

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. If $2x - 3y = 14$ and $-x + 2y = -8$, what is the value of $x + y$?

- A. -2
- B. 0
- C. 2
- D. 6

2. Which of the following is equivalent to $4a^2 - 9 + (2a - 3)(a - 1) + 3(2a - 3)$?

- A. $(3a + 5)(2a - 3)$
- B. $2(3a + 5)(2a - 3)$
- C. $(2a - 3)(a + 5)$
- D. $(2a - 3)(3a + 7)$

3. For $i = \sqrt{-1}$, which of the following is equivalent to $\frac{2i - 3}{i - 5}$?

- A. $\frac{13 - 7i}{24}$
- B. $\frac{13 - 13i}{24}$
- C. $\frac{17 - 7i}{26}$
- D. $\frac{17 - 13i}{24}$

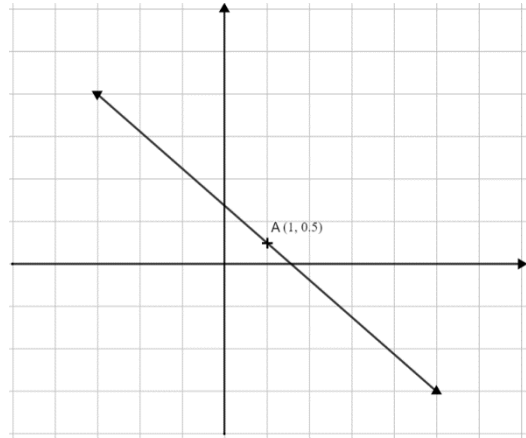
4. The “Bond Number” B_o or “Eötvös Number” is a formula used in fluid dynamics that shows the importance of gravitational forces compared to surface tension forces and is used to describe the shape of a droplet moving in a surrounding fluid. To find the bond number we apply the formula $B_o = \frac{\rho g D^2}{\sigma}$ where ρ represents the density of the liquid, g represents the acceleration due to gravity, D is the diameter of the droplet, and σ is the surface temperature. What is D in terms of B_o , ρ , g , and σ ?

- A. $D = \frac{B_o \sigma}{\rho g}$
- B. $D = \sqrt{\frac{B_o \sigma}{\rho g}}$
- C. $D = \sqrt{\frac{B_o \rho}{\sigma g}}$
- D. $D = \frac{B_o \rho}{\sigma g}$

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

- A. $-3\sqrt{3}$
- B. $\sqrt{3} - 3$
- C. $-\sqrt{3} + 3$
- D. $\sqrt{3} + 3$

Questions 6 and 7 refer to the graph below.



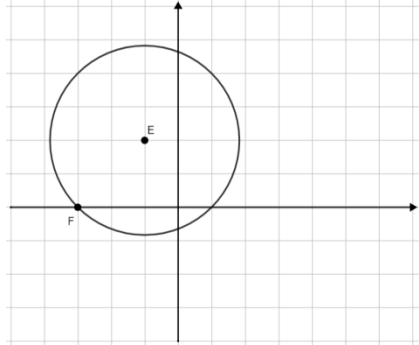
6. What is the slope of the line shown in the graph?

- A. $-\frac{1}{2}$
- B. $-\frac{7}{8}$
- C. $-\frac{8}{7}$
- D. -2

7. What is the equation of the line passing through $A(1, 0.5)$ and perpendicular to the graphed line?

- A. $y = \frac{1}{2}x$
- B. $y = 2x - \frac{3}{2}$
- C. $y = \frac{7}{8}x - \frac{3}{8}$
- D. $y = \frac{8}{7}x - \frac{9}{14}$

8. Using the figure below, what is the circumference of the circle with center E and passing through point F ?



- A. $\pi\sqrt{2}$
 B. $2\pi\sqrt{2}$
 C. $4\pi\sqrt{2}$
 D. $4\sqrt{2}$
9. If $\frac{-1}{2x} = \frac{x-3}{4}$, which of the following is the greatest value for x ?
- A. 2
 B. 1
 C. 0
 D. -1
10. If $9^{2x-1} = 3^8$, what is the value of $2x - 5$?
- A. -5
 B. 0
 C. 5
 D. 10
11. If the sum of half a number and 3 is smaller than twice the same number added to 3, which of the following could be the number?
- A. 1
 B. 0
 C. -0.5
 D. -2

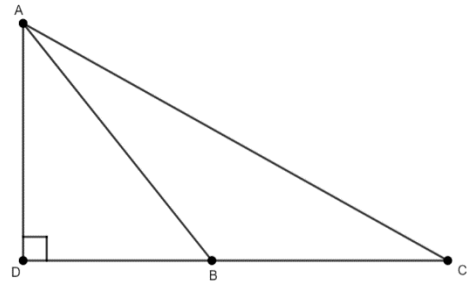
12. Given three consecutive even integers. If the sum of the first and three times the third is equal to 20, what is the sum of the three integers?

- A. 14
 B. 12
 C. 8
 D. 6

13. What is the range of the function $f(x) = x^2 + 4x - 3$?

- A. $[-1, +\infty)$
 B. $[1, +\infty)$
 C. $[7, +\infty)$
 D. $[-7, +\infty)$

14. In the figure below, $AB = 7$ cm, $DC = 13$ cm and $\tan C = \frac{2\sqrt{6}}{13}$. What is the dimension of segment BC ? (The figure is not drawn to scale.)



- A. 5 cm
 B. 8 cm
 C. 10 cm
 D. 12 cm

15. If xy is a *positive* integer and xz is a negative integer, which of the following is true?

- I. yz is always positive.
 II. $xy - xz$ is always positive.
 III. xyz is always negative.

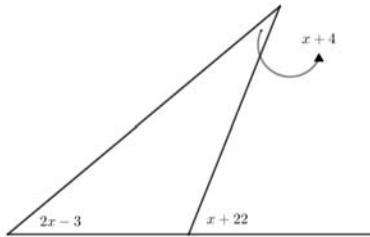
- A. I only
 B. II only
 C. III only
 D. I, II, and III

16. Given $f(x) = 2x^2 - 3x + 1$ and $g(x) = -3x + 5$, what is the value of $(f \circ g)(-2)$? (grid-in)

17. Joanne is a saleswoman in a TV store. Her salary is 1,300 Egyptian pounds per month, in addition to 10 Egyptian pounds for each TV she sells if the quantity sold is less than or equal to 10 TVs per month. If she sells more than 10 TVs in one month, she will get an extra bonus of 10% of her initial salary. Last November, she sold 12 TVs. What was her salary at the end of the month? (grid-in)

18. The function $h(x) = x^2 - ax - 3$ has zeros at $x = 3$ and $x = -1$. What is the value of a ? (grid-in)

19. Using the figure below, what is the value of x ? (grid-in)



20. What is the abscissa of the vertex of the function $f(x) = 3x^2 - 18x + 4$? (grid-in)

Section II
Calculator is required
(55 minutes)

1. Which of the following is a point of intersection between the line with equation $y = 3x + 9$ and the parabola with the equation $y = 2x^2 + 3x + 1$?

- A. (2, 3)
- B. (2, 15)
- C. (-2, 15)
- D. (-2, 2)

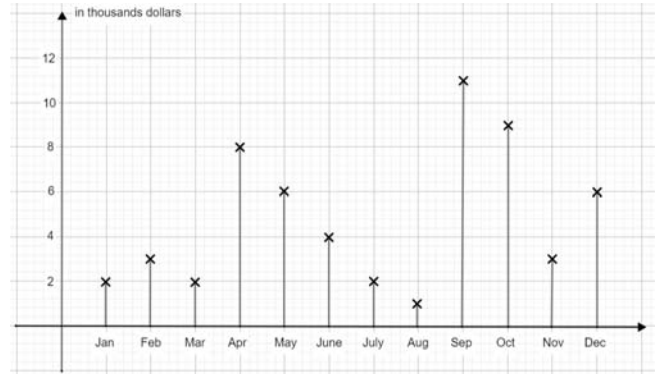
2. In his SAT Math practice test, Hamad solved 80% of the first section correctly, which included 20 questions. In the second section that included 38 questions, $\frac{1250}{19}$ % of the questions were solved correctly. How many questions were correct in Hamad's test?

- A. 6 questions
- B. 41 questions
- C. 42 questions
- D. 58 questions

3.
$$\begin{cases} -2x + 5y = 39 \\ 3x = -4y + 45 \end{cases}$$
From the system of equations above, what is the value of $2x + 7y$?

- A. -57
- B. 15
- C. 39
- D. 69

Questions 4, 5, and 6 refer to the information below.



Adam and his fiancée worked as freelance graphic designers all year long during 2019 to save money for their wedding and to buy furniture for their home. Their mixed salary each month, in thousands of dollars, is shown in the graph above.

4. During September, Adam worked 15 hours per day, while his fiancée worked 11 hours per day. Knowing that each one of them took 4 days off that month, and his fiancée was getting paid \$10.7 per hour, how much was Adam approximately getting paid per hour?

- A. \$16.6
- B. \$17.8
- C. \$20.4
- D. \$36.1

5. In which quarter of the year did they get the smallest income?

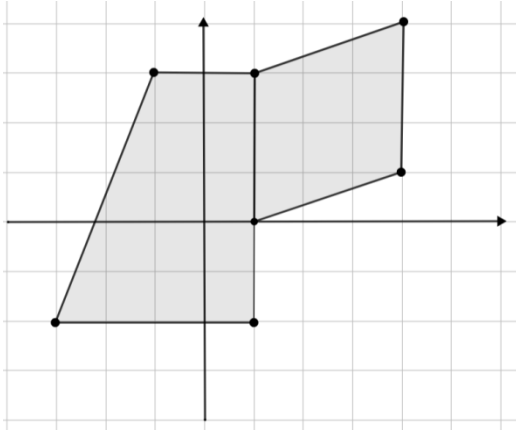
- A. 1st quarter
- B. 2nd quarter
- C. 3rd quarter
- D. 4th quarter

6. What is the percentage of May's income out of their total annual income?

- A. 3.41%
- B. 5.27%
- C. 9.52%
- D. 10.53%

7. A company lost 20% of their stock the first year, then 26% the second year. In the third year, their stock increased by 30%. Which of the following statements is true?
- The company's stock increased by 23.04% in comparison with the price of the stock before the start of the loss.
 - The company's stock decreased by 23.04% in comparison with the price of the stock before the start of the loss.
 - The company's stock decreased by 76.96% in comparison with the price of the stock before the start of the loss.
 - The company's stock increased by 76.96% in comparison with the price of the stock before the start of the loss.
8. What is the sum of the solutions of $(a - 1)(a^2 + 8a + 15) = 0$?
- 8
 - 7
 - 7
 - 8
9. Tanta University is an Egyptian university located in Tanta, Egypt. Since 1962, the administration was developed and was able to create more than 10 faculties. Statistics show, in an old release, that 3,636 students attend the Faculty of Medicine, and the ratio of female students to male students is 11:25. How many male students are attending the faculty?
- 2,544
 - 2,525
 - 2,000
 - 1,604
10. What is the x -intercept of the line passing through points $(3, 5)$ and $(4, -2)$?
- 7
 - $\frac{25}{7}$
 - $\frac{26}{7}$
 - 26
11. If $f(x) = \frac{2x^2 - 7x + 5}{x - 4}$ and $g(x) = \frac{1}{3}x^2 - 7$, what is the value of $f[g(3)] - f(2)$?
- $-\frac{69}{8}$
 - $-\frac{65}{8}$
 - $-\frac{61}{8}$
 - $-\frac{9}{2}$
12. What is the product of the solutions of $2x^4 = 4x^2 + 6$?
- $3i$
 - 0
 - $-3i$
 - 3
13. Petra registered in an online magazine for a monthly fee of \$15. However, to read premium articles, she has to pay an extra charge of \$0.3 per article. Which of the following represents the total amount Petra is going to pay per month if she reads x premium articles?
- $15x + 0.3$
 - $15 + 0.3x$
 - $15 \times 30 + 0.3x$
 - $15 \times 30x + 0.3$

14. What is the area of the shaded region in the figure below?



- A. 15 square units
 B. 19 square units
 C. 24 square units
 D. 27 square units
15. $ABCD$ is a parallelogram such that $A(1, 2)$, $B(4, 4)$, $C(6, 1)$, and $D(3, -1)$. What are the coordinates of E , the center of the parallelogram?
- A. $E(1.5, 3.5)$
 B. $E(4, 1.5)$
 C. $E(1.5, 4)$
 D. $E(3.5, 1.5)$
16. What is the inverse function of $f(x) = \frac{x-2}{2x}$?

- A. $f^{-1}(x) = \frac{2}{1-2x}$
 B. $f^{-1}(x) = 2 - \frac{1}{x}$
 C. $f^{-1}(x) = \frac{-2}{1-x}$
 D. $f^{-1}(x) = \frac{2}{x}$

Questions 17, 18, and 19 refer to the information below.

Gold is one of the most important items in the world. Its price increases and decreases every day. The average closing price for the past 8 years is shown in the table below.

Year	Average Closing Price (\$)
2020	1,771.9
2019	1,393.34
2018	1,268.93
2017	1,251.92
2016	1,158.86
2015	1,266.06
2014	1,409.51
2013	1,668.86

17. What is the mean of the average closing price of the last 5 years according to the given table?
- A. 1,137.2
 B. 1,351.82
 C. 1,368.99
 D. 1,622.18
18. Which of the following statements is true when comparing the annual percentage change from 2018 to 2020?
- A. It increased by 27.17%.
 B. It decreased by 27.17%.
 C. It decreased by 39.64%.
 D. It increased by 39.64%.
19. Supposing that the relation is linear, what is the rate of change between years 2013 and 2019?
- A. -45.92
 B. -39.36
 C. 39.36
 D. 45.92

20. Raymond went to the bookstore and bought 8 greeting cards to send them to his friends. However, he decided to send cards to only 5 of his friends. In how many ways can this be done?

- A. 40
- B. 56
- C. 960
- D. 6,720

21. In 2011, the population in Cairo was 9.12 million. Considering the population was increasing by 1% each year, what could be the approximate population in Cairo in 2022?

- A. 10.074154 million
- B. 10.123200 million
- C. 10.174896 million
- D. 10.276645 million

22. What are the values of a and b if $f(x) = (2a - 3)x^2 + bx - 1$ is equivalent to $g(x) = (4a + 3)x^2 + (3 - b)x - 1$?

- A. $a = 3$ and $b = 1.5$
- B. $a = -3$ and $b = 1.5$
- C. $a = -3$ and $b = -1.5$
- D. $a = 3$ and $b = -1.5$

23. If $4x + 14y = -7$, what is the value of $-x - \frac{7}{2}y$?

- A. $-\frac{7}{4}$
- B. $\frac{7}{4}$
- C. $-\frac{7}{2}$
- D. $\frac{7}{2}$

24. Acceleration is a vector quantity that represents the rate of change of velocity over time. In physics, when the velocity of an object is changing, it means the object is either accelerating or decelerating. The formula used to find the velocity \vec{v} of an object is $\vec{v} = \frac{\Delta\vec{r}}{\Delta t}$ and that of the acceleration is $\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$, where $\Delta\vec{r}$ is the displacement vector (change in position), $\Delta\vec{v}$ is the change in velocity vector, and Δt is the change in time of the object.

Which of the following statements is true regarding the given formula?

- I. If $\Delta\vec{r}$ increases and Δt decreases, the acceleration will increase.
- II. If $\Delta\vec{r}$ decreases and Δt increases, the acceleration will increase.
- III. If $\Delta\vec{r}$ decreases and Δt increases, the acceleration will decrease.

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

25. $-3 < 2x - y \leq 14$

Which point could be the solution for the inequality above?

- A. (0, 3)
- B. (4, -8)
- C. (3, 4)
- D. (4, 12)

26. For what values of x is

$$f(x) = \frac{2x^2 - 3}{(x - 3)(2x + 5)} \text{ undefined?}$$

- A. $x = 2.5$ and $x = 3$
- B. $x = -2.5$ and $x = -3$
- C. $x = 2.5$ and $x = -3$
- D. $x = -2.5$ and $x = 3$

27. If $\frac{a}{2b+1} = \frac{1}{2}$, which of the following is correct?

- A. $a + b = \frac{1}{2}$
- B. $a - b = \frac{1}{2}$
- C. $2a - b = \frac{1}{2}$
- D. $a - 2b = \frac{1}{2}$

Questions 28, 29, and 30 refer to the information below.

A football club published on its website the number of entrance tickets sold in 2018 and in 2019.

	Average number of tickets sold at the entrance door per game			Seasonal tickets	
	Male	Female	Child	Male	Female
2018	4521	1254	759	1122	780
2019	4668	1102	884	1088	794

	Ticket revenue from selling them at the entrance door per game (\$)			Seasonal ticket revenue (\$)	
	Male	Female	Child	Male	Female
2018	72336	16552.8	4402.2	78540	47970
2019	79822.8	15428	4420	80512	47640

28. What was the seasonal ticket price for a male person in 2018? How much did it decrease or increase in 2019?

- A. It costed \$70 in 2018, and it decreased by \$4 the next year.
- B. It costed \$74 in 2018, and it increased by \$4 the next year.
- C. It costed \$70 in 2018, and it increased by \$4 the next year.
- D. It costed \$74 in 2018, and it decreased by \$4 the next year.

29. Which of the following represents the equation of the line describing the change of the number of seasonal tickets sold for a female person to the revenue obtained from the same category?

- A. $y = -\frac{165}{7}x + 66355.7$
- B. $y = \frac{165}{7}x + 66355.7$
- C. $y = -\frac{165}{7}x - 66355.7$
- D. $y = \frac{165}{7}x - 66355.7$

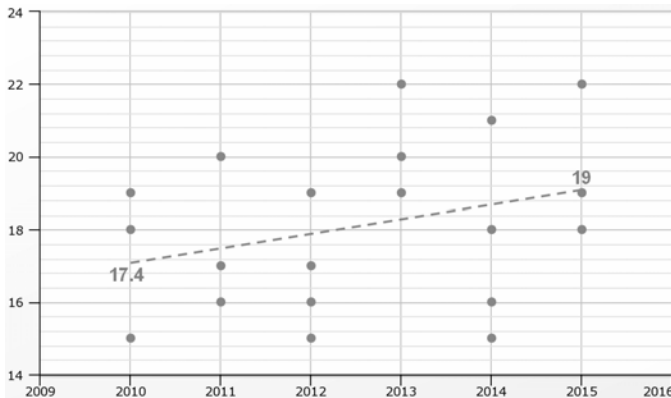
30. What is the average revenue ticket from selling them at the entrance door per game in 2019?

- A. \$13.16
- B. \$14.31
- C. \$14.98
- D. \$17.27

31. If $f(x) = -4x + 8(x - 5)$ and $g(x) = -3x + 1$, what is the value of $f(2) \times g(1)$? (grid-in)
32. The sum of twice a number x and eleven is equal to one third the difference of the same number and one. What is the value of $(1 - x)$? (grid-in)
33. If y varies directly as the cube of $2x$, and $y = 8$ when $x = 2$, what is y when x is equal to 4? (grid-in)

Questions 34 and 35 refer to the information below.

The scatterplot below shows how many laptops for different companies were repaired



by a computer engineer between years 2010 and 2015.

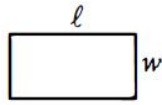
34. Based on the line of best fit shown as a dashed line, what is the average yearly increase in the number of repaired laptops rounded to the nearest tenth? (grid-in)
35. How many laptops were repaired between years 2012 and 2014? (grid-in)
36. Given that $3^x = 11$, what is the value of $2(3^{3x}) - 4$? (grid-in)
37. If $\sin a = 2 - \frac{\cos a}{3}$, what is the value of $9 \sin a + 3 \cos a$? (grid-in)
38. The density of a substance is equal to the quotient of its mass and its volume. What is the mass, in kilograms, of a liquid whose density is 14.2 g/cm^3 if its volume is equal to 6 L ? ($1 \text{ mL} = 1 \text{ cm}^3$) (grid-in)

Reference Sheet:

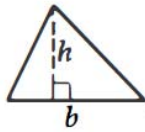


$$A = \pi r^2$$

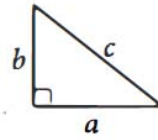
$$C = 2\pi r$$



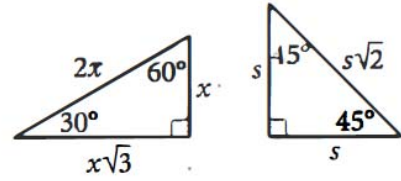
$$A = \ell w$$



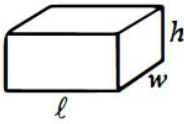
$$A = \frac{1}{2}bh$$



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



Special Right Triangles



$$V = \ell wh$$



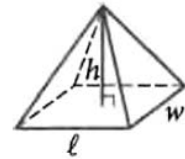
$$V = \pi r^2 h$$



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



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



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

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.