Mathematics Higher Units 1, 2 and 3 Paper 1 (Non-calculator) Winter 2002

1. (*a*) $y + x = 4$

(*b*) $135°$

2. (*a*) • $u + 3v = \begin{pmatrix} 4 \\ 1 \\ 1 \end{pmatrix}$

• $u - 3v = \begin{pmatrix} -2 \\ 13 \\ -5 \end{pmatrix}$

(*b*) proof

• $\begin{pmatrix} 4 \\ 1 \\ 1 \end{pmatrix} \bullet \begin{pmatrix} -2 \\ 13 \\ 5 \end{pmatrix}$

$= -8 + 13 - 5 = 0$

Alternative

• $(u + 3v).(u - 3v)$

$= |u|^2 - 9|v|^2$

$= 54 - 9 \times 6 = 0$

3. $y + 3x = 6$

4. (*a*) $\frac{\sqrt{3}}{2}, \frac{1}{2}$

(*b*) $\frac{\pi}{3}, \frac{4\pi}{3}$

5. $c = -19, d = 6$

6. (*a*) $y - 2x = -1$

(*b*) proof

For parabola

• $\frac{dy}{dx} = -2x + 6$

• $m = 2$

(same as gradient of tangent to circle)

OR

• $-x^2 + 6x - 5 = 2x - 1$

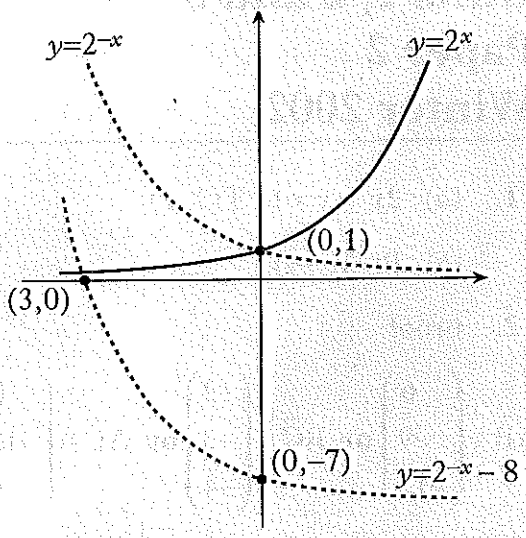
$(x - 2)^2 = 0$

• $\Rightarrow$ equal roots so tangent at $x = 2$

7. $\frac{3}{4}x^{\frac{4}{3}} - 2x^{\frac{1}{2}} + c$

8. (*a*) & (*b*)

Reflect graph in y-axis followed by a translation $\begin{pmatrix} 0 \\ -8 \end{pmatrix}$.



9. (*a*) $\frac{3(x+1)}{x+4}$

(*b*) $x \neq -4$

Mathematics Higher Units 1, 2 and 3 Paper 1 (Non-calculator) Winter 2002 (contd.)

10. $f'(x) = 2 - \dfrac{18}{(x-4)^2}$

$f'(x) = 0 \Rightarrow x = 1,\ 7$

$f'(x) > 0 \Rightarrow x < 1,\ x > 7$

11. 0

12.
- $\log_a p + \log_a r = \cos^2 x + \sin^2 x$
- $\log_a p + \log_a r = \log_a pr$
- $\log_a pr = 1$ and so $pr = a$

Alternative
- $p = a^{\cos^2 x}\ \ r = a^{\sin^2 x}$
- $pr = a^{\cos^2 x + \sin^2 x}$
- $pr = a^1 = a$

Mathematics Higher Units 1, 2 and 3 Paper 2 Winter 2002

1. (*a*) $2y + x = 6$, T(2, 2)

(*b*) P(–1, –4)

2. proof

$\vec{AB} = \begin{pmatrix} 6 \\ -9 \\ -12 \end{pmatrix}$ **or** $\vec{BC} = \begin{pmatrix} 2 \\ -3 \\ -4 \end{pmatrix}$ **or** $\vec{AC} = \begin{pmatrix} 8 \\ -12 \\ -16 \end{pmatrix}$

e.g. $\vec{AB} = 3\vec{BC}$ **or** $\begin{pmatrix} 6 \\ -9 \\ -12 \end{pmatrix} = 3\begin{pmatrix} 2 \\ -3 \\ -4 \end{pmatrix}$

e.g. $\vec{AB}$, $3\vec{BC}$ have common direction, B common pt. so A, B, C collinear

AB : BC = 3 : 1

3. (*a*) 100

(*b*) $n = 7,\ u_7 = 52{\cdot}65$

4. (*a*) $2\sin(x+30)°$

(*b*) max = 7 when $x = 60$

5. Double angle formulae yield

$\cos(2x) = \dfrac{1}{2}$ **or** $\sin^2(x) = \dfrac{1}{4}$

$\dfrac{\pi}{6},\ \dfrac{5\pi}{6},\ \dfrac{7\pi}{6},\ \dfrac{11\pi}{6}$

6. Evaluate $f(0{\cdot}1)$ and $f(0{\cdot}5)$, for example, to start with

$a = 0{\cdot}2$

7. Solve $\dfrac{dS}{dw} = 0$ and test for max/min

$d = 20\sqrt{\frac{2}{3}}$

8. $a = -0{\cdot}868$

9. (*a*) 950

(*b*) approx 12 hours

10. (*a*) $x^2 + (k - 2x)^2 - 2x - 4 = 0$ and apply discriminant

k=7

(*b*) (3, 1)

11. (*a*)

$$\int_{-5}^{0} (f(x) - (-6))dx + \int_{0}^{5} (g(x) - (-6))dx$$

$63\frac{17}{36}$

(*b*) 6 kilowatts