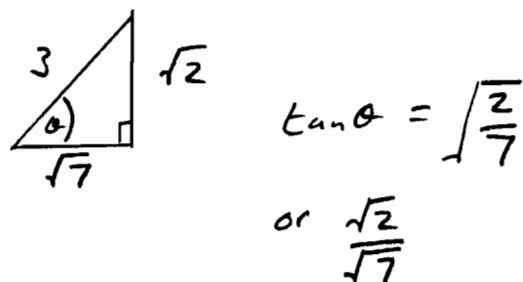


$$\begin{aligned}
 1) \quad & \int \left( x - \frac{3}{x^2} \right) dx \\
 & = \int \left( x - 3x^{-2} \right) dx \\
 & = \frac{x^2}{2} - \frac{3x^{-1}}{-1} + c \\
 & = \frac{x^2}{2} + \frac{3}{x} + c
 \end{aligned}$$



$$2) \quad \underbrace{1 \ 3 \ 5 \ 3} \ \underbrace{1 \ 3 \ 5 \ 3} \ 13 \dots$$

i) Periodic with period 4

$13 \times 4$  gives 52 terms

$55^{\text{th}}$  will be third in next

block of four

$$\underline{55^{\text{th}} \text{ term} = 5}$$

$$\text{ii) } 1 + 3 + 5 + 3 = 12$$

$$13 \times 12 = 156$$

(since 13 complete periods)

$$\text{Then } 1 + 3 + 5 = 9$$

Sum of first 55 terms

$$= 156 + 9 = 165$$

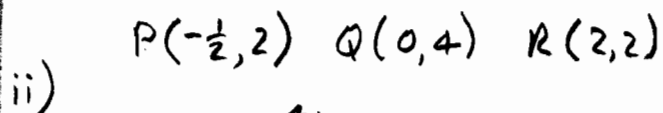
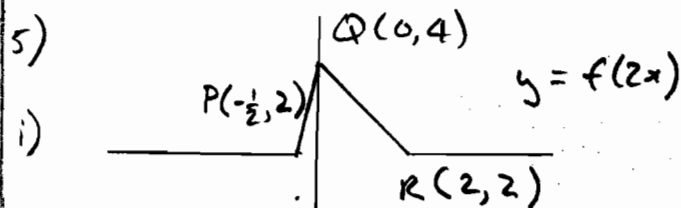
$$3) \quad \sin \theta = \frac{\sqrt{2}}{3}$$

$$4) \quad \text{Sector Area} = \frac{1}{2} r^2 \theta$$

$$8.45 = \frac{1}{2} r^2 \times 0.4$$

$$\frac{2 \times 8.45}{0.4} = r^2$$

$$\Rightarrow r = 6.5 \text{ cm}$$



$$P(-1, \frac{1}{2}) \quad Q(0, 1) \quad R(4, \frac{1}{2})$$

$$6) \text{ i) } u_1 = 5$$

$$u_{n+1} = u_n + 4$$

$$\text{AP } a = 5, d = 4$$

$$\begin{aligned}
 \text{51st term} &= a + 50d \\
 &= 5 + 50 \times 4 = 205
 \end{aligned}$$

6ii)

$$GP \quad a = 5 \quad r = \frac{2}{5}$$

$$S_{\infty} = \frac{a}{1-r}$$

$$\begin{aligned} S_{\infty} &= \frac{5}{1-\frac{2}{5}} \\ &= \frac{5}{\frac{3}{5}} \\ &= \frac{25}{3} = 8\frac{1}{3} \end{aligned}$$

7)  
i)Find  $\angle BAD$ 

Sine rule

$$\frac{5.6}{\sin A} = \frac{8.4}{\sin 79^\circ}$$

$$5.6 \sin 79^\circ = 8.4 \sin A$$

$$\sin A = \frac{5.6 \sin 79^\circ}{8.4}$$

$$A = \sin^{-1} \left( \frac{5.6 \sin 79^\circ}{8.4} \right)$$

$$\angle BAD = 40.9^\circ$$

7ii)

$$\angle BDC = 180 - 79 = 101^\circ$$

Cosine rule

$$BC^2 = 5.6^2 + 7.8^2 - 2 \times 5.6 \times 7.8 \cos 101^\circ$$

$$BC = 10.4 \text{ cm}$$

8)

$$y = 6\sqrt{x}$$

$$y = 6x^{\frac{1}{2}}$$

$$\frac{dy}{dx} = 3x^{-\frac{1}{2}} = \frac{3}{\sqrt{x}}$$

$$\text{When } x = 16 \quad \frac{dy}{dx} = \frac{3}{\sqrt{16}} = \frac{3}{4}$$

$$\text{When } x = 16 \quad y = 6\sqrt{16} = 24$$

Require line through  $(16, 24)$   
with gradient  $\frac{3}{4}$

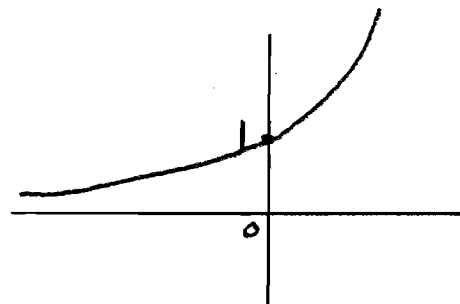
$$y - y_1 = m(x - x_1)$$

$$y - 24 = \frac{3}{4}(x - 16)$$

$$y - 24 = \frac{3}{4}x - 12$$

$$y = \frac{3}{4}x + 12$$

9) i)



$$\text{ii) } 3^{2x+1} = 10$$

$$\log_{10} 3^{2x+1} = \log_{10} 10 = 1$$

$$(2x+1)\log_{10} 3 = 1$$

$$2x+1 = \frac{1}{\log_{10} 3} = 2.0959$$

$$2x = 1.0959 \Rightarrow x = 0.55 \text{ to 2dp.}$$

$$10) \quad \frac{d}{dx} (x^3 - 3x^2 - 9x)$$

$$i) \quad = 3x^2 - 6x - 9$$

$$\text{At st. pt } \frac{dy}{dx} = 0$$

$$\Rightarrow 3x^2 - 6x - 9 = 0$$

$$\Rightarrow x^2 - 2x - 3 = 0$$

$$\Rightarrow (x-3)(x+1) = 0$$

$$\Rightarrow x = 3 \text{ or } x = -1$$

$$\text{When } x = 3, y = 3^3 - 3(3)^2 - 9(3)$$

$$= -27$$

$$\text{When } x = -1, y = (-1)^3 - 3(-1)^2 - 9(-1)$$

$$= 5$$

$$\frac{d^2y}{dx^2} = 6x - 6$$

$$\text{When } x = 3, \frac{d^2y}{dx^2} = 18 - 6 = 12$$

$$\frac{d^2y}{dx^2} > 0 \therefore \text{a min}$$

$$\text{When } x = -1, \frac{d^2y}{dx^2} = -6 - 6 = -12$$

$$\frac{d^2y}{dx^2} < 0 \therefore \text{a max}$$

$$\text{Max at } (-1, 5)$$

$$\text{Min at } (3, -27)$$

(Note: y coords were not reqd.)

$$10ii) \quad x^3 - 3x^2 - 9x = 0$$

$$\Rightarrow x(x^2 - 3x - 9) = 0$$

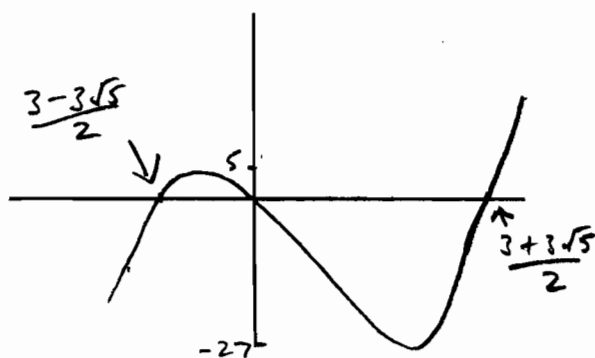
$$\text{Either } x = 0 \text{ or } x^2 - 3x - 9 = 0$$

$$x = \frac{3 \pm \sqrt{9 + 36}}{2}$$

$$x = \frac{3 \pm \sqrt{45}}{2} = \frac{3 \pm 3\sqrt{5}}{2}$$

(crosses x-axis at

$$(0, 0) \left( \frac{3+3\sqrt{5}}{2}, 0 \right) \left( \frac{3-3\sqrt{5}}{2}, 0 \right)$$



11 i)

$$A \approx \frac{1.5}{2} \left[ 2.3 + 2(2.7 + 3.3 + 4 + 4.8 + 5.2 + 5.2 + 4.4) + 2 \right]$$

$$A \approx 47.625 \text{ units}^2$$

11 ii)

$$1.5 \left[ 2.3 + 2.7 + 3.3 + 4.0 + 4.8 + 5.2 + 4.4 + 2.0 \right]$$

$$\text{Lower bound} = 43.05$$

$$11 \text{ iii) } y = -0.013x^3 + 0.16x^2 - 0.082x + 2.4$$

$$A = \int_0^{12} y \, dx$$

$$= \left[ -\frac{0.013x^4}{4} + \frac{0.16x^3}{3} - \frac{0.082x^2}{2} + 2.4x \right]_0^{12}$$

$$= 47.664$$

$$11 \text{ iv) } \text{When } x = 7.5 \text{ m}$$

$$y = 5.3 \text{ m}$$

This is 0.1 m higher than measured value. Approx 2% higher so quite a good fit.

12 i)

$$P = a \times 10^{bt}$$

$$\Rightarrow \log_{10} P = \log_{10} (a \times 10^{bt})$$

$$\Rightarrow \log_{10} P = \log_{10} a + \log_{10} 10^{bt}$$

$$\Rightarrow \log_{10} P = \log_{10} a + bt \log_{10} 10$$

$$\Rightarrow \log_{10} P = \log_{10} a + bt$$

$$y = c + mx$$

compares with straight line

$\log_{10} a$  is vertical intercept

$b$  is gradient

12 ii) See insert

12 iii)

Points on line of best fit

$$(60, 2.69) \quad (0, 1.99)$$

$$b = \frac{2.69 - 1.99}{60 - 0} = \frac{0.70}{60}$$

$$b = 0.01167$$

From graph intercept

$$\log_{10} a = 1.99$$

$$\Rightarrow a = 97.72$$

$$\therefore P = 97.72 \times 10^{0.01167t}$$

12 iv) In 2050  $t = 105$ 

$$P = 97.72 \times 10^{0.01167 \times 105}$$

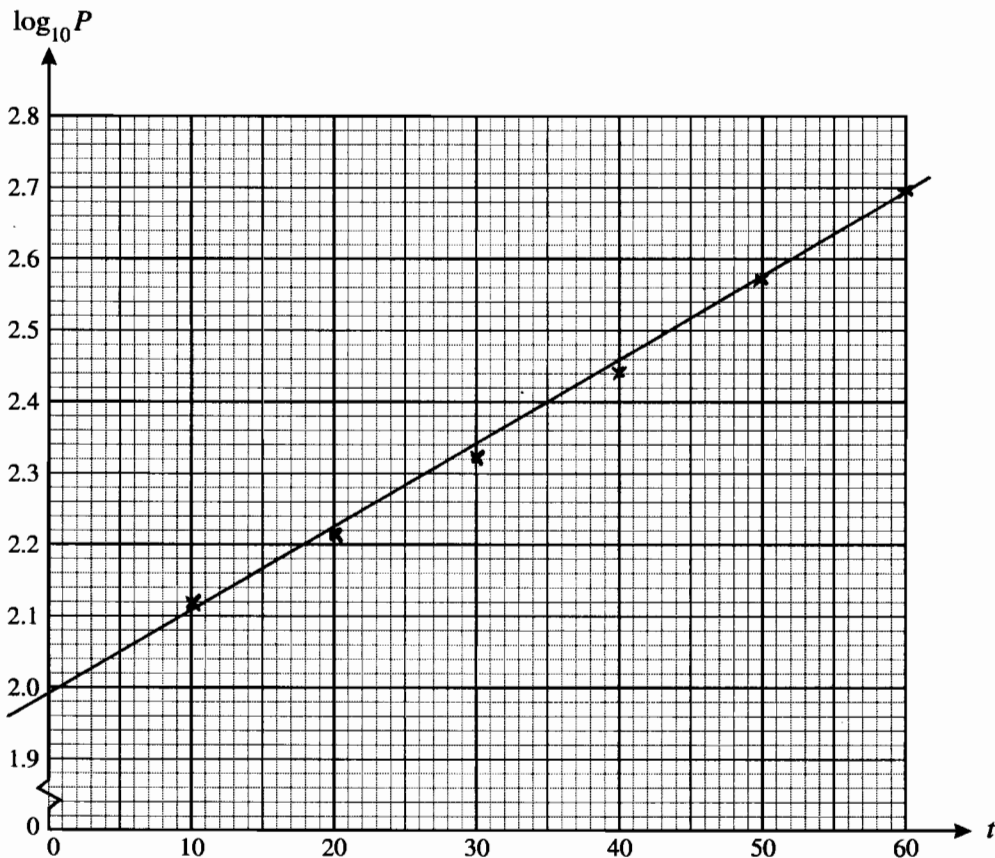
$$P = 1641.85$$

Population 1642 million

Estimate is unreliable when extrapolating well outside the data set.

12 (ii)

Year	1955	1965	1975	1985	1995	2005
$t$	10	20	30	40	50	60
$P$	131	161	209	277	372	492
$\log_{10} P$	2.12	2.21	2.32	2.44	2.57	2.69



**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations, is given to all schools that receive assessment material and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.