



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)

1. Ibrahim is x years old and Jamil is seven years younger. In five years, how old will Jamil be?

- A. $x + 2$
- B. $x - 2$
- C. $2x - 2$
- D. $x + 5$

2. Among the following ordered pairs, which one is a solution of the system

$$\begin{cases} y > x \\ y \leq -x \end{cases} ?$$

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

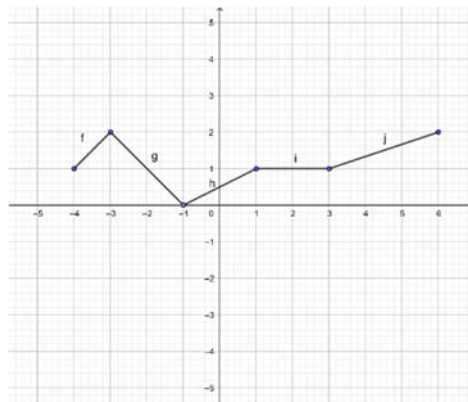
3. If a salesperson receives a base pay of 800 EGP per month and a 5% commission on sales, what is the equation relating sales (a) and the monthly income (b) for this person?

- A. $b = 800a + 0.05$
- B. $b = 0.05a + 800$
- C. $a = 800b + 0.05$
- D. $a = 0.05b + 800$

4. If $(x - 2)(y + 3) \geq 0$, then which of x and y could verify the inequality?

- A. $x = 3 ; y = -4$
- B. $x = 1 ; y = -2$
- C. $x = -1 ; y = -4$
- D. $x = -2 ; y = 0$

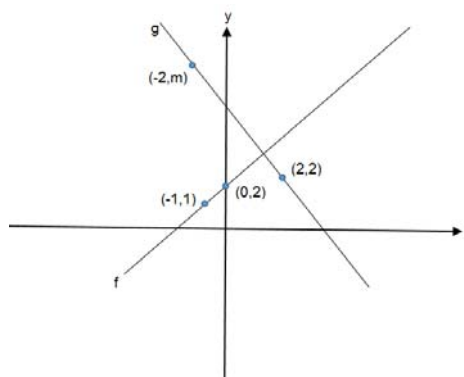
5. Which of the line segments in the figure below has the largest slope?



- A. f
- B. j
- C. h
- D. i

6. If $x + y = a + b$, $ax - by = a^2 - b^2$, then $x =$

- A. $a + b$
- B. $-a - b$
- C. b
- D. a



7. In the xy -plane above, line g is perpendicular to line f . What is the value of m ? (the figure is not drawn to scale)

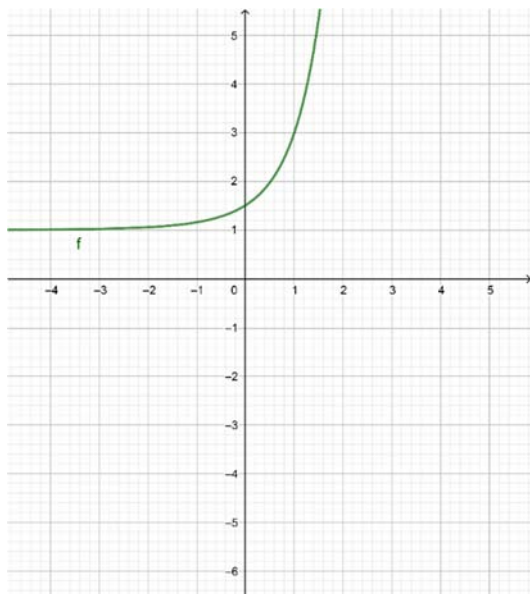
- A. 6
- B. -2
- C. 2
- D. 8

8. If $y = \frac{x^2 - 3}{x + 2}$, $x \neq -2$, then $y = x - m + \frac{1}{x + 2}$ for $m =$
- A. -2
 B. -1
 C. 1
 D. 2

$$4x^5 - 16x^3y^2 + 16xy^4$$

9. Which of the following is equivalent to the expression shown above?
- A. $x(2x^2 - 2y)^2$
 B. $x^2(2x^2 - 2y^2)^2$
 C. $x(2x^2 - 4y^2)^2$
 D. $x(4x^2 - 4y^2)^2$

Questions 10 and 11 refer to the following information.



The graph above represents the curve of an increasing function f .

10. What is the solution of $f(x) - 1.5 = 0$?
- A. 0
 B. 1.5
 C. 3
 D. 4.5

11. If x approaches positive infinity, then $f(x)$ will approach
- A. 0
 B. 1
 C. 5.5
 D. $+\infty$

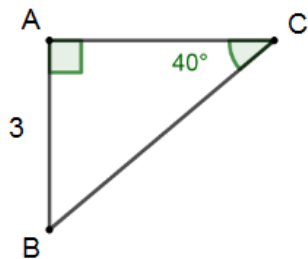
12. In planning maintenance for a city's infrastructure, a civil engineer estimates that, starting from the present, the population of the city will decrease by 15% every 25 years. If the present population of the city is 40,000, which of the following expressions represents the engineer's estimate of the population of the city t years from now?

- A. $40,000(0.15)^{25t}$
 B. $40,000(0.85)^{25t}$
 C. $40,000(0.85)^{\frac{t}{25}}$
 D. $0.85(40,000)^{\frac{t}{25}}$

13. In the xy - plane, the parabola with equation $y = (x - 6)^2$ intersects the line with equation $y = 4$ at two points A and B. What is the midpoint of $[AB]$?

- A. (6,0)
 B. (2,4)
 C. (8,4)
 D. (6,4)

14. In the right triangle below, what is the length of BC?

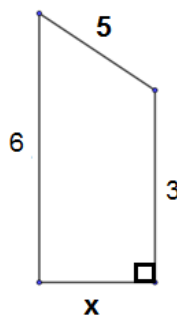


- A. $3 \sin 40$
 B. $\frac{\sin 40}{3}$
 C. $\frac{3}{\sin 40}$
 D. $3 \cos 40$



15. The angles shown above are acute and $\sin(a^\circ) = \cos(b^\circ)$. If $a = 2m - 11$ and $b = 5m + 10$, what is the value of m ? (the figure is not drawn to scale)

- A. $\frac{181}{7}$
 B. 13
 C. -7
 D. $\frac{1}{7}$



16. In the right trapezoid above, what is the length of x ? (the figure is not drawn to scale)

(Grid in)

17. If $2x - 3 = 0$, what is the value of $\frac{7}{3}x + \frac{1}{2}$?

(Grid in)

$$x^3 - 2x^2 + 2x - 4 = 0$$

18. For what real value of x is the equation above true?

(Grid in)

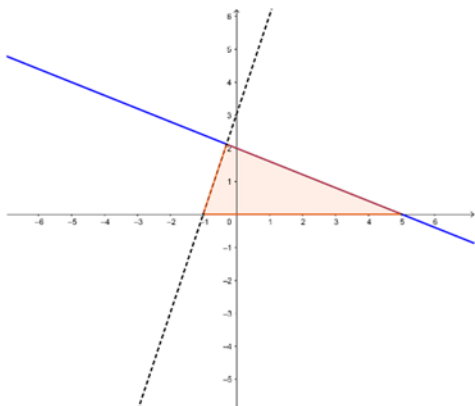
19. For what value of b does the equation $ba^2 + 2a - 3 = 0$ have a single real solution for a ?

(Grid in)

20. If $a^2 + b^2 = 20$ and $ab = 8$, then what is $(b - a)^2$?

(Grid in)

Section II
Calculator is required
(60 minutes)



1. Which of the following is a system of inequalities whose solution is the set of points that belong to the shaded area in the figure above?

A. $x > 0$
 $y > \frac{-2}{5}x + 2$
 $y < 3x + 3$

B. $y \geq 0$
 $y \leq \frac{-2}{5}x + 2$
 $y < 3x + 3$

C. $y < 0$
 $y > \frac{-2}{5}x + 2$
 $y \geq 3x + 3$

D. $y \geq 0$
 $y \geq \frac{-2}{5}x + 2$
 $y < 3x + 3$

2. In the xy -plane, the line determined by the points $(3, m)$ and $(m, 12)$ passes through the origin. Which of the following could be the value of m ?

- A. -6
 B. 9
 C. 1
 D. 0

$$y \leq -10x + 2000$$

$$y \leq 5x$$

3. In the xy -plane, if a point with coordinates (a, b) lies in the solution set of the system of inequalities above, what is the maximum possible value of b ?

- A. $\frac{400}{3}$
 B. $\frac{2000}{3}$
 C. 400
 D. 550

$$\begin{cases} \frac{2}{3}x + y = -3 \\ \frac{x}{3} + \frac{y}{2} = -3 \end{cases}$$

4. What is the solution of the above system?

- A. $(-6, 1)$
 B. $(6, 9)$
 C. $(6, -7)$
 D. \emptyset

5. When a system of two linear equations has no solution, how do the graphs of the equations appear?

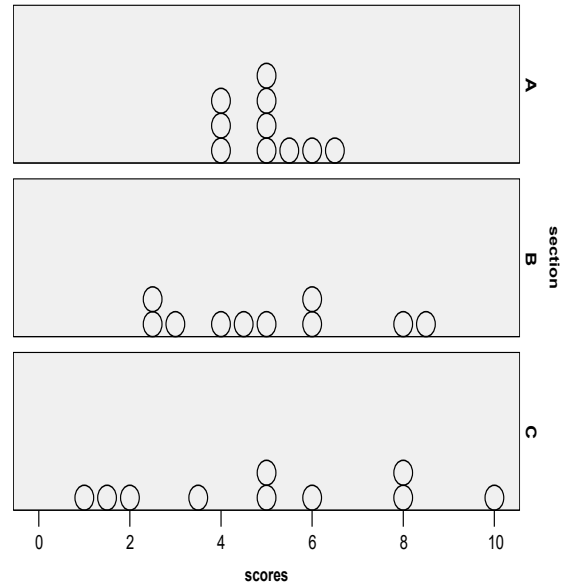
- A. The lines intersect at a single point.
 B. The lines have the same x -intercept.
 C. The lines are parallel.
 D. The lines are confounded.

6. The total revenue of a magic show is 16,360 EGP. If each adult ticket to attend the show cost 12 EGP and each children ticket cost 2 EGP, then what is the number of tickets of each type sold if 3,480 tickets in all were sold?
- 930 adult tickets and 2,550 children tickets
 - 940 adult tickets and 2,540 children tickets
 - 955 adult tickets and 2,525 children tickets
 - 960 adult tickets and 2,520 children tickets

Questions 7 and 8 refer to the following information.

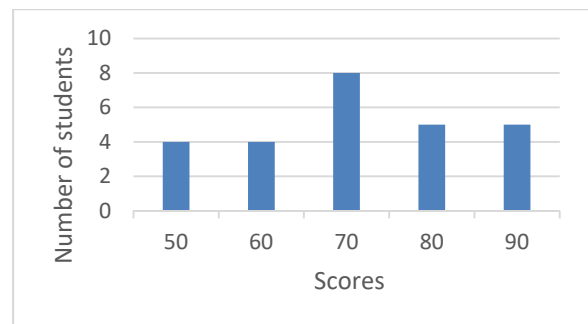
The expression $1.6y + 10.8$ models the number of eligible voters in millions in a certain country from 1990 to 2015 where $y = 1$ represents the number of years since 1990.

7. Find the approximate number of eligible voters in millions in 1999.
- 27
 - 25
 - 29
 - 3209
8. Assume that the model continues to hold for future years, what is the difference between the eligible voters in millions in 2020 and 2017?
- 5.2
 - 4.8
 - 6.4
 - 2.4



9. The dot plots above show the scores on a common quiz for the three sections A, B, and C. Knowing that the average score is the same for the three sections, which of the following correctly compares the standard deviation (σ) of the scores in each of the three sections?
- $\sigma_A < \sigma_B < \sigma_C$
 - $\sigma_A < \sigma_C < \sigma_B$
 - $\sigma_C < \sigma_B < \sigma_A$
 - $\sigma_B < \sigma_A < \sigma_C$

Questions 10, 11, and 12 refer to the following information.



The above bar chart shows the scores of a philosophy test over 100.

10. What is the median score?

- A. 8
- B. 60
- C. 70
- D. 80

11. What is the range of the scores?

- A. 40
- B. 3
- C. 10
- D. 20

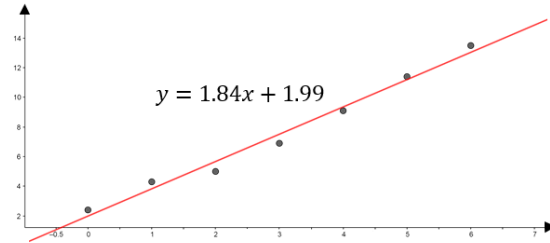
12. If 5 is subtracted from each score, what do the new mean x' and standard deviation α' become with respect to the original mean x and standard deviation α ?

- A. $x' = 5x$; $\alpha' = \alpha$
- B. $x' = x + 5$; $\alpha' = \alpha - 5$
- C. $x' = x - 5$; $\alpha' = \alpha$
- D. $x' = x - 5$; $\alpha' = \alpha - 5$

13. Which of the following variables are discrete?

- I. Number of players in a playground
- II. The speed in miles per hour of cars passing a certain point on a highway
- III. Academic rank in class
- IV. Height in inches
- V. Weight in kilograms

- A. I and II
- B. I, II, and III
- C. IV and V
- D. I and III



At 8:00 a.m., a patient is given a drip feed containing a particular chemical and its concentration in his blood is measured, in suitable units, at one interval as shown above in the scatterplot. A line of best fit and its equation $y = 1.84x + 1.99$ are also given.

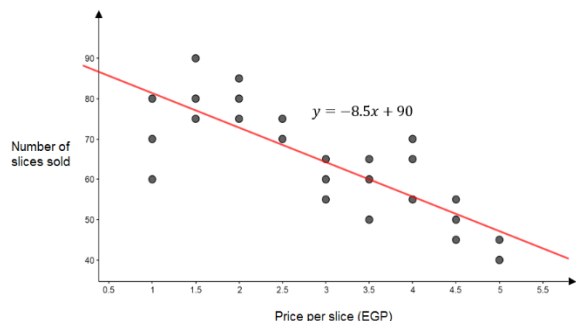
14. Which of the following is the best interpretation of the y-intercept in the equation of the line?

- A. If x increases by 1 unit, then y increases by 1.84 units.
- B. If x increases by 1 unit, then the concentration of the chemical in his blood is expected to increase by 1.84 units.
- C. Before drip feeding the patient, the concentration of this particular chemical in his blood is expected to be 1.99 units.
- D. At 9:00 a.m., the concentration of this particular chemical in his blood is expected to be 1.99 units.

15. If 35% of a number is equal to two-thirds of another number, what is the ratio of the first number to the second number?

- A. $\frac{21}{40}$
- B. $\frac{2}{95}$
- C. $\frac{40}{21}$
- D. $\frac{35}{150}$

Questions 16, 17, and 18 refer to the following information.



A kiosk sells slices of pizza and sets the price per slice each week. The scatterplot above shows the price and the number of slices sold over 25 weeks, along with the line of best fit and its equation.

16. How many slices does the kiosk expect to sell in a week when the price of a slice is 4 EGP?

- A. 10.5
- B. 56
- C. 58
- D. 62

17. What is the best interpretation of the meaning of the slope of the line of best fit?

- A. If the price of the slice increases by one EGP, the kiosk expects to sell 8.5 more slices of pizza.
- B. If the price of the slice decreases by one EGP, the kiosk expects to sell 8.5 fewer slices of pizza.
- C. If the price of the slice increases by one EGP, the kiosk expects to sell 8.5 fewer slices of pizza.
- D. If the store sells slices for 0 EGP, 90 people would be expected to accept the free slices of pizza.

18. For how many weeks was the number of slices sold smaller than the amount predicted by the line of best fit?

- A. 12
- B. 9
- C. 15
- D. 16

Questions 19 and 20 refer to information below.

In a farm, there are 30 rabbits of two sizes “small and big” and three colors “white, brown, and gray” as shown in the table below.

Color \ Size	White	Brown	Gray
Small	4	4	6
Big	10	2	4

One rabbit is selected at random from this farm.

19. What is the probability that the selected rabbit is white?

- A. $\frac{4}{14}$
- B. $\frac{7}{15}$
- C. 1
- D. $\frac{10}{30}$

20. Suppose that the selected rabbit is not of white color, what is the probability for this rabbit to be from the big size?

- A. $\frac{3}{5}$
- B. $\frac{3}{7}$
- C. $\frac{3}{8}$
- D. $\frac{16}{30}$

21. In a bag, there are 12 identical tokens numbered from 1 to 12. A token is drawn at random. What is the probability to obtain an even multiple of 3?

- A. $\frac{1}{4}$
- B. $\frac{1}{3}$
- C. $\frac{1}{2}$
- D. $\frac{1}{6}$

22. A bank has opened a new branch and, as part of a promotion, the bank branch is offering 2,000\$ certificates of deposit at an interest rate of 6% per year, compounded semi-annually. The bank is selling certificates with terms of 1, 2, 3 or 4 years. Which of the following functions gives the total amount, A , in dollars, a customer will receive when a certificate with a term of k years is finally paid?

- A. $A = 2000(1 + 0.03k)$
- B. $A = 2000(1 + 0.06k)$
- C. $A = 2000(1.06)^k$
- D. $A = 2000(1.03)^{2k}$

$$\left[\left(2 - \frac{a}{3} \right)^2 - (-2)^2 \left(1 + \frac{a^2}{3} \right) \right]$$

23. Which of the expressions is equivalent to the above expression?

- A. $a \left(\frac{11}{3}a + 4 \right)$
- B. $-a \left(\frac{11}{3}a - 2 \right)$
- C. $-\frac{a}{3} \left(\frac{11}{3}a + 4 \right)$
- D. $\frac{a}{3} \left(\frac{11}{3}a + 4 \right)^2$

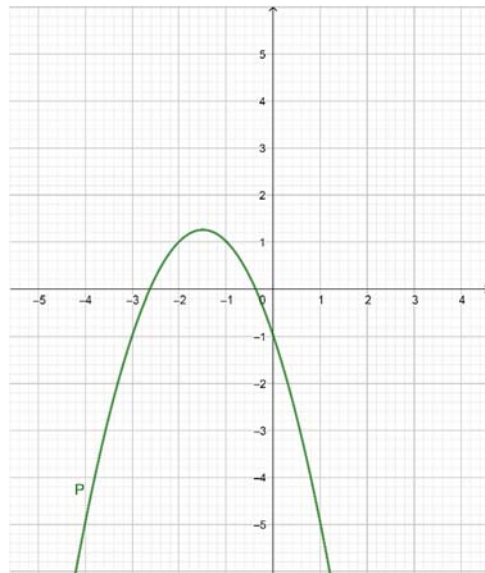
24. Which of the following is a solution for the equation $2x^2 - 7|x| + 5 = 0$?

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

25. From the set of equations below, which has a real solution?

- I. $\sqrt{2x - 1} = -x^2$
- II. $|x + 1| = -3$
- III. $(x + 1)^2 + 3 = 0$
- IV. $\sqrt{2x - 1} = x$

- A. I only
- B. IV only
- C. I, II, and III
- D. III and IV



26. The curve P above represents function f defined by $f(x) = -x^2 + ax + b$. What are the values of the real numbers a and b ?

- A. $a = -1$; $b = -3$
- B. $a = -3$; $b = -1$
- C. $a = -1.5$; $b = -1$
- D. $a = -2.5$; $b = -0.5$

27. Consider the function f defined by $f(x) = 2(x - 3)(x + 2)$. What is the ordinate of the vertex of function f ?
- A. 2
 B. -4.5
 C. 2.5
 D. -12.5
28. The solution of the equation $3^x = 5^{x-2}$ is
- A. $x = \frac{\ln 5}{2\ln(\frac{5}{3})}$
 B. $x = \frac{2\ln 5}{\ln(\frac{5}{3})}$
 C. $x = \frac{\ln 5}{\frac{\ln 3}{5}}$
 D. $x = \frac{-2\ln 5}{\ln(\frac{5}{3})}$
29. Which of the following statements is true?
- A. The amplitude of $f(t) = -2 \sin(2t) + 2$ is 1.
 B. The period of $g(t) = \frac{-1}{2} \cos(2t)$ is π .
 C. The period of $h(t) = 3 \tan(2t)$ is $\frac{\pi}{4}$.
 D. The amplitude of $k(t) = -3 \tan t$ is -3.
30. Which of the following is equal to $\frac{2-i}{3+2i}$?
- A. $\frac{4}{13} + \frac{7}{13}i$
 B. $\frac{4}{13} - \frac{7}{13}i$
 C. $\frac{4}{5} + \frac{7}{5}i$
 D. $\frac{2}{5} - \frac{7}{10}i$
31. Two numbers are in ratio 3:5. If 9 is subtracted from each, the new numbers are in the ratio 12:23. What is the biggest number?
32. A musical band agrees to play for 350\$ plus 20% of the ticket sales. What is the total sale price of the tickets needed for the band to receive at least 700\$?
33. Ahmad runs half the distance to school and walks for the remaining part of the journey. He runs at 3m/s but slows to 2m/s for the second half of the journey. He takes 55 minutes to complete the trip. Find the distance (in meters) Ahmad has to travel to reach school.
34. A sum of 7,200 \$ is to be divided equally among many people. If five people were excluded, each part would increase by 20\$. What is the number of people?

35. The original price of an article is 30,000 EGP and its discount price is 27,600 EGP. What is the discount percent?

36. Bob is paid an hourly rate. One week he earned 165 \$ by working 30 hours. If he works 40 hours the next week, how much will he earn?

37. In the polynomial function $P(x) = 3x^3 + (a - 1)x + 7$, what is the value of the constant number a if -1 is a root of P ?

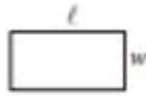
38. In the xy - plane, let $x^2 + y^2 - 2kx + 4y - 3k^2 = 0$ be the equation of a circle of center $A\left(\frac{1}{2}, -2\right)$ and radius $r = \sqrt{5}$. What is the value of the real number k ?

Reference Sheet

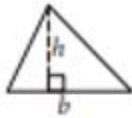


$$A = \pi r^2$$

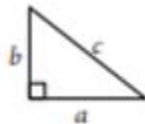
$$C = 2\pi r$$



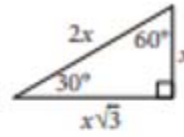
$$A = \ell w$$



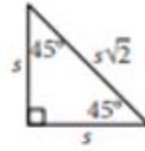
$$A = \frac{1}{2}bh$$



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



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.

