**1** **(a)** Sets $\mathscr{E}$, $A$ and $B$ are such that

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

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 $\mathscr{E} = \{x : 0 < x < 30\}$, $P = \{\text{multiples of } 5\}$, $Q = \{\text{multiples of } 6\}$ and $R = \{\text{multiples of } 2\}$. Use set notation to complete the following statements.

**(i)** $Q$ ..... $R$, [1]

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

**2** Given that $\dfrac{p^{\frac{1}{3}}q^{-\frac{1}{2}}r^{\frac{3}{2}}}{p^{-\frac{2}{3}}\sqrt{(qr)^5}} = p^a q^b r^c$, 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

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

(3)

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]

**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

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

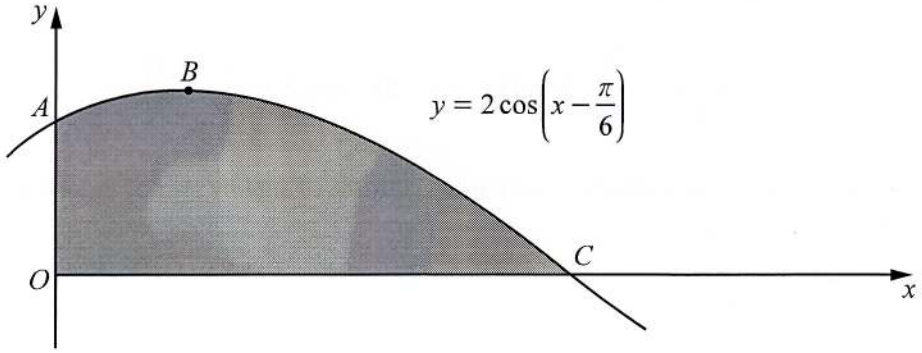
Write down all the matrix products which are possible using any two of these matrices. Do not evaluate these products. [2]

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

**(i)** Find $\mathbf{A}^{-1}$. [2]

**(ii)** Hence find **C**. [3]

7




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]

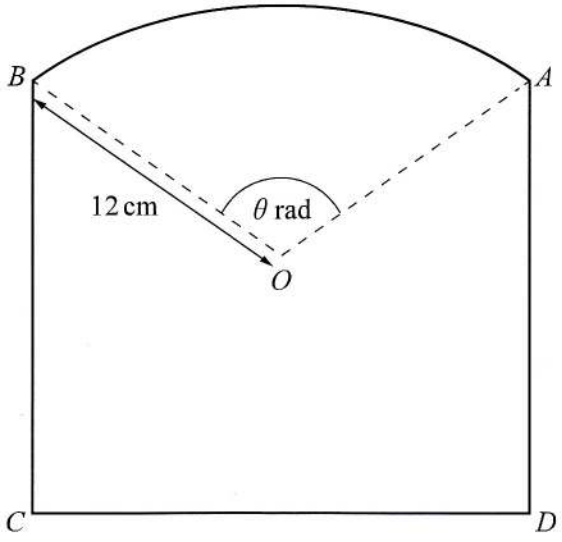
**(ii)** Find the coordinates of $B$. [2]

**(iii)** Find the coordinates of $C$. [2]

**(iv)** Find $\int 2\cos\left(x-\frac{\pi}{6}\right)\mathrm{d}x$. [1]

**(v)** Hence find the area of the shaded region. [2]

**8**




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 $\theta$ 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]

**(iii)** Given that the total area of the shape is 425 $cm^2$, find the length of $AD$. [5]

**9 Do not use a calculator in this question.**

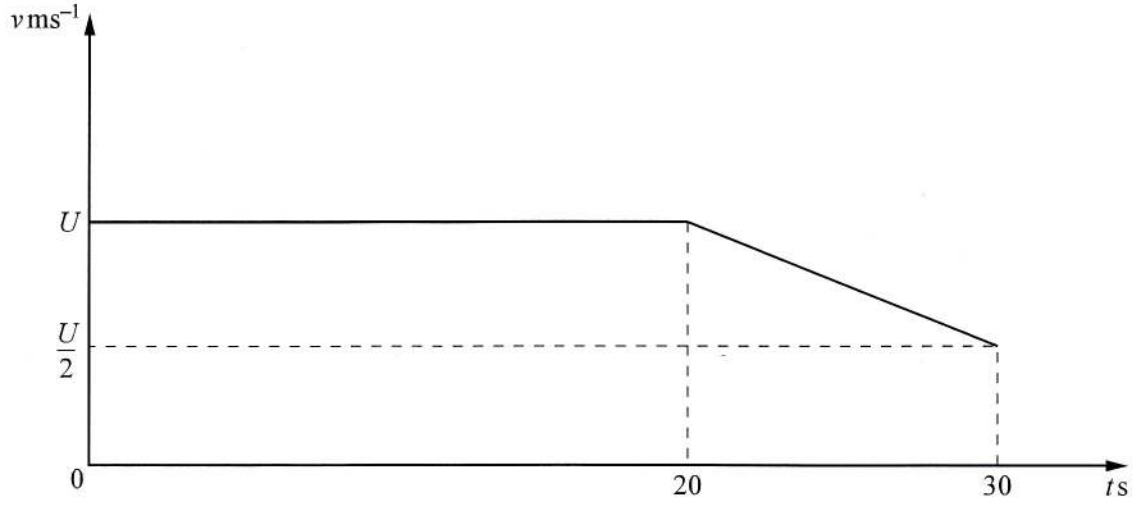
The polynomial $p(x)$ is $ax^3 - 4x^2 + bx + 18$. It is given that $p(x)$ and $p'(x)$ are both divisible by $2x - 3$.

**(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]

**10 (a)**




The diagram shows part of the velocity-time graph for a particle, moving at $v\,\text{ms}^{-1}$ in a straight line, $t$ 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, $v$ 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.**

**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]