

**ACADEMIC
EXCELLENCE
PROGRAM**

Methods Mock Test – Set A

Mathematics Methods Units 1 & 2

WACE Topic: Methods Year 11 – all topics

Easy and medium questions. Questions marked ★ are medium.

Section One: Calculator-Free

48 marks — 50 minutes

Question 1

[6 marks: 2, 2, 2]

Points $A(-2, 1)$ and $B(4, 9)$ are given.

- (a) Find the gradient of AB and the equation of line AB .

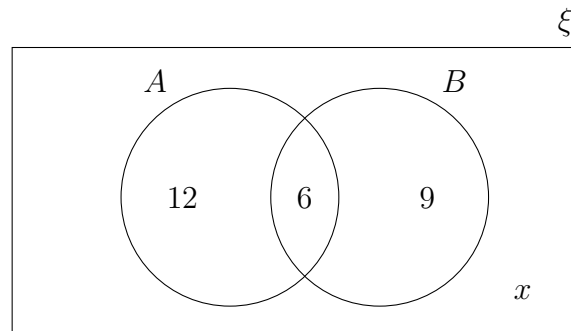
- (b) Find the equation of the line through B that is perpendicular to AB .

- (c) Find the midpoint of AB and the length of AB .

Question 2

[7 marks: 2, 2, 3]

The Venn diagram shows the number of elements in the sets A and B , where ξ contains 40 elements.



- (a) Find $n(A \cup B)$ and the value of x .
- (b) Evaluate $\binom{8}{3}$ and $\binom{10}{8}$ without a calculator.
- (c) A committee of 4 is chosen from 6 men and 5 women. In how many ways can this be done if the committee must contain at least one woman?

Question 3

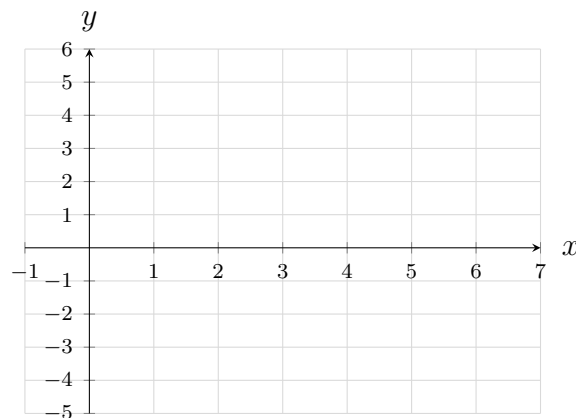
[7 marks: 2, 2, 3]

Consider $f(x) = x^2 - 6x + 5$.

(a) Solve $f(x) = 0$.

(b) Write $f(x)$ in the form $(x - h)^2 + k$ and state the turning point.

(c) Sketch $y = f(x)$ on the axes below, showing all intercepts and the turning point.

**Question 4**

[7 marks: 1, 1, 1, 4]

(a) Differentiate $5x^3 - 7x + 2$ with respect to x .

(b) Differentiate $\frac{2}{x^2}$ with respect to x .

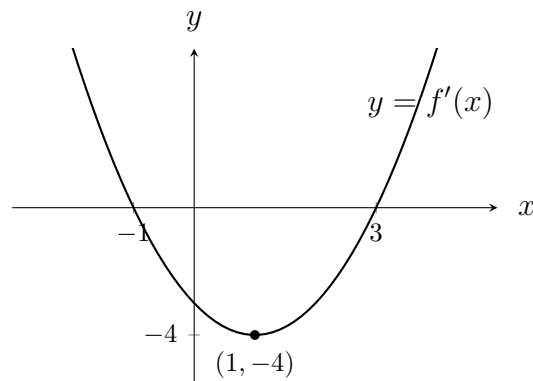
(c) Differentiate $(2x + 1)^3$ with respect to x .

(d) Find the equation of the tangent to the curve $y = x^2 - \frac{4}{x}$ at the point where $x = 2$.

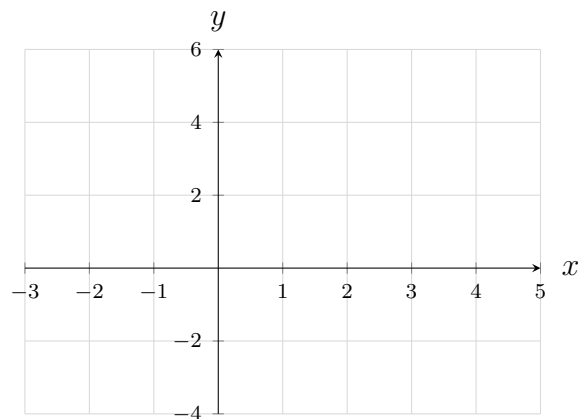
Question 5 ★

[6 marks: 1, 1, 2, 2]

The graph of $y = f'(x)$, the *derivative* of a function f , is shown below.



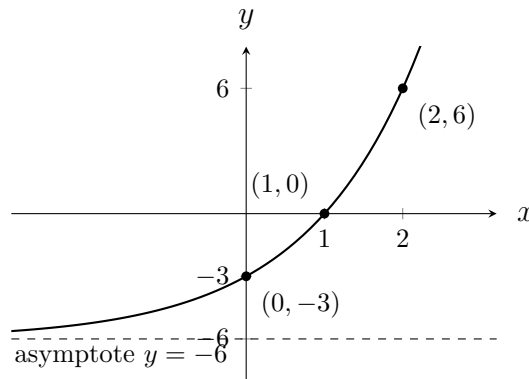
- (a) State the x -coordinates of the stationary points of f .
- (b) For what values of x is f increasing?
- (c) Determine the nature of each stationary point of f , giving a reason.
- (d) Sketch a possible graph of $y = f(x)$ on the axes below.



Question 6

[7 marks: 4, 3]

- (a) The graph of $y = ka^x + b$ is shown. Determine the values of a , b and k .



- (b) Solve $4^x = 8 \cdot 2^x$.

Question 7 ★

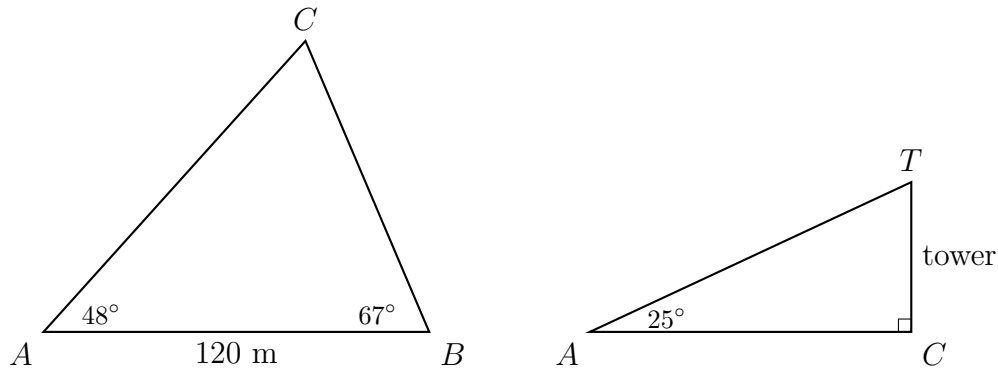
[8 marks: 2, 3, 3]

- (a) Write down the exact values of $\cos 210^\circ$ and $\sin \frac{5\pi}{3}$.
- (b) Solve $2 \sin^2 x - \sin x - 1 = 0$ for $0 \leq x \leq 2\pi$.
- (c) Given $\sin A = \frac{5}{13}$ where A is obtuse, find the exact values of $\cos A$ and $\tan A$, and hence the exact value of $\sin \left(A + \frac{\pi}{3} \right)$.

End of Section One

Section Two: Calculator-Assumed**77 marks — 85 minutes****Question 8***[8 marks: 1, 2, 2, 3]*

A surveyor stands at A and B , which are 120 m apart on level ground, and measures angles to the base C of a vertical tower. $\angle CAB = 48^\circ$ and $\angle ABC = 67^\circ$.

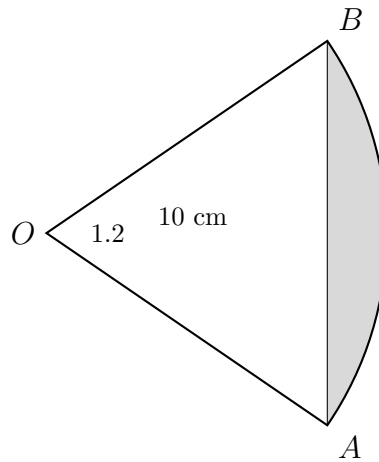


- (a) Find $\angle ACB$.
- (b) Find the distance AC , to the nearest 0.1 m.
- (c) The angle of elevation of the top T of the tower from A is 25° . Find the height of the tower, to the nearest metre.
- (d) Find the area of triangle ABC , to the nearest square metre.

Question 9

[8 marks: 2, 3, 2, 1]

The diagram shows a sector OAB of a circle with centre O and radius 10 cm. $\angle AOB = 1.2$ radians.

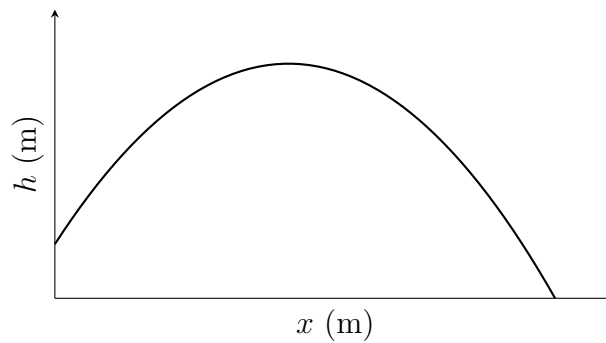


- (a) Find the arc length AB and the area of sector OAB .
- (b) Find the area of the shaded segment cut off by chord AB .
- (c) A different sector has angle 1.5 radians and perimeter 28 cm. Find its radius.
- (d) Find the area of the sector in part (c).

Question 10

[8 marks: 2, 2, 2, 2]

A ball is thrown from a point above the ground. Its height h metres at a horizontal distance x metres is modelled by $h = -0.05x^2 + x + 1.5$.

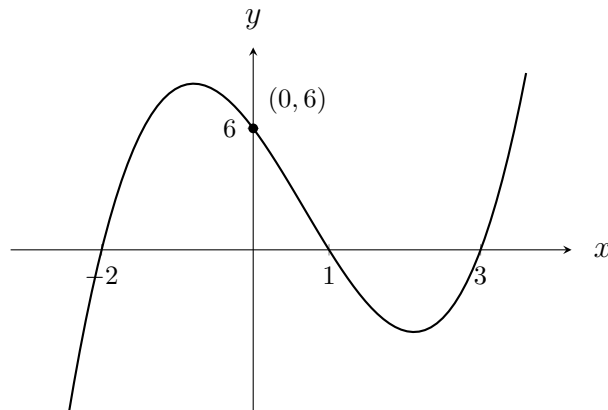


- (a) From what height was the ball thrown?
- (b) Find the maximum height reached and the horizontal distance at which it occurs.
- (c) Find how far the ball travels horizontally before landing, to the nearest 0.1 m.
- (d) For what horizontal distances is the ball at least 5 m above the ground?

Question 11 ★

[7 marks: 2, 2, 1, 2]

The graph of a cubic function is shown. It crosses the axes at the labelled points.

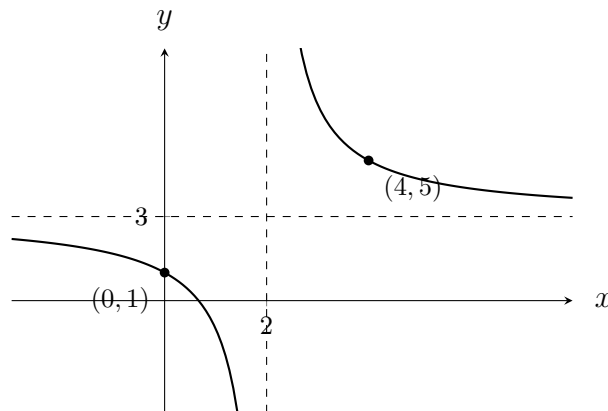


- (a) Determine the equation of the cubic.
- (b) Use calculus to find the coordinates of the turning points, to 2 decimal places.
- (c) Solve $f(x) < 0$.

Question 12

[6 marks: 1, 2, 1, 2]

The graph of a rectangular hyperbola passes through $(0, 1)$ and $(4, 5)$ and has the asymptotes shown dashed.



- (a) Write down the equations of the asymptotes.
- (b) Hence find the equation of the hyperbola in the form $y = a + \frac{k}{x - h}$.
- (c) Find the x -intercept.
- (d) The time T hours to complete a job is inversely proportional to the number n of workers. 6 workers take 10 hours. What is the least number of workers needed to finish in at most 4 hours?

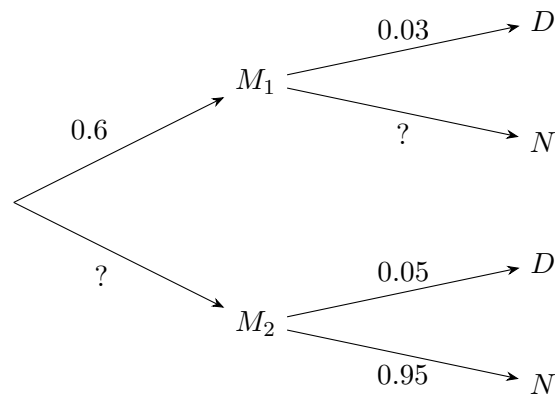
Question 13*[8 marks: 2, 3, 3]*

- (a) State the domain and range of $f(x) = \sqrt{9 - x^2}$.
- (b) Describe a sequence of transformations that maps $y = x^2$ onto $y = -2(x - 3)^2 + 1$.
- (c) A circle has equation $(x - 2)^2 + (y + 1)^2 = 25$.
- (i) State its centre and radius.
 - (ii) Show that the point $(5, 3)$ lies on the circle.
 - (iii) Find the exact x -intercepts of the circle.

Question 14

[8 marks: 1, 2, 3, 2]

Machine M_1 makes 60% of a factory's items and machine M_2 the rest. 3% of items from M_1 are defective and 5% of items from M_2 are defective.



- (a) Complete the two missing probabilities on the tree diagram. (D = defective, N = not defective)
- (b) Find the probability that a randomly chosen item is defective.
- (c) Given that an item is defective, find the probability it came from M_1 .
- (d) Two items are chosen at random. Find the probability that neither is defective (assume independence).

Question 15 ★

[9 marks: 4, 5]

- (a) A farmer has 80 m of fencing to make a rectangular pen against a straight wall (so only three sides need fencing). If the sides perpendicular to the wall have length x m, show that the area is $A = x(80 - 2x)$ and use calculus to find the maximum area.
- (b) A particle moves in a straight line with displacement $s = t^3 - 6t^2 + 9t$ metres from the origin after t seconds, for $0 \leq t \leq 4$. Find when the particle is momentarily at rest, and the total distance travelled in the 4 seconds.

Question 16

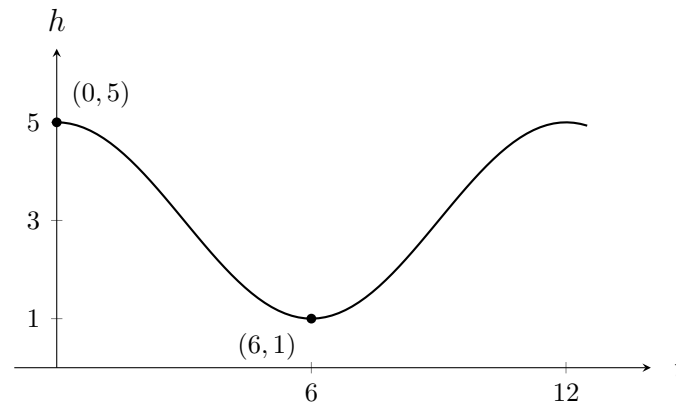
[7 marks: 3, 3, 1]

- (a) Find the constant term in the expansion of $\left(x - \frac{2}{x}\right)^6$.
- (b) A group has 7 boys and 5 girls. How many teams of 5 can be chosen that include at least 2 girls?
- (c) If a team of 5 is chosen at random from this group, find the probability that it has no girls.

Question 17

[8 marks: 3, 2, 3]

The depth h metres of water at a pier t hours after midnight is shown below.



- (a) State the amplitude and period and write down an equation of the form $h = a \cos(bt) + d$.
- (b) At what times in $0 \leq t \leq 12$ is the depth 4 m?
- (c) Use $\sin(A + B)$ to show that $\sin 2x = 2 \sin x \cos x$, and hence solve $\sin 2x = \cos x$ for $0 \leq x \leq 2\pi$.

End of Questions