1. a) $\frac{dC}{dV} = -192V^{-2} + \frac{1}{72}V$ o.e — M1 ATTEMPT DIFFERENTIATION, A2

SOLVES FOR ZERO — M1

$V = 24$ — A1

b) $\left(\frac{d^2C}{dV^2} =\right) 384V^{-3} + \frac{1}{72}$ o.e — B1

SUBSTITUTES "$V=24$", OBTAINS POSITIVE $\left(\frac{1}{24}\right)$ & STATES POSITIVE & CONCLUDES CORRECTLY — A1

c) SUBS "$V=24$" INTO $C = \frac{192}{V} + \frac{V^2}{144}$ OR SHOWS 12 — B1

FINAL ANSWER OF £12 OR 7200 PENCE (MUST HAVE MONETARY UNITS) — A1

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2. $\frac{1}{2}xy\sin 60 = 7\sqrt{3}$ — A1

$(\sqrt{37})^2 = x^2 + y^2 - 2xy\cos 60$ — A1

$xy = 28$ AND $x^2 + y^2 - xy = 37$ — A1

ATTEMPTS SENSIBLE SOLUTION — M1

$x^4 - 65x^2 + 784$ OR $y^4 - 65y^2 + 784$ — MA1

$x^2 =$ 49, 16 OR $y^2 =$ 49, 16 — A2

STATES $x=4, y=7$ ONLY OR $x=4, y=7$ IN EITHER ORDER — A1

3. use of $\tan\psi = \frac{\sin\psi}{\cos\psi}$ B1

$4\sin^2\psi + 4\sin\psi + 1 = 0$ MA1

$(2\sin\psi + 1)^2 = 0$ M1

sight of $-30°$ A1

$210°$, $330°$ c.a.o A1 A1

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4. $\frac{dc}{dt} = -36T^{-2} + \frac{4}{3}T$ M1 attempts differentiation; A1 A1

$\therefore -36T^{-2} + \frac{4}{3}T'' > 0$ M1

$4T^3 > 108$ o.e MA1

$T > 3$ A1

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5. $\binom{7}{5}(4x)^5\left(\frac{1}{kx}\right)^2$ OR $\binom{7}{2}(4x)^5\left(\frac{1}{kx}\right)^2$ OR $\frac{7\times6}{1\times2}(4x)^5\left(\frac{1}{kx}\right)^2$ B3

$\frac{21504}{k^2} = k^2$ MA1

$k = 32$ c.a.o A1

6. a) CENTRE AT (2,0), RADIUS = 4 B3

b) (i) $\cos\theta = \frac{2}{4}$ o.e $\sin\theta = \frac{\sqrt{12}}{4}$ M1

$\theta = \frac{\pi}{3}$ A1 dep

$\pi - \frac{\pi}{3} = \frac{2\pi}{3}$ A1 dep

(ii) $\frac{1}{2} \times 2 \times 4 \times \sin\frac{\pi}{3} = 2\sqrt{3}$ M1 A1

$\frac{1}{2} \times 4^2 \times \frac{2\pi}{3} = \frac{16\pi}{3}$ M1 A1

$2\sqrt{3} + \frac{16}{3}\pi = \frac{2}{3}(8\pi + 3\sqrt{3})$ A1

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7. SIGHT OF $(\log_2 x)^2$ B1

SIGHT OF "7−3" OR $\log_2\left(\frac{128}{8}\right)$ OR $\log_2 16$ M1

$(\log_2 x)^2 = 4$ (DO NOT ACCEPT $\log_2 x^2 = 4$) MA1 dep

$\log_2 x = \pm 2$ A1 (both)

$x = 4$ A1

$x = \frac{1}{4}$ A1

8. a) $\int_k^{2k} \frac{x^2+6}{x^4}\,dx$ M1 INTEGRATION WITH LIMITS CORRECT

$x^{-2} + 6x^{-4}$ B1 B1

$-x^{-1} - 2x^{-3}$ M1 M1

$\left(\frac{1}{k} + \frac{2}{k^3}\right) - \left(\frac{1}{2k} + \frac{2}{8k^3}\right)$ O.E MA1 (Allow 1 error)

$\frac{1}{2k} + \frac{2}{8k^3}$ A1

$\therefore = \frac{9}{4}$ B1 THIS MAY APPEAR IN ANY OF THE PREVIOUS LINES

MULTIPLIES CONVINCINGLY BY $4k^3$ OR BY 4 FOLLOWED BY k^3 AND OBTAINS THE ANSWER GIVEN $9k^3 - 2k^2 - 7 = 0$ MA1

b) $(k-1)(k^2 + bk + c)$ M1

$(k-1)(9k^2 + 7k + 7)$ MA1

$"7"^2 - 4 \times 9 \times 7"$ M1 A1

OBTAINS NEGATIVE (-203) & CONCLUDES CORRECTLY A1

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9. a) SIGHT OF 1.06 B1

$1250 + 1250 \times 1.06 + 1250 \times 1.06^2$ OR 2575×1.06 OR 2729.5 M1

OBTAINS CORRECTLY £3979.50 A1

b) $1250 + 1250 \times 1.06 + 1250 \times 1.06^2 + \ldots + 1250 \times 1.06^{40}$ M1 STRUCTURE

(OR 1250 FACTORIZED OR MISSING M1 "40"

$\frac{1250\left(1.06^{40} - 1\right)}{1.06 - 1}$ M1 STRUCTURE

A1 ALL CORRECT

193452.457... A1

(ACCEPT ANY SENSIBLE CORRECT ANSWER)

10. SINE WAVE INTERSECTING y AXIS IN $y>0$ B1

2 INTERCEPTS AT 15° & 105° B1

MIN AT $(60, -1)$ MAX AT $(150, 1)$ B1