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.
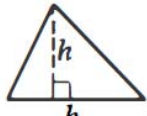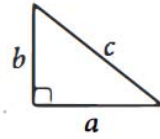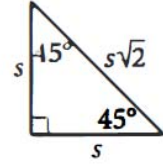
Reference:

$A = \pi r^2$

$C = 2\pi r$
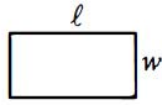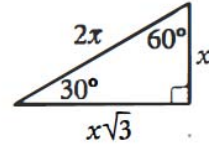
$A = \ell w$

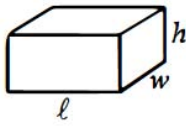$A = \dfrac{1}{2}bh$
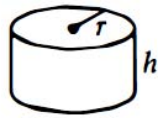
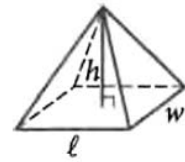$c^2 = a^2 + b^2$

Special Right Triangles

$V = \ell w h$

$V = \pi r^2 h$

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

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

$V = \dfrac{1}{3}\ell w h$

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

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

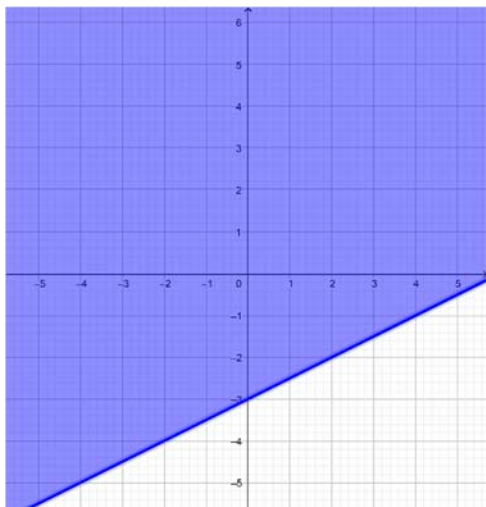The sum of the measures in degrees of the angles of a triangle is 180.

Section I
Calculator is not required
(30 minutes)

1. The difference between twice a number and two is three times the number. Which of the following represents the equation that can be used to solve the number?

   A. $2x - 2 = 3(x - 2)$
   B. $2 - 2x = 3$
   C. $2x - 2 = 3x$
   D. $2x - 3x = 3 + x$

2. If 50% of a is b, then $a =$

   A. $50b$
   B. $\frac{b}{2}$
   C. $2b$
   D. $0.50b$

3. Ibrahim needs enough fencing to enclose a rectangular garden with a perimeter of 200 meters. If the length of his garden is to be 60 meters, which of the following equations can be used to solve the width of the garden?

   A. $2x + 120 = 200$
   B. $x + 60 = 200$
   C. $2x - 200 = 120$
   D. $2x + 60 = 200$

Questions 4 and 5 refer to the same information

$$g = 12 - \frac{m}{20}$$

Ibrahim fills up the gas tank of his car before going on a trip. The equation above models the amount of gas g, in gallons, remaining in Ibrahim's car after he has driven m kilometers.

4. How many gallons of gas can Ibrahim's tank hold?

   A. 20
   B. 8
   C. 12
   D. 11.95

5. What does 20 represent in the equation above?

   A. Ibrahim's tank can hold 20 gallons of gas.
   B. Ibrahim's car can travel 20 kilometers on 12 gallons of gas.
   C. Ibrahim uses 20 gallons of gas per kilometer.
   D. Ibrahim's car can travel 20 kilometers to the gallon.

6. In June 2021, Peter wants to manage his time carefully to know the number of interviews, T, he can take. For each interview that he takes, he expects to spend 3.5 hours working on the candidate's application. In addition to this, he expects to spend an additional 5 hours to schedule interviews for all candidate. If Peter has 80 hours available in June, how many interviews can he take?

   A. 21
   B. 24
   C. 9
   D. 23

7. Which of the inequalities below represents the solution of the shaded region in the figure above?

A. $-y \le -0.5x - 3$
B. $-y \le -0.5x + 3$
C. $y \ge -0.5x - 3$
D. $-y \le 0.5x + 3$

8. Which of the following is the simplest form of the expression $\dfrac{24ab^4c^2}{27a^3b^4c}$?

A. $\dfrac{8a^2c}{9}$
B. $\dfrac{8c}{9a^2}$
C. $\dfrac{9a^2}{8c}$
D. $\dfrac{8b^8c}{9a^2}$

9. A factor of the polynomial $7x^2 + 14x - 21$ is:

A. $7x - 7$
B. $7x + 7$
C. $x - 3$
D. $7x + 3$

10. For what values of a and b will the equation $x^2 + ax = b$ have the solutions 1 and -1?

A. $a = 1;\ b = 1$
B. $a = 0;\ b = 1$
C. $a = 0;\ b = -1$
D. $a = 1;\ b = 0$

11. The graphs of $f(x) = \big||x| - 2\big|$ and $g(x) = 1$ in the same system will have:

A. 0 points of intersection
B. 1 point of intersection
C. 2 points of intersection
D. 4 points of intersection

12. What is the coefficient of x^3 when $\frac{2}{5}x^3 + 2x^2 - 3$ is multiplied by $5x + \frac{2}{5}$?

A. 10
B. $\dfrac{4}{25}$
C. $\dfrac{54}{5}$
D. $\dfrac{254}{25}$

$$\left(\frac{2x - 3}{x - 3}\right)^2 \div \frac{3}{2x - 6}$$

13. Which of the following is equivalent to the expression above, given that $x \ne 3$?
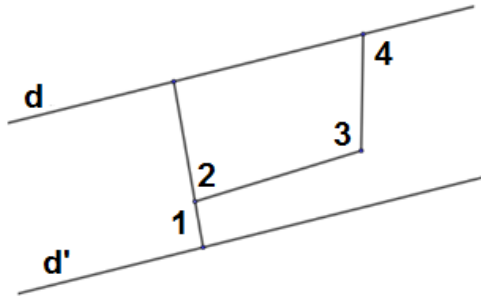
A. $\dfrac{2(2x-3)^2}{3(x-3)}$
B. $\dfrac{2(x-3)}{3(2x-3)^2}$
C. $\dfrac{2(2x-3)}{3(x-3)^2}$
D. $\dfrac{2(2x-3)^2}{3}$

14. The graph of an exponential function K in the xy-plane, where $y = K(x)$ has a y-intercept of h, where h is a negative constant number. Which of the following could be function K?

A. $K(x) = -h(x)^3$
B. $K(x) = 2(h)^x$
C. $K(x) = h(4)^x$
D. $K(x) = -\sqrt{3}hx$

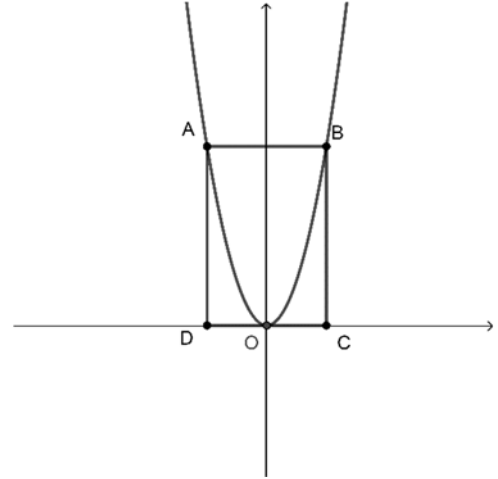15. If C is a circle of center (2,0) and radius $= 2$, then which of the following points is inside the circle?

A. (1,3)
B. (2,-2)
C. (3,-1)
D. (4,0)

16. In the figure above, d and d′ are parallel lines, $\angle 2 = 103°$, $\angle 3 = 107°$ and $\angle 4 = 97°$. What is the measure of $\angle 1$? (The figure is not drawn to scale) **(Grid in)**

$$3x - 1 = \sqrt{3k^2 - x}$$

17. If $k > 0$ and $x = 2$ in the equation above, what is the value of k? **(Grid in)**

18. In the figure above, ABCD is a square and points A, B and O lie on the parabola of equation $y = \frac{1}{k}x^2$, where k is a constant number. If the area of ABCD is 16 cm^2, what is the value of k? (The figure is not drawn to scale). **(Grid in)**

x	y
-4	-9
0	-1
2	3
p	9

19. If the values in the table above represent a linear relationship between x and y, what is the value of p? **(Grid in)**

20. How many asymptotes does the curve of the function f defined by $f(x) = \frac{x^2 - 3}{9 - x^2}$ admit? **(Grid in)**

Section II
Calculator is required
(60 minutes)

1. If x is a positive number less than 1, then which of the following is true?

   I. $x^2 < x$
   II. $x^3 > x$
   III. $x + 1 > 1$

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

2. In a school competition, students have to prepare sketches of length x minutes. The minimum length is 2 minutes and the maximum length is 3 minutes.

   Which inequality represents the given situation?

   A. $|x - 2| < 3$
   B. $|x - 3| < 2$
   C. $|x - 2.5| \leq 0.5$
   D. $|x - 0.5| \leq 2.5$

   (d): $x + 2y + 2 = 0$

3. Which of the equations below could not be a line perpendicular to line (d) given above?

   A. $4x - 2y - 2 = 0$
   B. $2x - y + 3 = 0$
   C. $2x + y + 1 = 0$
   D. $6x - 3y = 0$

4. Street food tickets at the park cost 10 EGP for children and 15 EGP for adults. On a certain day, 1,500 tickets were bought for a total of 19,750 EGP.

   What is the amount of money made from the tickets for adults only on that day?

   A. 5,490 EGP
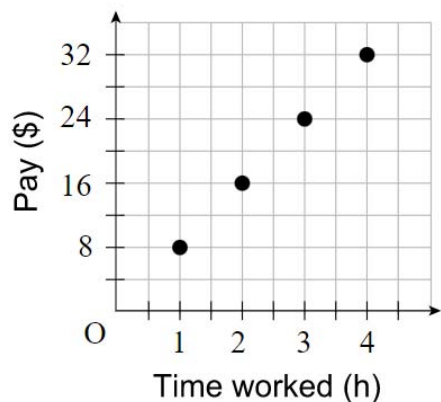   B. 7,500 EGP
   C. 12,000 EGP
   D. 14,250 EGP

   $$2\left(\frac{x}{3} - \frac{1}{4}\right) - 2x = \frac{2}{5}$$

5. What is the solution to the equation above?

   A. $x = \dfrac{-9}{28}$
   B. $x = \dfrac{-27}{40}$
   C. $x = \dfrac{-27}{10}$
   D. $x = \dfrac{3}{40}$

6. If the straight line (d) of equation $kx + 3y - 1 = 0$ passes through the point $(-0.5, 1)$, what is the slope of (d)?

   A. 4
   B. $\dfrac{4}{3}$
   C. $\dfrac{-4}{3}$
   D. $\dfrac{-3}{4}$

7. The graph above shows the amount of money earned by Dana who works at a restaurant based on the number of hours she works every day.

What is the unit rate of Dana's working hour?

A. $8/h
B. $1/h
C. 1 h/$
D. $4/h

8. If $ax + by = a - b$ and $bx - ay = a + b$ then:

A. $x = y = 1$
B. $x = y = -1$
C. $x = 1$ and $y = -1$
D. $x = -1$ and $y = 1$

9. On a math test of 30 questions, Mona got 75% of the 12 geometry questions correct, 60% of the 10 algebra questions correct and 25% of the 8 trigonometry questions wrong. What percentage of all the questions did Mona get correct?

A. 56.6%
B. 160%
C. 70%
D. 210%

10. The price of the COVID-19 vaccine in the black market was first increased by 15% and then increased by 10% after two weeks. What is the percent increase in the price of the vaccine?

A. 126.5%
B. 26.5%
C. 25%
D. 1.265%
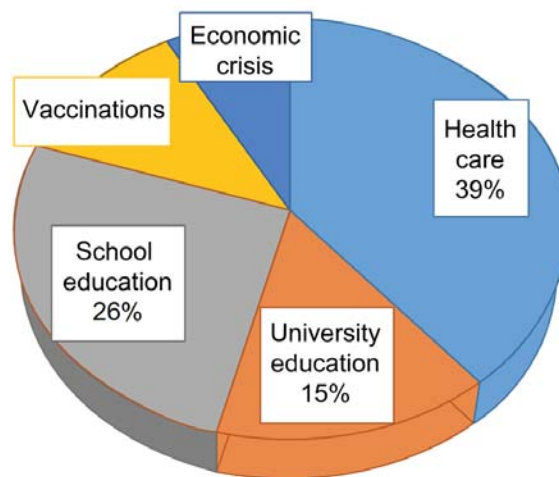
11. Alice surveyed all the students in the secondary department at her school to see their most important concern through the pandemic situation of corona virus. The results are shown in the figure above. If the ratio of students who answered "Vaccinations" to those who answered "Economic crisis" was 3:2, what percentage of the students answered "Vaccinations"?

A. 8%
B. 12%
C. 18%
D. 10%

9

Questions 12, 13, 14 and 15 refer to the same information.

Home Electricity Use Per Appliance
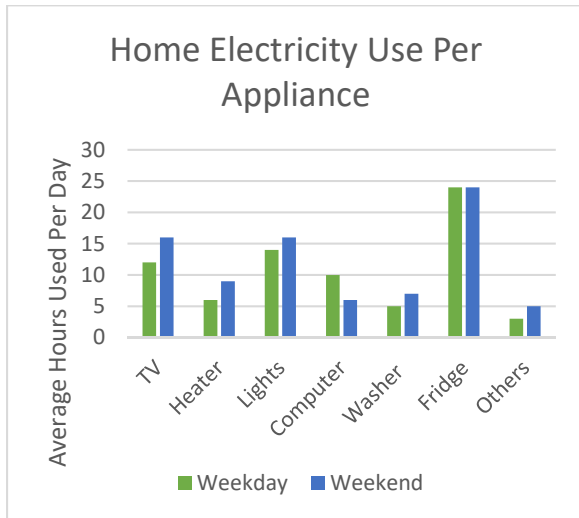
12. What information does the graph above provide?

    A. Average kilowatts used by each appliance in a day
    B. Total electricity per day
    C. Hours appliance used per day
    D. Average hours used in a day by each appliance

13. Which appliance has more usage on weekdays than on weekends?

    A. TV
    B. Lights
    C. Computer
    D. Fridge

14. How many hours a day, on average, is the washer used on weekdays?

    A. 5
    B. 6
    C. 7
    D. 12

15. Which appliances are used on weekends for an average of at least three hours per day more than on weekdays?

    A. lights and washer
    B. TV, computer and washer
    C. TV and heater
    D. Others

16. In a bag there are 14 identical tokens numbered from 0 to 13. A token is drawn at random. What is the probability to obtain an odd multiple of 3?

    A. $\frac{3}{14}$
    B. $\frac{2}{5}$
    C. $\frac{1}{7}$
    D. $\frac{2}{13}$

17. How much money would you need to deposit today at 8% annual interest compounded monthly to have $10,000 in the account after 5 years?

    A. $6,500.5
   **B.** $6,680.13
    C. $6,712.10
    D. $5,989.3

18. A box contains 7 identical balls, three red, two green and two blue. Three balls are drawn randomly and successively one after the other without replacing the ball in the box. What is the probability to get exactly one ball of each color?

    A. $\frac{2}{35}$
    B. $\frac{12}{343}$
    C. $\frac{72}{343}$
    D. $\frac{12}{35}$

19. Consider k points on the plane where no three points are collinear. How many straight lines can be drawn using these points?

A. $\dfrac{k(k-2)}{2}$

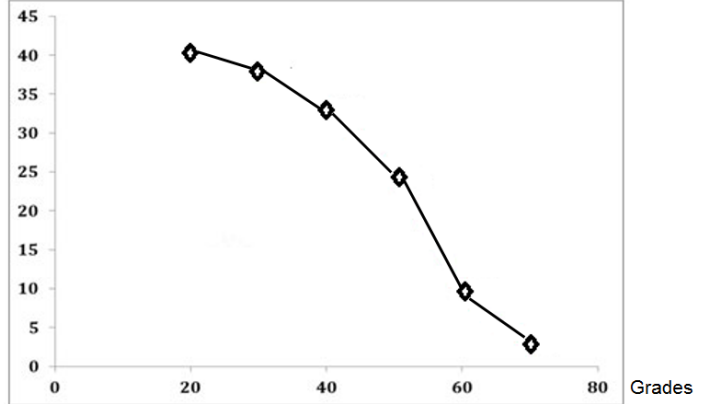B. $\dfrac{k(k-1)}{2}$

C. $k(k-1)$

D. $\dfrac{k}{2!}$

Absences vs. Exam Scores
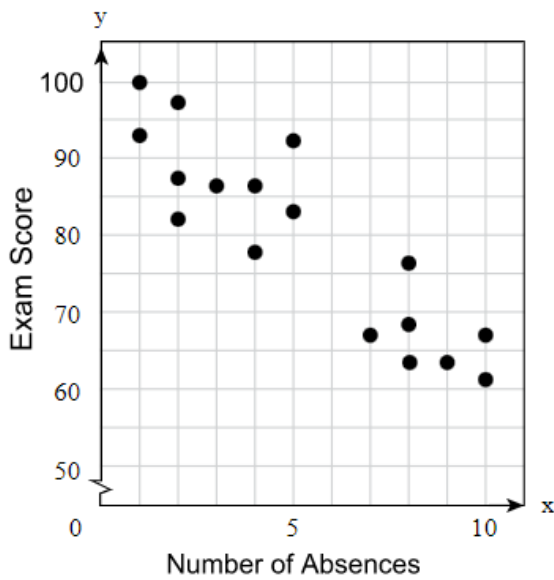
20. Mrs. Mary made the scatterplot above to show the relationship between the number of absences and a student's final exam score without drawing the line of best fit. Which of the following scores could a student approximately get on the final exam with 6 absences?

A. 70

B. 65

C. 87

D. 76

Decreasing cumulative Frequency

21. The polygon line above represents the grades distribution of a class on a history exam.

What is the mode of the above distribution?

A. 20

B. 40

C. 50

D. 60

22. If $3^x \cdot \sqrt[4]{3} = 9^{2x}$, then $x =$

A. 4

B. $\dfrac{1}{12}$

C. $\dfrac{4}{3}$

D. $\dfrac{-7}{4}$

11

23. The math teacher asked four of her students to draw the function $f(x) = \dfrac{2}{x-1}$ in the xy-plane and to write only one piece of information from their obtained curves. The table below shows the results.

| Maya	The curve admits a center of symmetry of coordinates (1,0).
Tarek	The curve admits two vertices.
Mirna	The curve admits an asymptote of equation $y = 1$.
Albert	The range of the function is $\mathbb{R}$.

Which student could be right?

A. Maya
B. Tarek
C. Mirna
D. Albert

24. If $A = \dfrac{\sqrt{16x^2y^2}}{\sqrt[3]{-125x^3y^3} + 2xy}$ and $x > 0, y < 0$ then $A =$

A. $\dfrac{-4}{7}$

B. $\dfrac{3}{4}$

C. $\dfrac{-4}{3}$

D. $\dfrac{4}{3}$

25. If $f(x) = x^2 + 3$ and $h(x) = x.f(x) + 3x$, what is $h(-1)$?

A. 1
B. -7
C. -5
D. -4
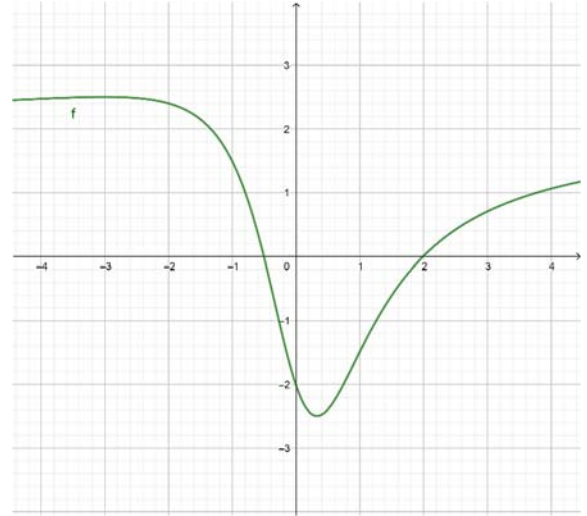
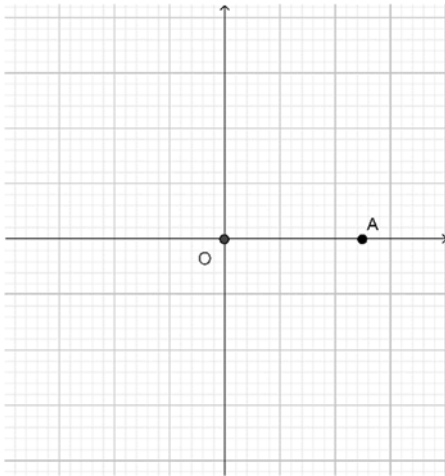**26.** The curve above represents the curve of function f defined over $\mathbb{R}$.

What is the solution of $0 \le f(x) \le 2$?

A. $\left[\dfrac{-4}{3}, -0.5\right] \cup [2, +\infty[$

B. $[-2, -1] \cup [0, +\infty[$

C. $[-2.5, -0.5]$

D. $\left[\dfrac{-4}{3}, -0.5\right] \cup [-2, +\infty[$

27. Which of the following represents $3^4 = 81$ in logarithmic form?

A. $\log_3 4 = 81$
B. $\log_4 81 = 3$
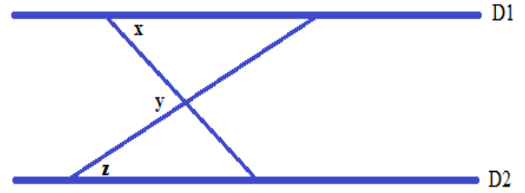**C.** $\log_3 81 = 4$
D. $\log_{81} 3 = 4$
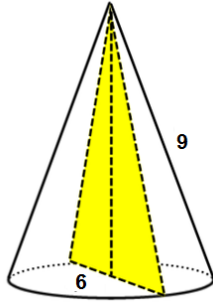
28. What is the area of the cross section perpendicular to the base of the right cone with a diameter of 6? (The figure is not drawn to scale)

A. $36\sqrt{2}$

B. $6\sqrt{2}$

C. $18\sqrt{2}$

D. 18

29. In the xy-plane above, if the coordinates of point B are $\left(-\sqrt{3}, -\sqrt{3}\right)$, what is the measure, in radians, of angle AOB?

A. $-\dfrac{\pi}{4}$

B. $\dfrac{3\pi}{4}$

C. $\dfrac{-3\pi}{4}$

D. $\dfrac{4\pi}{5}$

**30.** In the figure above, D1 and D2 are two parallel lines.

Which of the following is always true?

A. $z = x$

B. $z = x - y$

C. $x = y - z$

D. $x + z + y = 180$

31. If $|2x - 3| \le 4$, what is the greatest possible value of $|3x - 2|$? **(Grid in)**

32. A father decides to give his son 10 EGP for every math question solved correctly as to encourage him to study mathematics more, but takes back 5 EGP if the solution is wrong. After 30 questions, each has given and received the same amount of money. How many correct questions did the son solve? **(Grid in)**

33. What is 17% of 36% of 2500? **(Grid in)**
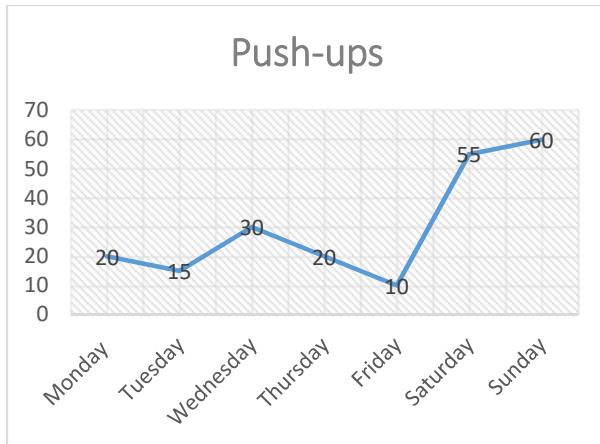
Push-ups

34. The graph above shows the number of push-ups Bob did last week.

What was the average number of push-ups?

35. On Mother's Day, a big store put a freezer and a refrigerator on sale. The owner of the store suggests that:

The probability that a person buys a refrigerator is $\frac{5}{7}$.

The probability that a person buys a freezer if he buys a refrigerator is $\frac{2}{5}$.

The probability that a person buys a freezer if he doesn't buy the refrigerator is 5%.

What is the probability that the person buys the freezer? **(Grid in)**

36. In a class of 25 students, the average of the grades of the boys, girls and the class is 12, 14 and 13.2 respectively. How many girls are in this class? **(Grid in)**

37. How many solutions, in $\mathbb{R}$, does the equation $e^{3x} - 3x - 3 = 0$ admit? **(Grid in)**
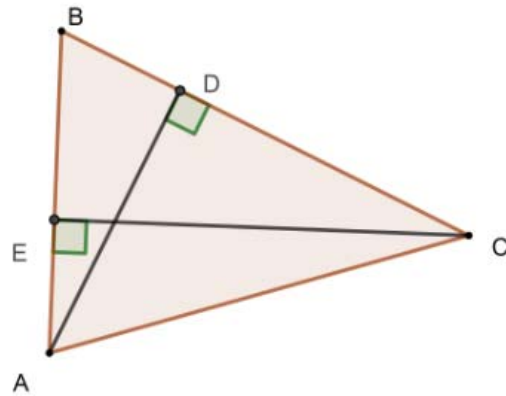
38. In the triangle above, $\overline{AD} \perp \overline{BC}$ and $\overline{CE} \perp \overline{BA}$ such that $BD = 5, BE = 6$ and $AD = 8$. What is the length of $\overline{CE}$? (The figure is not drawn to scale) **(Grid in)**