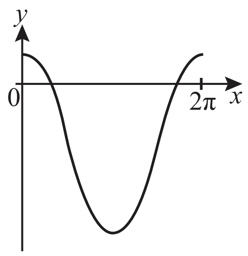
1 **(i)** $\sin x = \sqrt{(1-p^2)}$	B1 [1]	Allow $1 - p$ if following $\sqrt{(1-p^2)}$ ± is B0.
(ii) $\tan x = \dfrac{\sin x}{\cos x} = \dfrac{\sqrt{1-p^2}}{p}$	B1√ [1]	√ for answer to **(i)** used.
(iii) $\tan(90 - x) = \dfrac{p}{\sqrt{1-p^2}}$	B1√ [1]	√ for reciprocal of **(ii)**
2 **(i)** slant length = 10 cm. circumference of base = 12π arc length = 10θ (= 12π) $\rightarrow \theta = 1.2\pi$ or 3.77 radians.	B1 B1 B1√ B1 [4]	 Use of $r\theta$, θ calculated, not 6 or 8.
(ii) $\frac{1}{2}r^2\theta = 188.5$ cm ^{2} or 60π.	M1 A1√ [2]	Use of $\frac{1}{2}r^2\theta$ with radians and r = calculated '10', not 6 or 8.
3 $y = \dfrac{2}{\sqrt{5x-6}}$		
(i) $\dfrac{dy}{dx} = 2 \times -\frac{1}{2} \times (5x-6)^{-\frac{3}{2}} \times 5$ $\rightarrow -\frac{5}{8}$	B1 B1 B1 [3]	B1 without '×5'. B1 For '×5' Use of 'uv' or 'u/v' ok.
(ii) integral = $\dfrac{2\sqrt{5x-6}}{\frac{1}{2}} \div 5$ Uses 2 to 3 → 2.4 − 1.6 = 0.8	B1 B1 M1 A1 [4]	B1 without '÷5'. B1 for '÷ 5' Use of limits in an integral.
4 $\overrightarrow{OA} = \mathbf{i} + 2\mathbf{j}$ and $\overrightarrow{OB} = 4\mathbf{i} + p\mathbf{k}$,		
(i) $\overrightarrow{AB} = \mathbf{b} - \mathbf{a} = 3\mathbf{i} - 2\mathbf{j} + 6\mathbf{k}$ Unit vector = $(3\mathbf{i} - 2\mathbf{j} + 6\mathbf{k}) \div 7$	B1 M1 A1√ [3]	Must be $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$ Divides by modulus. √ on vector AB.
(ii) Scalar product = 4 $= \sqrt{5} \times \sqrt{(16 + p^2)} \times \cos\theta$ $\rightarrow p = \pm 8$	M1 M1 M1 A1 [4]	Use of $x_1x_2 + y_1y_2 + z_1z_2$ For modulus. All linked correctly including correct use of $\cos\theta = 1/5$.
5 A (0, 8) B (4, 0) $8y + x = 33$ m of $AB = -2$ m of $BC = \frac{1}{2}$ Eqn BC $\rightarrow y - 0 = \frac{1}{2}(x - 4)$ Sim eqns → C (16, 6) Vector step method → D (12, 14) (or AD $y = \frac{1}{2}x + 8$, CD $y = -2x + 38$) (or $M = (8, 7) \rightarrow D = (12, 14)$)	 B1 M1 M1 M1 A1 M1 A1 [7]	 Use of $m_1m_2 = -1$ for BC or AD Correct method for equation of BC Sim Eqns for BC, AC. M1 valid method.

6 **(i)** Sim triangles $\frac{y}{16-x}=\frac{12}{16}$ (or trig) $\rightarrow y = 12 - \frac{3}{4}x$ $A = xy = 12x - \frac{3}{4}x^2$.	M1 A1 A1 [3]	Trig, similarity or eqn of line (could also come from eqn of line) ag – check working.
(ii) $\frac{dA}{dx} = 12 - \frac{6x}{4}$ $= 0$ when $x = 8$. $\rightarrow A = 48$. This is a Maximum. From −ve quadratic or 2nd differential.	B1 M1 A1 B1 [4]	 Sets to 0 + solution. Can be deduced without any working. Allow even if '48' incorrect.
7 **(a)** **(i)** $a = 300$, $d = 12$ $\rightarrow 540 = 300 + (n-1)12 \rightarrow n = 21$	M1 A1 [2]	Use of nth term. Ans 20 gets 0. Ignore incorrect units
(ii) $S_{26} = 13\,(600 + 25\times12) = 11700$ $\rightarrow$ 3 hours 15 minutes.	M1 A1 [2]	Correct use of s_n formula.
(b) $ar = 48$ and $ar^2 = 32 \rightarrow r = \frac{2}{3}$ $\rightarrow a = 72$. $S_\infty = 72 \div \frac{1}{3} = 216$.	M1 A1 M1 A1√ [4]	Needs ar and ar^2 + attempt at a and r. Correct S_∞ formula with $\lvert r\rvert < 1$
8 $f : x \mapsto 3\cos x - 2$ for $0 \leqslant x \leqslant 2\pi$.		
(i) $3\cos x - 2 = 0 \rightarrow \cos x = \frac{2}{3}$ $\rightarrow x = 0.841$ or 5.44	M1 A1 A1√ [3]	Makes cos subject, then $\cos^{-1}$ √ for 2π – 1st answer.
(ii) range is $-5 \leqslant f(x) \leqslant 1$	B2,1 [2]	B1 for $\geqslant -5$. B1 for $\leqslant 1$.
(iii) 	B1,B1 [2] B1 [1]	B1 starts and ends at same point. Starts decreasing. One cycle only. B1 for shape, not 'V' or 'U'.
(iv) max value of $k = \pi$ or 180°. **(iv)** $g^{-1}(x) = \cos^{-1}\left(\frac{x+2}{3}\right)$	M1 A1 [2]	Make x the subject, copes with 'cos'. Needs to be in terms of x.

9 $y = \frac{8}{x} + 2x$		
(i) $\frac{dy}{dx} = \frac{-8}{x^2} + 2$	M1 A1	Attempt at differentiation. algebraic – unsimplified.
(− 6 at *A*) $\frac{dy}{dt} = \frac{dy}{dx} \times \frac{dy}{dt}$ $\rightarrow -0.24$	M1 A1 [4]	Ignore notation – needs product of 0.04 and 'his' $\frac{dy}{dx}$.
(ii) $\int y^2 = \int \frac{64}{x^2} + 4x^2 + 32$	M1	Use of integral of y^2 (ignore π)
$= (\frac{-64}{x} + \frac{4x^3}{3} + 32x)$	A3,2,1	3 terms → −1 each error.
Limits 2 to 5 used correctly → 271.2π or 852 (allow 271π or 851 to 852)	DM1 A1 [6]	Uses correct limits correctly. (omission of π loses last mark)
10 $f : x \mapsto 2x^2 - 3x$, $g : x \mapsto 3x + k$,		
(i) $2x^2 - 3x - 9 > 0$ → x =3 or −1½ Set of x $x > 3$, or $x < -1½$	M1 A1 A1 [3]	For solving quadratic. Ignore > or ⩾ condone ⩾ or ⩽
(ii) $2x^2 - 3x = 2(x - \frac{3}{4})^2 - \frac{9}{8}$	B3,2,1	– x^2 in bracket is an error.
Vertex $(\frac{3}{4}, -\frac{9}{8})$	B1√ [4]	√ on '*c*' and '*b*'.
(iii) gf(x) = $6x^2 - 9x + k = 0$	B1	
Use of $b^2 - 4ac \rightarrow k = \frac{27}{8}$ oe.	M1 A1 [3]	Used on a quadratic (even fg).