Q1 Find the distance between the points of intersection of the curve $y = 3 + \dfrac{4}{x}$ and the line $y = 4x + 9$. [6]

Q2. The functions f and g are defined for real values of x by

$$f(x) = \sqrt{x - 1} - 3 \qquad \text{for } x > 1,$$

$$g(x) = \frac{x - 2}{2x - 3} \qquad \text{for } x > 2.$$

(i) Find gf(37). [2]

(ii) Find an expression for $f^{-1}(x)$. [2]

(iii) Find an expression for $g^{-1}(x)$. [2]

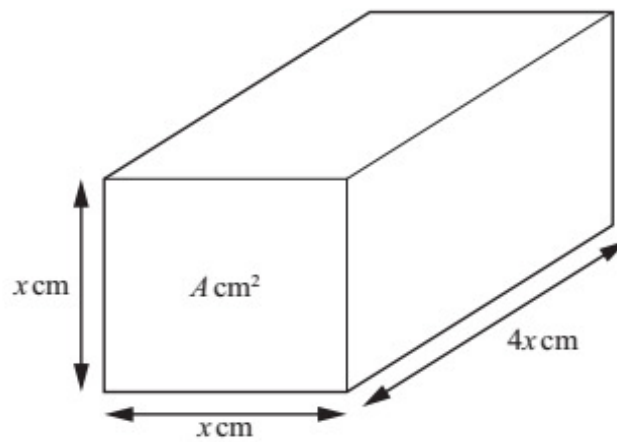**Q3 (i)** Prove that $\sec x \operatorname{cosec} x - \cot x = \tan x.$ [4]

(ii) Use the result from part **(i)** to solve the equation $\sec x \operatorname{cosec} x = 3 \cot x$ for $0° < x < 360°$. [4]

Q4 A function f is such that $f(x) = ax^3 + bx^2 + 3x + 4$. When $f(x)$ is divided by $x - 1$, the remainder is 3. When $f(x)$ is divided by $2x + 1$, the remainder is 6. Find the value of a and of b. [5]

Q5 (i) Solve the equation $2t = 9 + \dfrac{5}{t}$. [3]

(ii) Hence, or otherwise, solve the equation $2x^{\frac{1}{2}} = 9 + 5x^{-\frac{1}{2}}$. [3]

Q6

The figure shows a rectangular metal block of length $4x$ cm, with a cross-section which is a square of side x cm and area A cm^2. The block is heated and the area of the cross-section increases at a constant rate of 0.003 cm^{2}s^{-1}. Find

(i) $\dfrac{\mathrm{d}A}{\mathrm{d}x}$ in terms of x, [1]

(ii) the rate of increase of x when $x = 5$, [3]

(iii) the rate of increase of the volume of the block when $x = 5$. [4]

Q7 Differentiate, with respect to x,

   (i) $(1 - 2x)^{20}$,   [2]

   (ii) $x^2 \ln x$,   [3]

   (iii) $\dfrac{\tan(2x + 1)}{x}$.   [3]

Q8 The diagram shows a semicircle, centre O, of radius 8 cm. The radius OC makes an angle of 1.2 radians with the radius OB. The arc CD of a circle has centre A and the point D lies on OB. Find the area of

   (i)   sector COB,   [2]

   (ii)   sector CAD,   [5]
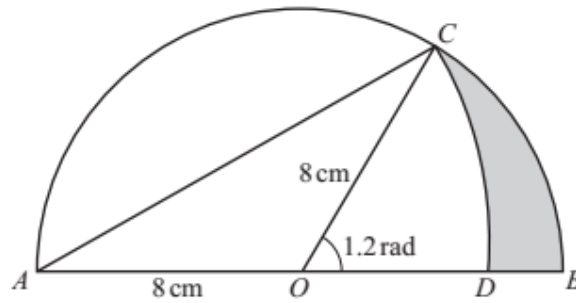
   (iii)   the shaded region.   [3]

Q9 The line $2y = 3x - 6$ intersects the curve $xy = 12$ at the points P and Q. Find the equation of the perpendicular bisector of PQ. [8]

Q10 **(i)** Find the first 4 terms in the expansion of $(2+x^2)^6$ in ascending powers of x. **[4]**

(ii) Find the term independent of x in the expansion of $(2+x^2)^6\left(1-\dfrac{3}{x^2}\right)^2$. [3]

Q11 The table shows experimental values of two variables x and y.

x	1	2	3	4	5
y	3.40	2.92	2.93	3.10	3.34

It is known that x and y are related by the equation $y = \dfrac{a}{\sqrt{x}} + bx$, where a and b are constants.

(i) Complete the following table.

$x\sqrt{x}$					
$y\sqrt{x}$					

[1]

(ii) On the grid on page 11 plot $y\sqrt{x}$ against $x\sqrt{x}$ and draw a straight line graph. **[3]**

(iii) Use your graph to estimate the value of a and of b. [3]

(iv) Estimate the value of y when x is 1.5. [1]

The graph has axes labeled $y\sqrt{x}$ (vertical) and $x\sqrt{x}$ (horizontal). The vertical axis is marked from 1 to 8 and the horizontal axis is marked 2, 4, 6, 8, 10, 12, with the origin labeled O.