3 - 2x$ and $g(x) = \frac{-x^2}{6}$, Which of the following could not be in the range of $f(g(x))$?
 - 4
 - 2
 - 0
 - 2

7. A shop sells two sizes of doughnuts: mini and regular. Mini doughnuts have a diameter of 1.8 inches while regular ones have a diameter of 3 inches. Approximately, by what percentage is a regular normal doughnut larger (in area) than a mini doughnut?

- A. 67%
 B. $67\pi\%$
 C. 78%
 D. 178%

8. Line (A) passes through the points $(-\frac{5}{3}, 0)$ and $(0, -\frac{2}{3})$. Which of the following lines will never intersect with line (A)?

- A. $y = -\frac{5}{2}x - 1$
 B. $y = \frac{5}{2}x - 1$
 C. $y = -\frac{2}{5}x - 1$
 D. $y = \frac{2}{5}x - 1$

$$\begin{cases} 2x + 15y = 18 \\ kx - 5y = -7 \end{cases}$$

9. What is the value of k if the above system of simultaneous equations admits no solutions?

- A. $-\frac{1}{3}$
 B. -6
 C. $-\frac{2}{3}$
 D. $\frac{2}{3}$

10. An oven costs \$150 less than 4 times the cost of a microwave. If the oven and the microwave cost together \$725, how much more does the oven cost than the microwave?

- A. \$175
 B. \$275
 C. \$375
 D. \$550

11. From 2020 to 2021, the amount in Tom's bank account decreased by 11% to \$49840. What was the initial amount in her bank account?

- A. \$54820
 B. \$44358
 C. \$56000
 D. \$45309

$$(4x + 1)^2 - 9x^2 = 0$$

12. What is the absolute value of the difference between the two roots of the above equation?

- A. $\frac{8}{65}$
 B. $\frac{6}{7}$
 C. $\frac{1}{4}$
 D. $\frac{3}{14}$

Questions 13 and 14 refer to the following information.

The table below summarizes the results of a survey about the favorite school subject for a group of 350 students according to their educational stage.

	Primary	Secondary	Tertiary	Total
Math	65	80	30	175
English	35	55	10	100
Science	15	10	25	50
History	10	5	10	25
Total	125	150	75	350

13. According to the data, which subject had the lowest percentage of likers among primary students?

- A. Math
 B. English
 C. Science
 D. History

14. If a secondary student is chosen randomly, what is the probability that he favors Math or Science?

- A. $\frac{9}{35}$
- B. $\frac{18}{25}$
- C. $\frac{8}{15}$
- D. $\frac{3}{5}$

15. Given a cone whose height is the quadruple of its diameter. If the volume of the cone is 72π , what is the diameter of its base?

- A. 4
- B. 5
- C. 6
- D. 9

16. If $11x-7y = 6$ and $17x-13y = 9$, what is the value of $x-y$?

- A. 0
- B. $-\frac{1}{2}$
- C. $\frac{1}{2}$
- D. -2

17. Anton has \$20 to spend on stationary. Pens (p) cost \$1.4 each, coloring crayons (c) are priced at \$3.5 per pack and highlighters (h) sell for \$2 each. He must buy a notebook for \$5.5 as well. Which of the following describes how many highlighters Anton can buy?

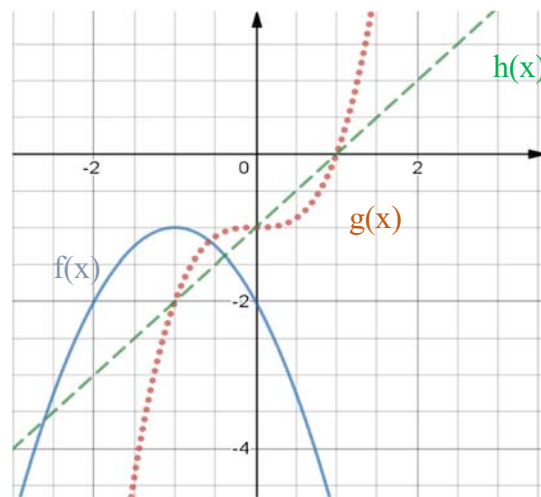
- A. $h \leq \frac{14.5-1.4p-3.5c}{2}$
- B. $h \leq \frac{14.5+1.4p+3.5c}{2}$
- C. $h \leq \frac{20-1.4p-3.5c}{2} - 5.5$
- D. $h \leq \frac{20-1.4p-3.5c}{2}$

18. By what percentage should we raise the price of a good to return to its initial price knowing that it was subject to a 20% discount 2 weeks ago?

- A. 15%
- B. 20%
- C. 25%
- D. 30%

19. The general elections in a country provided a parliament composed of 35% deputies from the democratic party, 20% for the conservative party, 20% for the republican party and 27 members of the labor party. How many more democrats are there than conservatives?

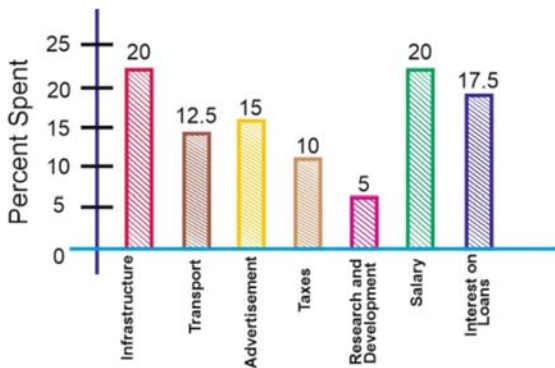
- A. 9
- B. 18
- C. 27
- D. 36



20. Based on the graph above, what is the value of $f(-1)+g(-1)+h(-1)$?

- A. -4
- B. -5
- C. -6
- D. -7

21. A painter paints walls at an average rate of 1.2 walls per hour. He is asked to paint a villa containing 18 rooms each containing 5.4 walls on average. How long will he be actively painting the villa?
- A. 2 days, 18 hours
 B. 3 days
 C. 3 days, 9 hours
 D. 3 days, 18 hours



22. The bar graph above represents the percentage of money spent by a company on different sectors last year. If 200,000 dollars were spent on the transport sector, what was the budget used for salaries?
- A. \$320,000
 B. \$340,000
 C. \$360,000
 D. \$370,000

$$\begin{cases} y \leq 3x - 2 \\ y > \frac{3x}{4} - 3 \end{cases}$$

23. In which quadrant(s) does the system above have no solutions?
- A. Quadrant I
 B. Quadrants II and III
 C. Quadrant II
 D. Quadrant III

24. A line, having a slope of $-\frac{1}{5}$ passes through the points A (2 ; $\alpha-3$) and B ($2\alpha+1$; -4). What is the value of α ?
- A. -2
 B. $-\frac{2}{3}$
 C. $\frac{2}{3}$
 D. 2

Questions 25 and 26 refer to the following information.

The height of a launched cannonball can be described as a function of time according to the following quadratic equation:

$$h(t) = -2t^2 + 14t + 36$$

25. What is the maximum height attained by the cannonball?
- A. 60.5
 B. 36
 C. 9
 D. 2
26. After how many seconds will the cannonball hit the ground?
- A. 2
 B. 7
 C. 9
 D. 11

$$\frac{\sqrt[4]{3}}{\sqrt[8]{3}}$$

27. Which of the following is equivalent to the quotient of the division given above?
- A. $\sqrt{3}$
 B. $\sqrt[4]{3}$
 C. $\sqrt[8]{3}$
 D. 9

28. The number of bees in a beehive rose from 2400 to 2520 in a month. How many bees do we expect to have in the next month knowing that the population experiences the same percent increase every month?

- A. 2600
- B. 2640
- C. 2646
- D. 2656

29. Which value of x could make the inequality $\frac{2}{3}(x + 2) - x > 5$ true?

- A. -12
- B. -10
- C. -8
- D. -6

30. Harvey wants to buy a new apartment. He estimates that he will need its area to be around 1400 square feet. But, the provider measures its units in square meters. If 1 meter is nearly 3.28 feet, how many square meters approximately will Harvey need?

- A. 427
- B. 130
- C. 4592
- D. 15062

31. The mean of x, y, z and t is 11.5. The mean of x, y, z, t and q is 11.8. What is the value of q ?

32. The function g is defined by $g(x) = 3x^2 + kx - 8$ and $g(-2) = -4$. What is the value of $g(-3)$?

33. What is the remainder of the division of $P(x) = 4x^3 - x^2 - 8x + 6$ by $x - 1$?

34. The concentration of solution in sugar is directly proportional to the mass of sugar dissolved in the solution. If the concentration of a solution is 1.5mol/L when 54g are dissolved, how many grams are dissolved if the concentration is 2.1mol/L?

35. In a right triangle, if $\tan x = \frac{24}{7}$, then what is the value of $\cos x$?

x	-3	-2	-1	0	1	2
$p(x)$	7	4	1	-2	$-\frac{7}{5}$	-8
$q(x)$	-7	-5	-3	-1	1	3

36. The table above shows several values for the functions $p(x)$ and $q(x)$. What is the value of $p(q(0))$?

37. Consider the system $\begin{cases} -2x + y < 3 \\ y + x \geq -5 \end{cases}$. For $x = 2$, what is the highest integer value of y ?

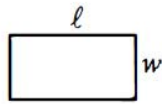
38. Trevor has \$600 to spend on shopping, 25 percent of which he spent to buy groceries. If he budgets 30 percent of the remaining amount for clothes, allots \$120 for cooking utensils and spends the rest on gaming accessories, what percentage of the original \$600 did he spend on gaming accessories? (Input your answer without the % sign)

Reference Sheet:

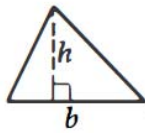


$$A = \pi r^2$$

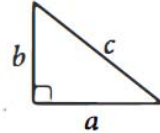
$$C = 2\pi r$$



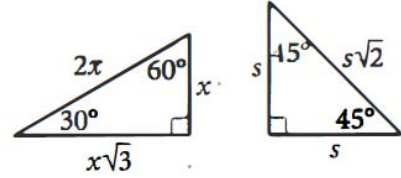
$$A = \ell w$$



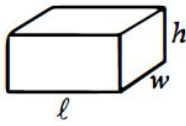
$$A = \frac{1}{2}bh$$



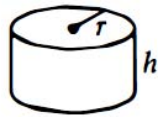
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = \ell wh$$



$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}\ell wh$$

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is 2π .

The sum of the measures in degrees of the angles of a triangle is 180.