

- 1 (a) Sets \mathcal{E} , A and B are such that

$$n(\mathcal{E}) = 26, n(A \cap B') = 7, n(A \cap B) = 3 \text{ and } n(B) = 15.$$

Using a Venn diagram, or otherwise, find

(i) $n(A)$, [1]

(ii) $n(A \cup B)$, [1]

(iii) $n(A \cup B)'$. [1]

- (b) It is given that $\mathcal{E} = \{x : 0 < x < 30\}$, $P = \{\text{multiples of } 5\}$, $Q = \{\text{multiples of } 6\}$ and $R = \{\text{multiples of } 2\}$. Use set notation to complete the following statements.

(i) $Q \dots\dots\dots R$, [1]

(ii) $P \cap Q = \dots\dots\dots$ [1]

②

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- 2 Given that $\frac{p^{\frac{1}{3}}q^{-\frac{1}{2}}r^{\frac{3}{2}}}{p^{-\frac{2}{3}}\sqrt{(qr)^5}} = p^a q^b r^c$, find the value of each of the integers a , b and c . [3]

- 3 By using the substitution $y = \log_3 x$, or otherwise, find the values of x for which

$$3(\log_3 x)^2 + \log_3 x^5 - \log_3 9 = 0. \quad [6]$$

4 (i) Find the first 3 terms in the expansion of $\left(2x^2 - \frac{1}{3x}\right)^5$, in descending powers of x . [3]

(ii) Hence find the coefficient of x^7 in the expansion of $\left(3 + \frac{1}{x^3}\right)\left(2x^2 - \frac{1}{3x}\right)^5$. [2]

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- 5 (i) Find the equation of the normal to the curve $y = \frac{1}{2} \ln(3x + 2)$ at the point P where $x = -\frac{1}{3}$. [4]

The normal to the curve at the point P intersects the y -axis at the point Q . The curve $y = \frac{1}{2} \ln(3x + 2)$ intersects the y -axis at the point R .

- (ii) Find the area of the triangle PQR . [3]

- 6 (a) Matrices X , Y and Z are such that

$$X = \begin{pmatrix} 2 & 3 \\ 4 & -1 \\ 6 & 5 \end{pmatrix}, Y = (1 \quad -1 \quad 0) \quad \text{and} \quad Z = \begin{pmatrix} 0 & -1 \\ 5 & 3 \end{pmatrix}.$$

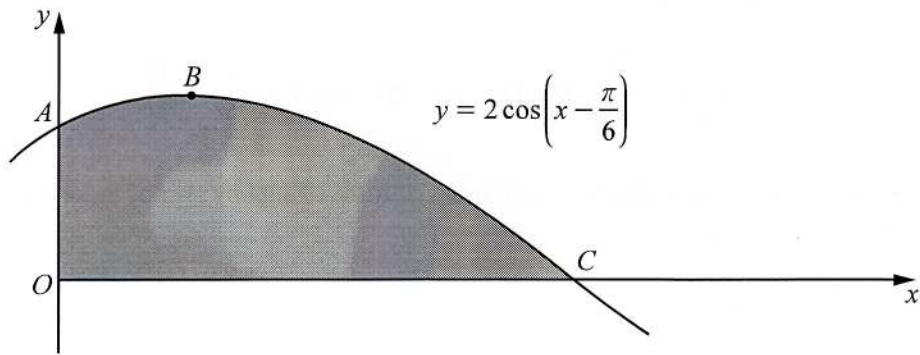
Write down all the matrix products which are possible using any two of these matrices. Do not evaluate these products. [2]

- (b) Matrices A , B and C are such that $A = \begin{pmatrix} 2 & -1 \\ 4 & 7 \end{pmatrix}$, $B = \begin{pmatrix} -4 & 2 \\ 10 & 4 \end{pmatrix}$ and $AC = B$.

(i) Find A^{-1} . [2]

(ii) Hence find C . [3]

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The diagram shows part of the graph of $y = 2 \cos\left(x - \frac{\pi}{6}\right)$. The graph intersects the y-axis at the point A , has a maximum point at B and intersects the x-axis at the point C .

(i) Find the coordinates of A . [1]

(ii) Find the coordinates of B . [2]

(iii) Find the coordinates of C.

[2]

(iv) Find $\int 2 \cos\left(x - \frac{\pi}{6}\right) dx$.

[1]

(v) Hence find the area of the shaded region.

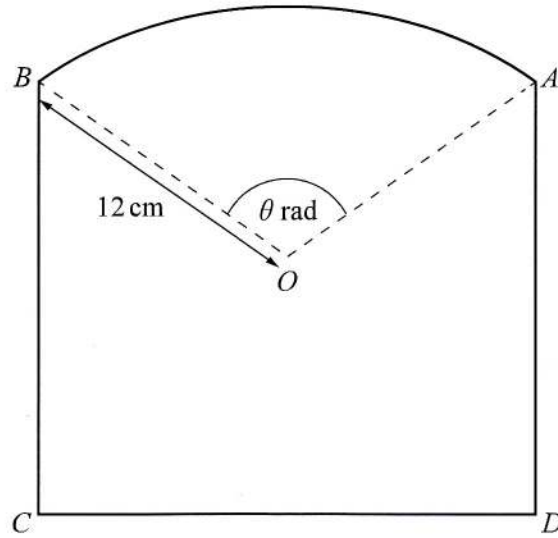
[2]

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The diagram shows a sector AOB of the circle, centre O , radius 12 cm , together with points C and D such that $ABCD$ is a rectangle. The angle AOB is θ radians and the perimeter of the sector AOB is 47 cm .

(i) Show that $\theta = 1.92$ radians correct to 2 decimal places. [2]

(ii) Find the length of CD . [2]

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(iii) Given that the total area of the shape is 425 cm^2 , find the length of AD .

[5]

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9 Do not use a calculator in this question.

The polynomial $p(x)$ is $ax^3 - 4x^2 + bx + 18$. It is given that $p(x)$ and $p'(x)$ are both divisible by $2x - 3$.

(i) Show that $a = 4$ and find the value of b .

[4]

(ii) Using the values of a and b from part (i), factorise $p(x)$ completely.

[2]

(iii) Hence find the values of x for which $p(x) = x + 2$.

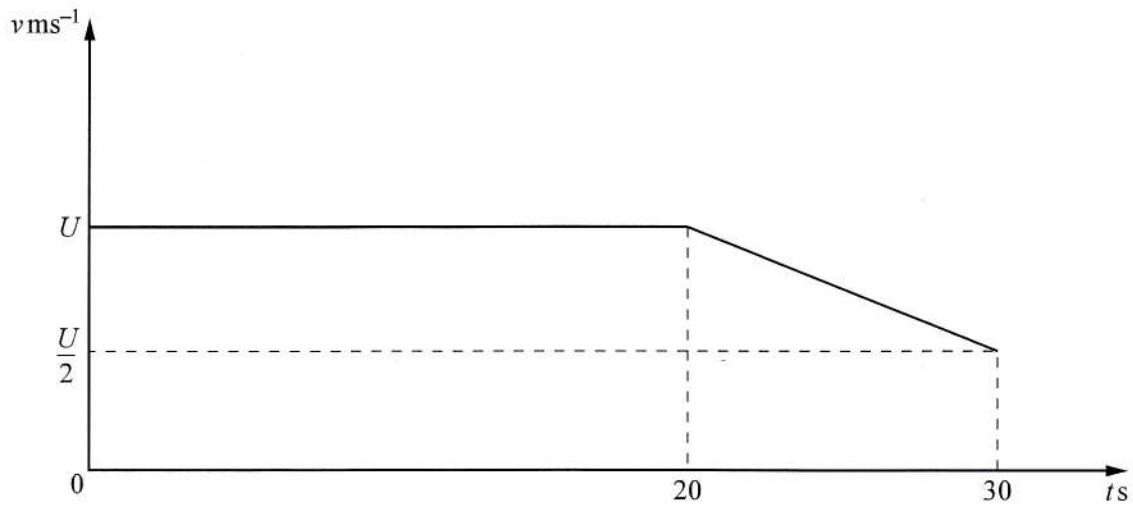
[3]

(12)

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10 (a)



The diagram shows part of the velocity-time graph for a particle, moving at $v \text{ ms}^{-1}$ in a straight line, $t \text{ s}$ after passing through a fixed point. The particle travels at $U \text{ ms}^{-1}$ for 20 s and then decelerates uniformly for 10 s to a velocity of $\frac{U}{2} \text{ ms}^{-1}$. In this 30 s interval, the particle travels 165 m.

(i) Find the value of U .

[3]

(ii) Find the acceleration of the particle between $t = 20$ and $t = 30$.

[2]

(b) A particle P travels in a straight line such that, t s after passing through a fixed point O , its velocity, $v \text{ ms}^{-1}$, is given by $v = \left(e^{\frac{t^2}{8}} - 4 \right)^3$.

(i) Find the speed of P at O .

[1]

(ii) Find the value of t for which P is instantaneously at rest.

[2]

(iii) Find the acceleration of P when $t = 1$.

[4]

Question 11 is printed on the next page.

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11 The variables x and y are such that when $\ln y$ is plotted against x , a straight line graph is obtained. This line passes through the points $x = 4, \ln y = 0.20$ and $x = 12, \ln y = 0.08$.

(i) Given that $y = Ab^x$, find the value of A and of b . [5]

(ii) Find the value of y when $x = 6$. [2]

(iii) Find the value of x when $y = 1.1$. [2]

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