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

$$\left(x-\frac{3}{2x}\right)^6 \qquad r^{th} \text{ term} = {}^6C_{r-1}\,(x)^{6-(r-1)}\left(-\frac{3}{2}x^{-1}\right)^{r-1}$$

$$= {}^6C_{r-1}\, x^{7-r}\left(-\frac{3}{2}\right)^{r-1}\left(x^{1-r}\right) = {}^6C_{r-1}\, x^{8-2r}\left(-\frac{3}{2}\right)^{r-1}$$

independent of x : $8-2r=0 \Rightarrow r=4$

$$\Rightarrow 4^{th} \text{ term} = {}^6C_3\left(-\frac{3}{2}\right)^3(x^0) = 67.5 \ \#$$

2 Solve the equation $3\sin^2\theta = 4\cos\theta - 1$ for $0° \leqslant \theta \leqslant 360°$. [4]

$$3\sin^2\theta = 4\cos\theta - 1 \Rightarrow 3(1-\cos^2\theta) = 4\cos\theta - 1$$

$$\Rightarrow -3\cos^2\theta + 3 = 4\cos\theta - 1 \Rightarrow 3\cos^2\theta + 4\cos\theta - 4 = 0$$

$$\Rightarrow (3\cos\theta - 2)(\cos\theta + 2) = 0 \ \begin{cases} \cos\theta = -2 & \text{rejected} \\ \cos\theta = 2/3 \Rightarrow & \boxed{\theta_1 = 48.2°,\ \theta_2 = 311.8°} \end{cases}$$

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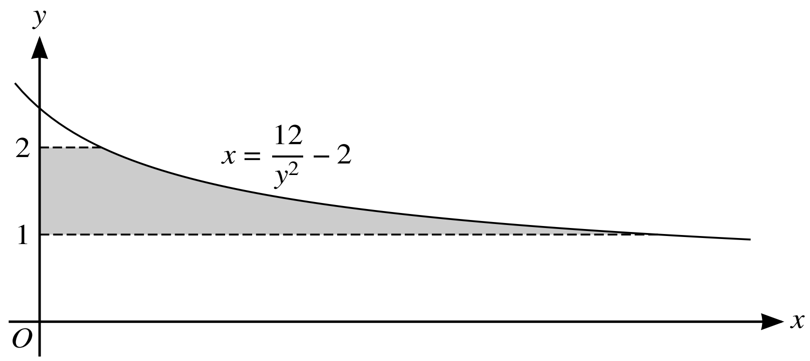
3



The diagram shows part of the curve $x = \frac{12}{y^2} - 2$. The shaded region is bounded by the curve, the y-axis and the lines $y = 1$ and $y = 2$. Showing all necessary working, find the volume, in terms of π, when this shaded region is rotated through 360° about the y-axis. [5]

$$x = \frac{12}{y^2} - 2 \quad \to \quad V = \pi \int_{y=1}^{2} x^2 \, dy = \pi \int_{1}^{2} \left(\frac{12}{y^2} - 2\right)^2 dy$$

$$= \pi \int_{1}^{2} \left(\frac{144}{y^4} - \frac{48}{y^2} + 4\right) dy = \left(\frac{-144}{y^3} + \frac{48}{y} + 4y\right)\Bigg]_{1}^{2} \times \pi$$

$$= \left[\left(\frac{-144}{2^3} + \frac{48}{2} + 4(2)\right) - \left(\frac{-144}{1^3} + \frac{48}{1} + 4(1)\right)\right] \times \pi$$

$$\to \boxed{V = 22\pi} \; /\!/$$

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