# EST II
# MATH – LEVEL 1

**Date:**

**Test Center:**

**Room Number:**

**Student's Name:**

**National ID:**

**EST ID:**

**Duration:**      60 minutes

40 Multiple Choice Questions

**Instructions:**

- Place your answers 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.
- Graphing and scientific calculators are allowed.

**Question 1.** The sum of three consecutive integers is 168. The second one is equal to:

    **A.** 55

    **B.** 56

    **C.** 57

    **D.** 58

    **E.** 59

**Question 2.** If $\frac{p-3q}{4} + \frac{q}{2} = \frac{2p+q}{2} - \frac{11}{4}$, then the value of $p$ in terms of $q$ is:

    **A.** $-\frac{1}{5q} - \frac{11}{5}$

    **B.** $-\frac{1}{5q} + \frac{11}{5}$

    **C.** $-q + \frac{11}{3}$

    **D.** $\frac{3}{5q} - \frac{11}{5}$

    **E.** $q + \frac{11}{3}$

**Question 3.** Let $g(x) = \frac{x^2+4}{-4x^2-5x+6}$. For which values of $x$ is $g(x)$ undefined?

    **A.** $x = -2$ and $x = -\frac{3}{4}$

    **B.** $x = -2$ and $x = \frac{3}{4}$

    **C.** $x = 2$ and $x = -\frac{3}{4}$

    **D.** $x = 2$ and $x = \frac{3}{4}$

    **E.** $x = 2$ and $x = \frac{4}{3}$

**Question 4.** Consider a line $d$ of equation $2y = 3x + 5$. Line $L$ is perpendicular to $d$, and $T$ is a line parallel to $L$. If $A(-5, 3)$ is a point on $T$, then the equation of $T$ is:

    **A.** $2y - 3x = 1$

    **B.** $3y - 2x = -3$

    **C.** $3y - 2x = -1$

    **D.** $3y + 2x = -1$

    **E.** $3y + 2x = 3$

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**Question 5.** In a geometric sequence, the $5^{\text{th}}$ term is $3{,}200{,}000$ and the $10^{\text{th}}$ term is $1{,}024$. What is the first term of this sequence?

- **A.** $2 \times 10^9$
- **B.** $2 \times 10^{10}$
- **C.** $2 \times 10^{11}$
- **D.** $2 \times 10^{16}$
- **E.** $2 \times 10^{20}$

$$15, 16, 17, y, 20, 21, 24, 20$$

**Question 6.** If the mean of the dataset above is equal to $20$, what is the value of the median?

- **A.** $18$
- **B.** $19$
- **C.** $20$
- **D.** $21$
- **E.** $22$

**Question 7.** Which of the following functions is the inverse of function $p$ defined by $p(x) = \frac{x-1}{x+2}$?

- **A.** $p^{-1}(x) = \frac{2x}{1-x}$

- **B.** $p^{-1}(x) = \frac{x-1}{2x-1}$

- **C.** $p^{-1}(x) = \frac{2x-1}{x+1}$

- **D.** $p^{-1}(x) = \frac{1-2x}{1-x}$

- **E.** $p^{-1}(x) = \frac{2x+1}{1-x}$
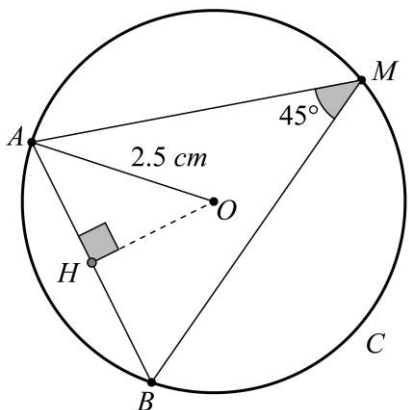
**Question 8.** $2\sin^2(x) \cdot \sec^2(x) + \tan^2(x) =$

- **A.** $3\cot(x)$
- **B.** $\frac{1}{2}\tan(x)$
- **C.** $3\tan^2(x)$
- **D.** $\cot^2(x)$
- **E.** $\tan^2(x)$

**Question 9.** Which of the following statements is/are true for the function $f$ defined by $f(x) = -2|x + 3| + 3$?

**I.** The graph of $f$ has a vertex at $(-3, 3)$.
**II.** The graph of $f$ is a V-shape that opens downward.
**III.** The graph of $f$ passes through $(0, 3)$.

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

**Question 10.** Consider a circle $C$ with center $O$ and radius $r = 2.5\ cm$. Points $M$, $A$, and $B$ lie on $C$ such that $m\angle AMB = 45°$, as shown in the adjacent figure. What is the approximate length of the altitude $OH$ drawn from $O$ to $\overline{AB}$? *(Figure not drawn to scale)*



**A.** $1.521\ cm$
**B.** $1.611\ cm$
**C.** $1.768\ cm$
**D.** $1.823\ cm$
**E.** $3.295\ cm$

**Question 11.** A line $d$ with equation $x - y + 3 = 0$ is tangent to a circle $C$ with center $A(m - 3, 2m)$ and radius $\sqrt{2}\ cm$ at $T(0, t)$. Which of the following is the value of $m$?

**A.** $-2.0$
**B.** $1.5$
**C.** $2.0$
**D.** $3.5$
**E.** $4.0$

**Question 12.** The graph of function $f$ defined by $f(x) = \frac{-x+1}{x^2}$ and the straight line $D$ with equation $y = x - 1$ intersect at point $I$. The coordinates of $I$ are:

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

**Question 13.** $C$ is a circle with center $(-2, 3)$ and radius $5$. Line $D$, with equation $3x + 4y - 31 = 0$, is tangent to $C$. The coordinates of the point of tangency are:
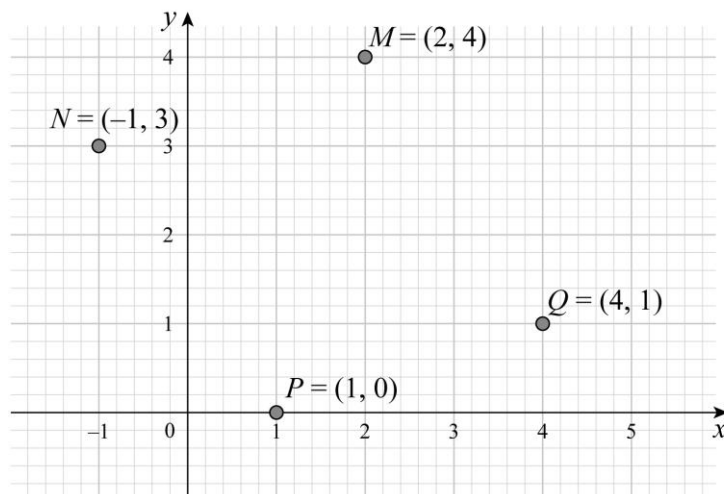
    **A.** $(5, 4)$

    **B.** $(1, 7)$

    **C.** $(1, 1)$

    **D.** $(1, -1)$

    **E.** $(-3, 10)$

**Question 14.** A security system opens a gate using a code of three digits followed by two letters. The digits chosen from 2, 5, 6, 7, 8, and the letters from $A$, $B$, $C$, and $D$. If the repetition of digits and letters is not allowed, then the probability that the code includes the digit $6$ and the letter $A$ is equal to:

    **A.** $\dfrac{1}{10}$

    **B.** $\dfrac{2}{10}$

    **C.** $\dfrac{3}{10}$

    **D.** $\dfrac{4}{10}$

    **E.** $\dfrac{5}{10}$

**Question 15.** Given an equilateral triangle $MNP$ such that $MP = MN = (2x - 5)\ cm$ and $NP = (x + 2)\ cm$, the area of $\Delta MNP$ is:

    **A.** $\dfrac{81}{2}\sqrt{3}\ cm^2$

    **B.** $\dfrac{81}{4}\sqrt{3}\ cm^2$

    **C.** $\dfrac{81}{8}\sqrt{3}\ cm^2$

    **D.** $\dfrac{9}{2}\sqrt{3}\ cm^2$

    **E.** $\dfrac{9}{4}\sqrt{3}\ cm^2$

**Question 16.** Consider the points $M$, $N$, $P$, and $Q$ shown in the figure above. The quadrilateral $MNPQ$ is a/an:

    **A.** Isosceles trapezoid
    **B.** Parallelogram
    **C.** Rectangle
    **D.** Rhombus
    **E.** Square

**Question 17.** Toni allocated a sum of $1,584 for his graduation. He will be distributing this sum on his haircut, photography, shoes, and suit in the ratio of $2 : 5 : 6 : 9$, respectively. How much will he spend on the suit?
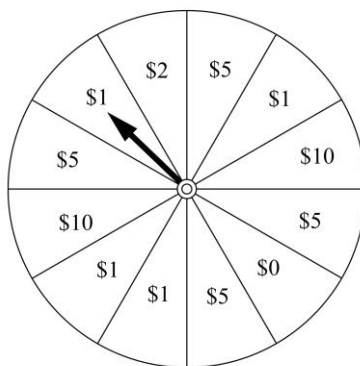
    **A.** $144
    **B.** $360
    **C.** $432
    **D.** $520
    **E.** $648

**Question 18.** If $f$, $g$, and $h$ are three functions defined by $f(x) = x^3 - 3$, $g(x) = 4x^2 + 1$, and $h(x) = x$, then $(g \circ f \circ h)(x) =$

    **A.** $4x^6 + 24x^3 + 36$
    **B.** $4x^6 - 24x^3 + 37$
    **C.** $4x^5 + 24x^3 - 37$
    **D.** $4x^5 + 18x^3 + 36$
    **E.** $4x^5 - 18x^3 + 1$

**Question 19.** A simplified form of the expression $\frac{20(\sin(x)\cdot\cos(x))}{3} \times \frac{\tan(x)+\cot(x)}{4}$ is:

**A.** $\frac{5}{3}\sin(x)\cdot\cos(x)$

**B.** $\cot(x)$

**C.** $2\tan(x)$

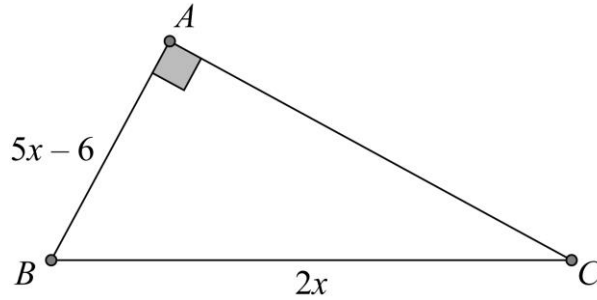**D.** $\frac{5}{3}$

**E.** $\frac{20}{3}$



**Question 20.** A spinner is divided into 12 sections labeled \$0, \$1, \$2, \$5, and \$10, as shown in the figure above. If the spinner is spun twice and all sectors have equal probability of landing on the given arrow, what is the probability of obtaining a sum of 10?

**A.** $\frac{1}{36}$

**B.** $\frac{2}{36}$

**C.** $\frac{4}{36}$

**D.** $\frac{5}{36}$

**E.** $\frac{7}{36}$

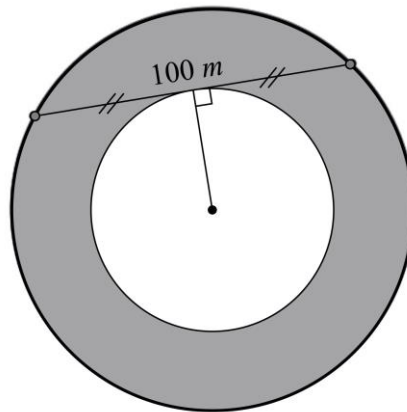**Question 21.** If $|7 - 4x| > 3x + 1$, which of the following is the solution of the inequality?

**A.** $x < \frac{7}{6}$

**B.** $x < \frac{6}{8}$

**C.** $x < \frac{6}{7}$ or $x > 8$

**D.** $x > 7$

**E.** $x > \frac{6}{7}$ or $x < 7$

A

$5x - 6$

B        $2x$        C

**Question 22.** $ABC$ is a right triangle as shown in the figure above. If $AB = 5x - 6$ and $BC = 2x$, which of the following is true if $ABC$ is also isosceles? *(Figure not drawn to scale)*

A. $x = \dfrac{6}{7}$

B. $x = \dfrac{30 - 6\sqrt{2}}{23}$

C. $x = \dfrac{6}{5}$

D. $x = 2$

E. None of the above

100 m

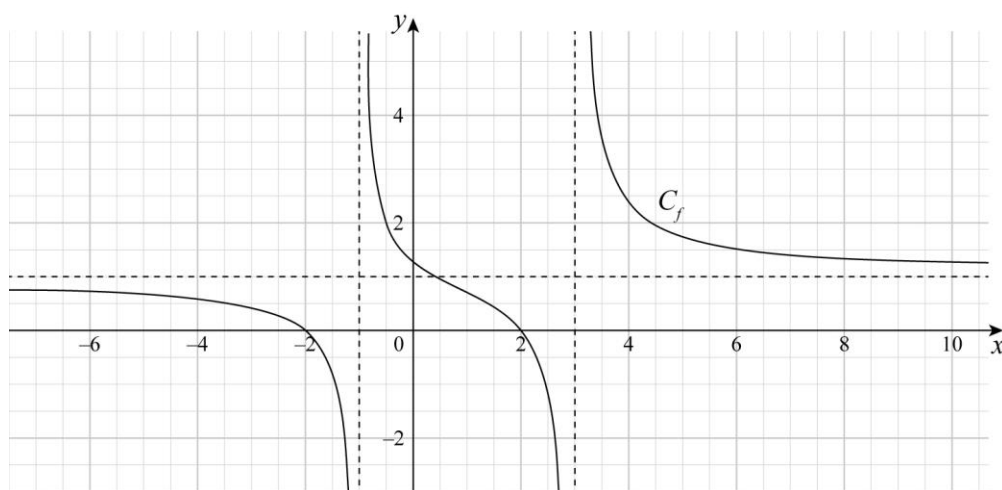**Question 23.** In the figure above, the area of the shaded part is: *(Figure not drawn to scale)*

A. $100\pi \ m^2$

B. $250\pi \ m^2$

C. $1{,}000\pi \ m^2$

D. $1{,}250\pi \ m^2$

E. $2{,}500\pi \ m^2$

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**Question 24.** A chemist has a solution $A$ that is 30% acid and another solution $B$ that is 60% acid.

How many liters of each solution should be mixed to form 120 liters of a new solution that is 40% acid?
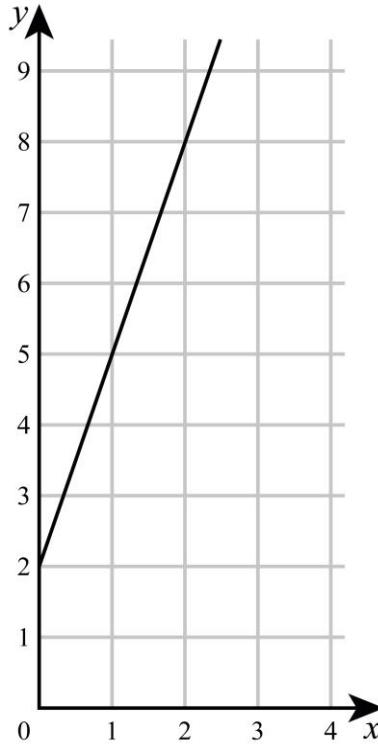
*Note:* Solution $A$ and Solution $B$ are HCl acids, and their percentage concentrations are given as v/v (volume by volume) to ensure scientific accuracy.

| | Volume of solution $A$ | Volume of solution $B$ |
|---|---|---|
| **A.** | 88 $L$ | 32 $L$ |
| **B.** | 80 $L$ | 40 $L$ |
| **C.** | 50 $L$ | 70 $L$ |
| **D.** | 30 $L$ | 90 $L$ |
| **E.** | 20 $L$ | 100 $L$ |



**Question 25.** In the figure above, the curve $C_f$ represents the graph of a function $f$. Which of the following rational functions correspond to $f$?

A. $\dfrac{1-x^2}{(x+1)(x-3)}$

B. $\dfrac{x^2-1}{(x+1)(x-3)}$

C. $\dfrac{x^2-4}{(x+1)(x-3)}$

D. $\dfrac{4-x^2}{(x-1)(x-3)}$

E. $\dfrac{x^2-4}{(-x+1)(x+3)}$

**Question 26.** Which of the situations below is best described by the graph above?

    **A.** A guy starts with $4 in his account and earns $3 for every item he sells.

    **B.** A person pays a fixed fee of $2 for a taxi ride and an additional $3 for every mile traveled.

    **C.** The height of a plant is $2\ cm$, and it grows by $1\ cm$ every week.

    **D.** The price of a cup of coffee is $2, and an additional $2 is charged for every extra shot.

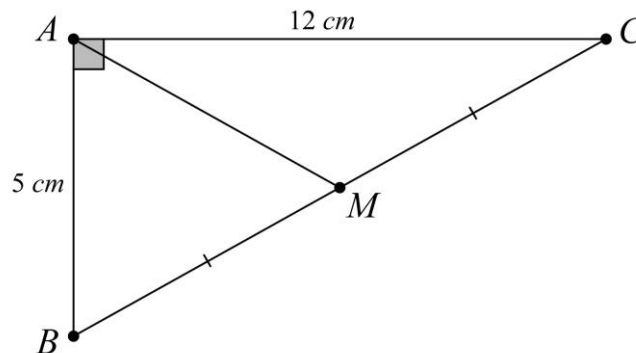    **E.** The temperature is 2 degrees Celsius and rises by 1.5 degrees every hour.

**Question 27.** Which of the following points does not satisfy the system of inequalities: $\begin{cases} y \geq 2x - 1 \\ y < -x + 4 \end{cases}$?

    **A.** $(0, 0)$

    **B.** $(1, 1)$

    **C.** $(1, 2)$

    **D.** $(2, 3)$

    **E.** $(0, 3)$

| Day | Temperature |
|---|---|
| Monday | 12 |
| Tuesday | 14 |
| Wednesday | 13 |
| Thursday | 11 |
| Friday | $x$ |
| Saturday | 15 |
| Sunday | $y$ |

**Question 28.** The table above shows the temperatures, in degrees Celsius, recorded over a week in a certain village. If the coldest day was Friday, the warmest day was Sunday, the range of temperatures is 6, and the mean temperature is 13, then $(x, y) =$

    **A.** $(10, 16)$

    **B.** $(13, 19)$

    **C.** $(16, 10)$

    **D.** $(16, 12)$

    **E.** $(18, 14)$



**Question 29.** $ABC$ is a right triangle at $A$, such that $AB = 5\ cm$ and $AC = 12\ cm$. If $\overline{AM}$ is the median relative to $\overline{BC}$, then $AM$ equals: *(Figure not drawn to scale)*

    **A.** $3.0\ cm$

    **B.** $3.5\ cm$

    **C.** $4.5\ cm$

    **D.** $5.5\ cm$

    **E.** $6.5\ cm$

The following table shows the annual salaries of all $200$ employees in a company.

| Annual Salary in $\$1,000$ | $[5-7)$ | $[7-9)$ | $[9-11)$ | $[11-13)$ | $[13-15]$ |
|---|---|---|---|---|---|
| **Men** | 45 | 25 | 30 | 20 | 12 |
| **Women** | 15 | 20 | 10 | 15 | 8 |

**Question 30.** One employee is randomly selected from the company. What is the probability that the employee is a man with an annual salary of at least $\$11,000$?

A. $\frac{4}{25}$

B. $\frac{32}{132}$

C. $\frac{50}{132}$

D. $\frac{32}{55}$

E. $\frac{35}{55}$

**Question 31.** The HR department is organizing a race featuring five employees, each representing a different salary class. The probability that the representative of the first salary class wins is $p$. As the salary class goes up, the probability of winning is halved. What is the probability that the employee representing the $[5-7)$ class wins?
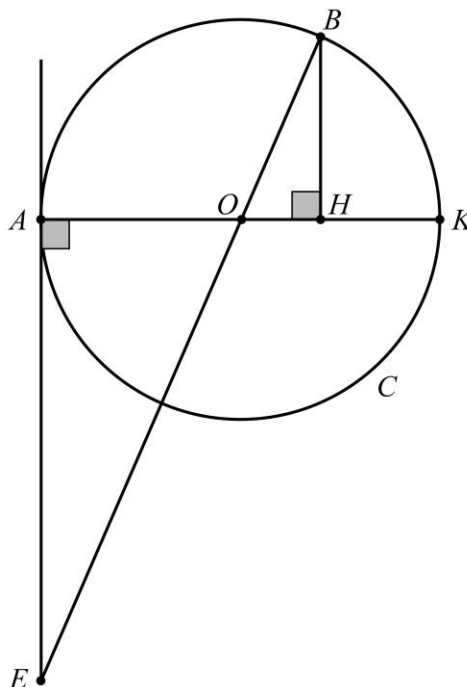
A. $1$

B. $\frac{4}{5}$

C. $\frac{16}{31}$

D. $\frac{1}{2}$

E. $\frac{8}{31}$

In the figure above, $C$ is a circle with center $O$ and radius $4\ cm$. Point $K$ is diametrically opposite to $A$ with respect to $O$. $\overline{AE}$ is perpendicular to $\overline{OA}$. Point $H$ lies on $\overleftrightarrow{OK}$ such that $OH = 1.6\ cm$. Point $B$ lies on $C$ such that $\overline{BH}$ is perpendicular to $\overline{OK}$. (*Figure not drawn to scale*)

**Question 32.** To the nearest tenth, the measure of $\angle OBH$ is:

      **A.** 22.5°
      **B.** 23.6°
      **C.** 24.6°
      **D.** 25.5°
      **E.** 26.5°

**Question 33.** $OE$ is equal to:

      **A.** $6\ cm$
      **B.** $8\ cm$
      **C.** $10\ cm$
      **D.** $12\ cm$
      **E.** $14\ cm$

**Question 34.** Given $x$ and $y$ are 2 natural numbers; if $x^2 = 2^6 \times 3^2 \times 5^4 \times 7^2$ and $y^3 = 2^3 \times 3^9 \times 5^6$, then $GCD(x, y)$ is equal to:

    **A.** $2 \times 3 \times 5^2$
    **B.** $2^2 \times 5 \times 3 \times 7$
    **C.** $2^3 \times 3 \times 7 \times 5^2$
    **D.** $2^3 \times 3^2 \times 5^2$
    **E.** $2^3 \times 7 \times 5^2$

**Question 35.** Using the information in the adjacent figure, the value of $\frac{x}{y}$ is: *(Figure not drawn to scale)*

    **A.** $\frac{1}{\sqrt{3}}$ *cm*

    **B.** $\sqrt{3}$ *cm*

    **C.** $\frac{4}{\sqrt{3}}$ *cm*

    **D.** $3$ *cm*

    **E.** $6$ *cm*



**Question 36.** Samir has a number of marbles between 300 and 350. When the marbles are divided into groups of 12 or groups of 18, there are always 3 marbles left. How many marbles does Samir have?
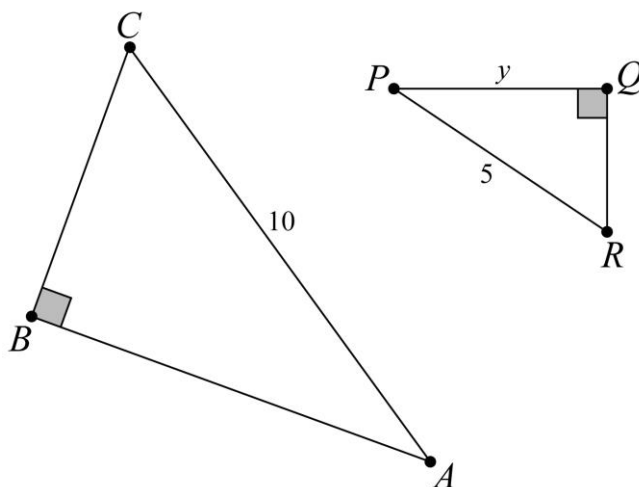
    **A.** 350
    **B.** 329
    **C.** 327
    **D.** 324
    **E.** 291

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**Question 37.** A craftsman who works 6 hours per day can complete a given project in 15 days, receiving $8 per hour. He is asked to finish the project in 10 days. Knowing that he will get a 50% increase on his hourly rate for each day he works more than 6 hours, what is the maximum he will be paid for the project?

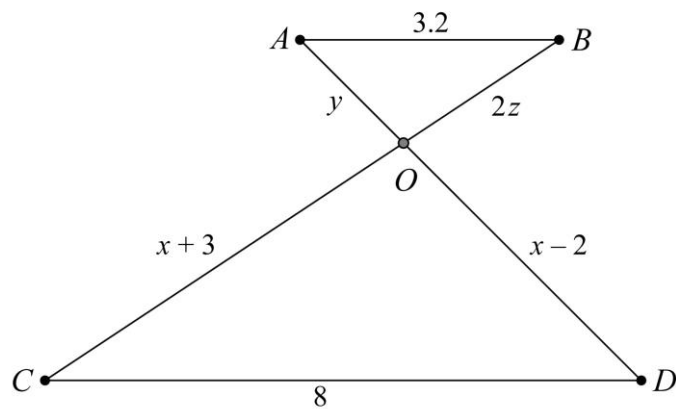   A. $480

   B. $840

   C. $960

   D. $1,080

   E. $1,320

**Question 38.** If ♥ is an operation defined by $a \heartsuit b = a^2 - b^2 + 13$, where $a$ and $b$ are real numbers, then the value of $[(3 \heartsuit 1) \heartsuit (-2)] \heartsuit 0$ is:

   A. 202,500

   B. 202,501

   C. 202,510

   D. 202,513

   E. 202,520



**Question 39.** $\Delta ABC$ and $\Delta PQR$ are similar. What is the ratio of similarity of $\Delta ABC$ to $\Delta PQR$? *(Figures not drawn to scale)*

   A. 1.50

   B. 1.75

   C. 2.0

   D. 2.50

   E. 3.0

3.2

A ● ———————— ● B

y   O   2z

x + 3        x − 2

C ●———————● D
    8

**Question 40.** $\overline{AB}$ is parallel to $\overline{CD}$ and $x = 7$. What is the value of $y + z$? *(Figure not drawn to scale)*

    **A.** 1
    **B.** 2
    **C.** 3
    **D.** 4
    **E.** 6