SECTION A Questions 1 to 10

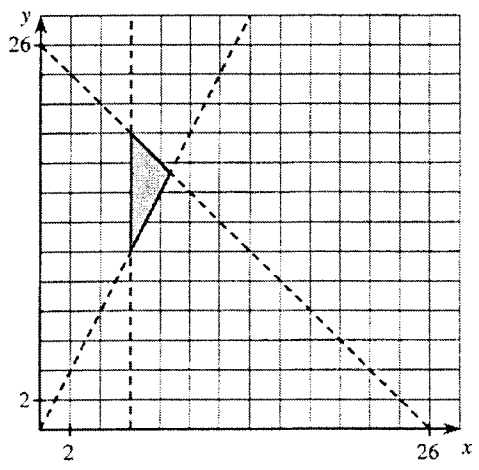
In the Answer Booklet, shade the letter that corresponds to your answer.

1 Martin must prepare for final examinations in Economics and Mathematics. This week, he can study a maximum of 26 hours. He will spend at least 6 hours on Economics. Martin knows the time he needs to study Mathematics is at least twice what he needs for Economics.

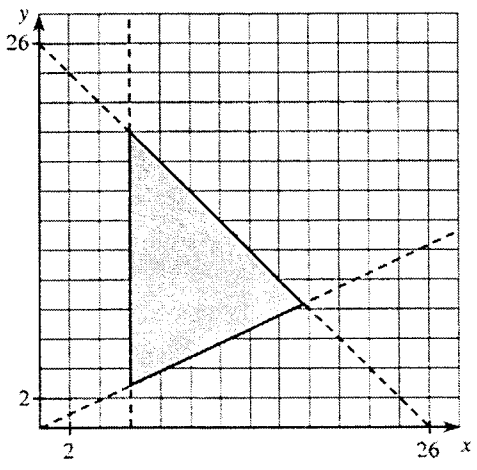
Let x: number of hours studying Economics
y: number of hours studying Mathematics

Which of the following polygons represents Martin's situation?

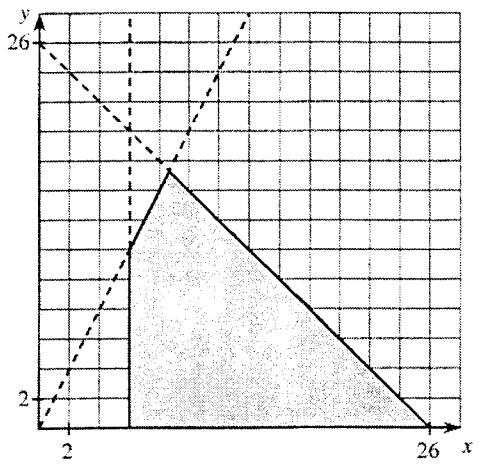
A)



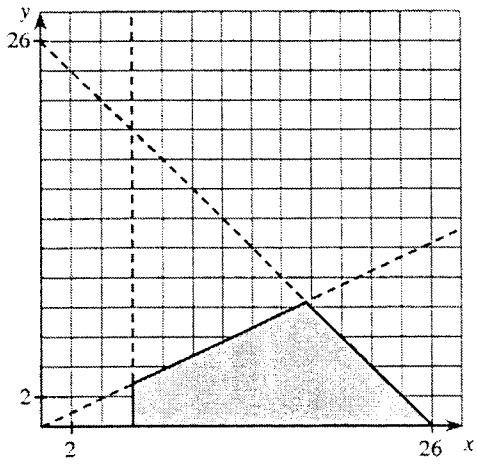
C)



B)



D)



2 Given functions f and g:

$$f(x) = x + 3 \quad \text{and} \quad g(x) = x^2 - x + 2$$

Which expression represents $(g \circ f)(x)$?

A) $x^2 - x + 5$

B) $x^2 + 5x - 8$

C) $x^2 + 5x + 8$

D) $x^2 + 5x + 14$

3 **Which of these functions has an inverse that is NOT a function?**

A) $y = \log_b x + k$

B) $y = a(x - h)^2 + k$

C) $y = a\sqrt{b(x - h)} + k$

D) $y = \dfrac{a}{b(x - h)} + k$

4 The *Mount Tessa Ski Resort* bases its prices on the time spent at the hill according to the following equation:

$$c(t) = 1.50 \left[\frac{t + 30}{20} \right]$$

where t represents the time, in minutes, at the hill
and c represents the cost of the ticket, in dollars

If James is at the hill for 2 hours, how much will he pay for his ticket?

A) $5.25

B) $10.50

C) $11.25

D) $12.00

5 **What is the numerical value of the following logarithmic expression?**

$$\log_2 \sqrt{8} + \log_3 \frac{1}{3} + 6^{\log_6 1}$$

A) $\frac{1}{3}$

B) $\frac{1}{2}$

C) $\frac{3}{2}$

D) $\frac{7}{2}$

6 Given the function $f(x) = 2 \sin (3x) + 1$.

What are the zeros of this function in the interval $[0, \pi]$?

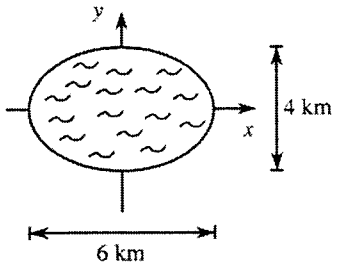
A) $\left\{\frac{7\pi}{6}, \frac{11\pi}{6}\right\}$

B) $\left\{\frac{2\pi}{9}, \frac{4\pi}{9}\right\}$

C) $\left\{\frac{\pi}{18}, \frac{5\pi}{18}\right\}$

D) $\left\{\frac{7\pi}{18}, \frac{11\pi}{18}\right\}$

7 Mark lives by a lake. The lake is in the shape of an ellipse with a length of 6 km and a width of 4 km, as shown.



According to a legend, there is a treasure buried somewhere along the shore of the lake.

Mark wants to find the treasure. He makes a map of the lake on a Cartesian plane scaled in kilometres. The centre of the lake corresponds with the origin of the Cartesian plane.

Which inequality represents the region in which the legend says the treasure is buried?

A) $\frac{x^2}{9} + \frac{y^2}{4} \geq 1$

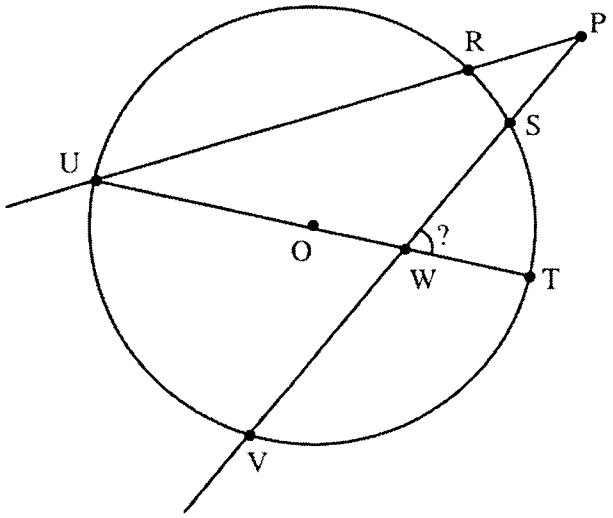
B) $\frac{x^2}{36} - \frac{y^2}{16} \geq 1$

C) $\frac{x^2}{9} + \frac{y^2}{4} \leq 1$

D) $\frac{x^2}{36} - \frac{y^2}{16} \leq 1$

8 In the figure on the right:

$m\angle RPS = 40°$
$m\overset{\frown}{UR} = 110°$
$m\overset{\frown}{RS} = 30°$



What is the measure of angle SWT?

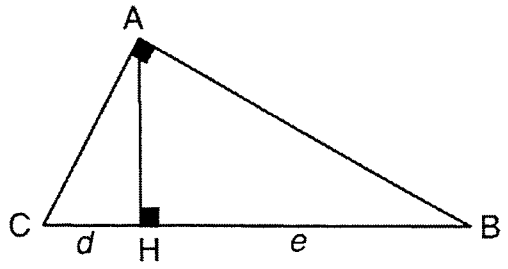
A) 35°

B) 40°

C) 70°

D) 75°

9 Given the adjacent triangle BAC.



Which expression represents the measure of $\overline{AB}$?

A) $\sqrt{de}$

B) $\sqrt{de + e^2}$

C) $e + \sqrt{de}$

D) $\sqrt{de + d^2}$

10 Tom is competing on a Drag-Race track. Starting from rest his car speeds up at a constant rate, reaching a maximum speed of 150 km/h in 12 seconds. Using the brakes, his car then slows down at the same rate.

This situation is described by the absolute value function whose rule is

$$S(t) = -\frac{150}{12}\left|t - 12\right| + 150,$$

where S represents the speed of his car (Km/h) as a function of the time t (sec.).

For how long is his car's speed at least 50 km/h?

A) 4 sec.

B) 12 sec.

C) 16 sec.

D) 20 sec.

SECTION B This section of the exam comprises questions 11 to 15.

Write the answers in the appropriate space in the Answer Booklet.

11 Given the function $f(x) = -2|x + 1| + 3$.

For what values of x is $f(x) \leq -7$?

12 The equations of two parabolas are given below:

$$y^2 = -12x$$
$$(x - 4)^2 = 8(y - 7)$$

The directrix of the first parabola intersects with the directrix of the second.

What are the coordinates of this point of intersection?

13 In a laboratory, the reproduction of a particular species of insect is studied. At the beginning of the experiment, there are 25 insects. The number of insects increases by 30% every week. The number of insects as a function of time is given by

$$f(t) = 25(1.3)^t$$

where

t: number of weeks since the beginning of the experiment
$f(t)$: number of insects after t weeks

After how many weeks will there be 13 570 insects?

14 On each student's Statistics exam, the teacher wrote the student's mark and Z-score. She also indicated that the standard deviation of the group was 8.

Fred's Z-score is 3. Since he didn't make any mistakes, his test mark is 100%.
Vincent's Z-score is -0.75.

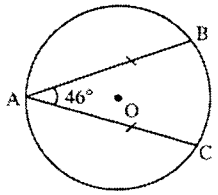
What is Vincent's test mark?

15 Each of the circles below has an arc AB.

Match the arc AB in each figure in the column on the left with its correct measure in the column on the right.

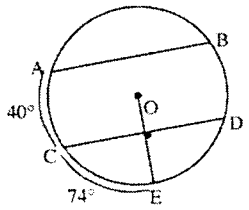
Figures

1) $m\overline{AB} = m\overline{AC}$ and $m\angle A = 46°$



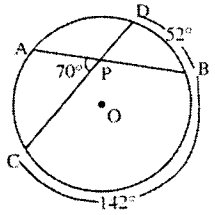
2) $\overline{AB} \parallel \overline{CD}$ and $\overline{OE} \perp \overline{CD}$

$m\overset{\frown}{AC} = 40°$ and $m\overset{\frown}{CE} = 74°$



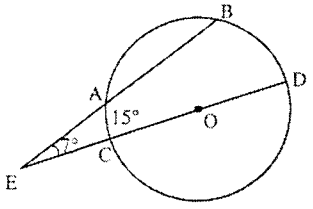
3) $m\overset{\frown}{DB} = 52°$,

$m\overset{\frown}{BC} = 142°$ and $m\angle APC = 70°$



4) $m\angle AEC = 7°$ and $m\overset{\frown}{AC} = 15°$

$\overline{CD}$ is a diameter



$m\overset{\frown}{AB}$

A) 130°

B) 132°

C) 134°

D) 136°

E) 138°

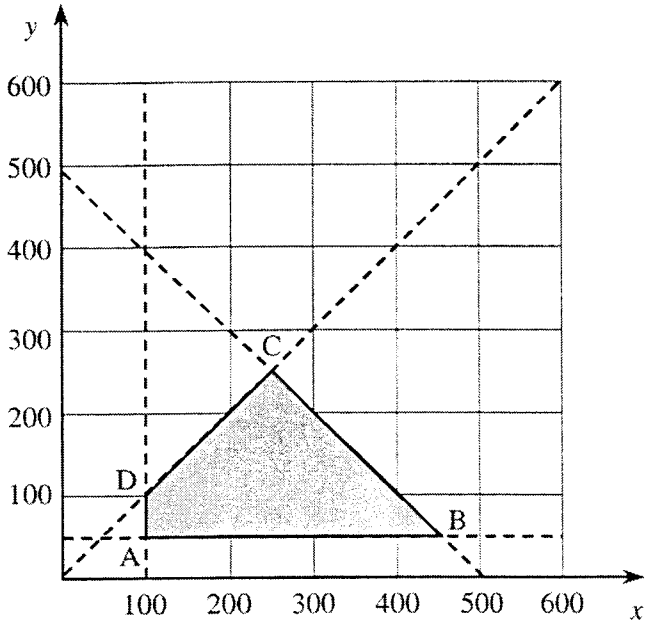
SECTION C Questions 16 to 25

- Show all your **work** as well as your **answer**. The work shown is taken into consideration when marks are awarded.
- Your written information must be legible, complete, and clearly stated in correct language so the marker understands exactly what you have done.

Even if your answer is correct, no marks will be given unless acceptable work is shown.

16 To raise money, the Graduation Committee decides to sell cases of fruit. The following polygon represents the constraints that must be respected.

If x represents the number of cases of oranges for sale and y, the number of cases of grapefruit for sale, the constraints are:



① $x \leq y$
② $x + y \leq 500$
③ $x \geq 100$
④ $y \geq 50$

For each case of oranges and grapefruit sold, the Graduation Committee makes a profit of $1.00 and $1.50, respectively.

Yesterday, the head of the committee received a call from the supplier. Because of a recent flood, the supplier can deliver a maximum of 400 cases of fruit.

By how much will the maximum possible revenue decrease because of the flood?

17 Starting 26 weeks before an election, a firm holds a weekly poll on voter intention.

During this polling period, the popularity of Party "A" varies according to an absolute value function.

In the first survey Party "A" polled 28%. Ten weeks later, the party reached its maximum survey result of 43%.

When did Party "A" have 25% of the survey results?

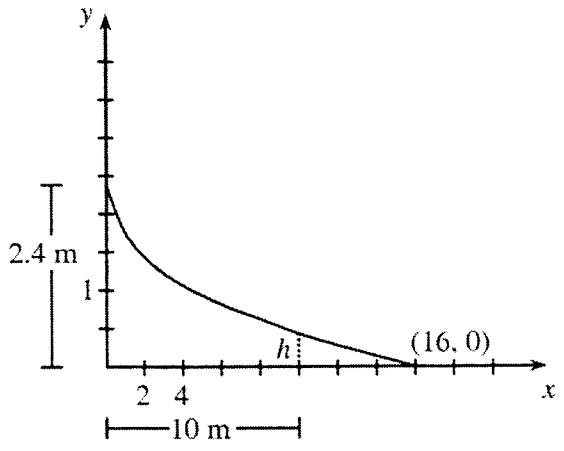
18 A publisher is about to release a new novel. The cost of promoting the book is $20 000. The cost of printing is $5 per copy. Each book will be sold for $14.

How many copies of this novel must the publisher sell in order to make a profit of $4 per book?

Note: $$\textbf{Profit per book} = \frac{(\textbf{Total net profit})}{(\textbf{Number of copies})}$$

19 This winter, Carol's father made a slide. Placed on a Cartesian plane scaled in metres, a model of the slide follows a square root function, as shown below. The top of the slide, 2.4 m above the ground, coincides with the vertex of the square root function. The foot of the slide is 16 m horizontally from the top.

Carol starts going down the slide. However, her scarf becomes jammed in the sled so that she stops at a horizontal distance of 10 m.



At what height did she stop?

20 An airplane is flying at an altitude of 10 000 m. At 21:00, the pilot begins the descent towards Pierre Elliott Trudeau Airport. The descent follows an exponential model ending with the plane's landing. At 21:04, the airplane is at an altitude of 5222 m.

At what time will the airplane be at an altitude of 280 m?

21 A fountain in a shopping centre has a single jet of water. The height of the jet of water varies according to a sinusoidal function. Joel notes that, in exactly one minute, the jet goes from a minimum height of 1 m to a maximum height of 5 m and back to 1 m.

At 13:00, the jet of water is at a height of 1 m.

What will be the height of the jet of water, to the nearest tenth of a metre, when the clock reads 13:12:40? (13 hours, 12 minutes, 40 seconds)

22 **Prove the following trigonometric identity:**

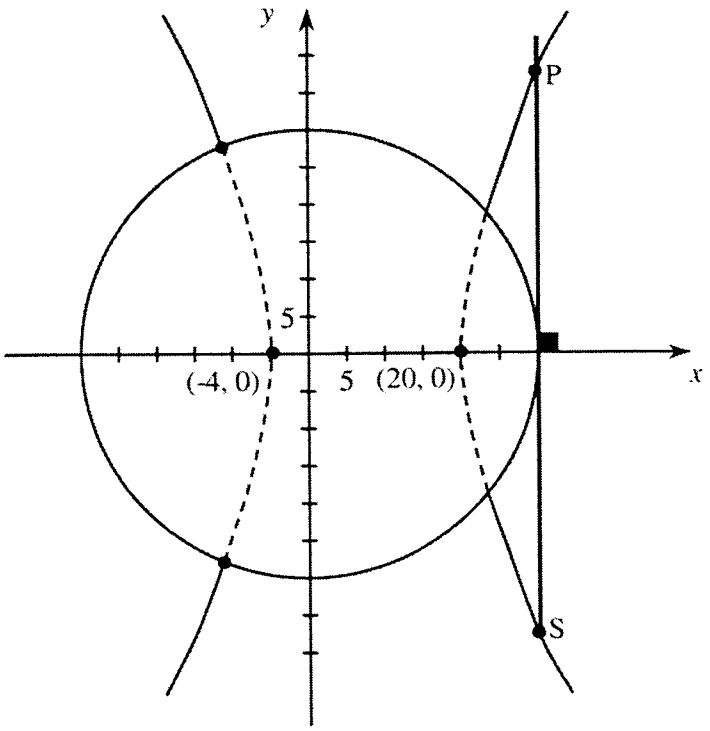
$$\tan x + \frac{\cos x}{1 + \sin x} \equiv \sec x$$

23 Work on a new traffic circle will soon begin. As shown below, the blueprint is drawn on a Cartesian plane scaled in metres. The access ramps will follow a hyperbolic path.

The traffic circle is represented by the circle with equation $x^2 + y^2 = 900$.

The access ramps are represented by the hyperbola with vertices (-4, 0) and (20, 0), and asymptotes $y_1 = -2(x - 8)$ and $y_2 = 2(x - 8)$.

Two traffic signs will be placed at points P and S such that segment PS is tangent to the circle and perpendicular to the focal axis.

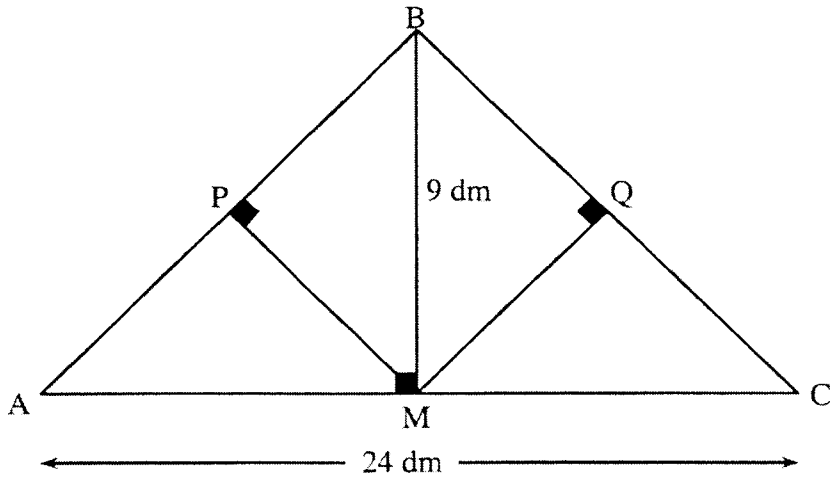


What is the distance, to the nearest metre, between the two signs (m $\overline{PS}$)?

24 The line whose equation is $4x + 3y - 43 = 0$ is tangent to a circle with centre C(3, 2).

What is the equation of this circle?

25 Isaac is building a house for his dog, Newton. His plan, shown below, is measured in decimetres. Triangle ABC is isosceles and angles APM, BMA and BQM each measures 90°.



What is the measure of each roof support, represented by segments $\overline{PM}$ and $\overline{QM}$?