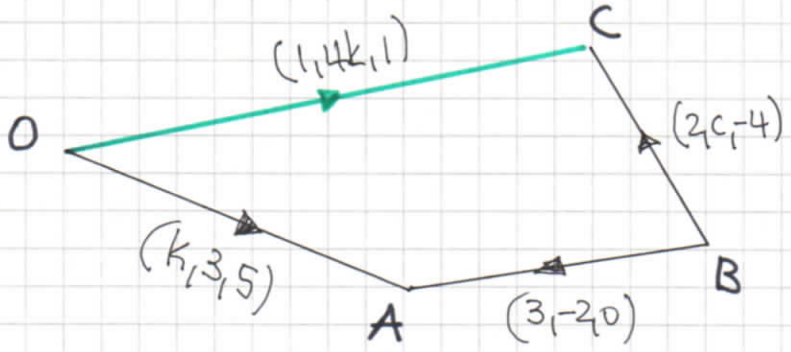
IYGB – MP2 PAPER R – QUESTION 1

STARTING WITH A VECTOR DIAGRAM



$A(k,3,5)$
$\overrightarrow{BA} = (3,-2,0)$
$\overrightarrow{BC} = (2,c,-4)$
$C(1,4k,1)$

FORMING A VECTOR EQUATION

$\Rightarrow \overrightarrow{OA} + \overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{OC}$

$\Rightarrow (k,3,5) - (3,-2,0) + (2,c,-4) = (1,4k,1)$

$\Rightarrow (k-1, c+5, 1) = (1,4k,1)$

$[\underline{i}]$: $k-1=1 \Rightarrow \underline{k=2}$

$[\underline{j}]$: $c+5 = 4k$

$c+5 = 8$

$\underline{c=3}$

FINALLY WE CAN FIND THE DISTANCE BC

$\rightarrow |\overrightarrow{BC}| = |2,3,-4|$

$\Rightarrow |\overrightarrow{BC}| = \sqrt{2^2+3^2+(-4)^2}$

$\Rightarrow |\overrightarrow{BC}| = \sqrt{4+9+16}$

$\Rightarrow |\overrightarrow{BC}| = \underline{\sqrt{29} \approx 5.39}$

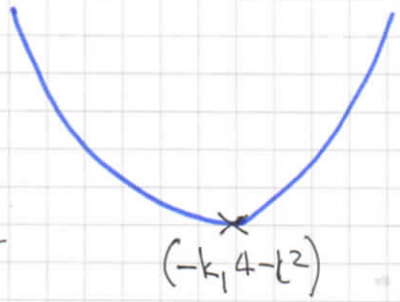
IYGB - MP2 PAPER R - QUESTION 2

a) COMPLETING THE SQUARE

$f(x) = x^2 + 2kx + 4, \quad x \in \mathbb{R}$

$f(x) = (x+k)^2 - k^2 + 4$

$f(x)$ HAS A MINIMUM VALUE OF $4-k^2$



$f(x) \geqslant 4 - k^2$

b) $f(g(2)) = 4$

$\Rightarrow f(3 - k \times 2) = 4$

$\Rightarrow f(3-2k) = 4$

$\Rightarrow (3-2k)^2 + 2k(3-2k) + \cancel{4} = \cancel{4}$

$\Rightarrow 9 - 12k + \cancel{4k^2} + 6k - \cancel{4k^2} = 0$

$\Rightarrow 9 = 6k$

$\Rightarrow k = \frac{3}{2}$

IYGB - MP2 PAPER R - QUESTION 3

START FORMING EQUATIONS AS FOLLOWS

$$\begin{array}{ccc} u_2 & u_3 & u_9 \\ a+d & a+2d & a+8d \end{array} \quad \leftarrow \quad u_n = a+(n-1)d$$

$$a+d \xrightarrow{\times r} a+2d \xrightarrow{\times r} a+8d$$

$$\Rightarrow \left[\begin{array}{l} (a+d)r = a+2d \\ (a+2d)r = a+8d \end{array}\right]$$

ELIMINATE THE COMMON RATIO r, BY DIVISION

$$\Rightarrow \frac{a+d}{a+2d} = \frac{a+2d}{a+8d}$$

$$\Rightarrow (a+d)(a+8d) = (a+2d)^2$$

$$\Rightarrow \cancel{a^2} + 8ad + ad + 8d^2 = \cancel{a^2} + 4ad + 4d^2$$

$$\Rightarrow 4d^2 + 5ad = 0$$

$$\Rightarrow d(4d+5a) = 0$$

$$\Rightarrow 5a + 4d = 0 \qquad (d \neq 0)$$

$$\Rightarrow d = -\frac{1}{5}a$$

NOW RETURNING & PICKING ONE OF THE ORIGINAL EQUATIONS WHICH CONTAIN a, d & r

$$\Rightarrow (a+d)r = a+2d$$

$$\Rightarrow \left(a - \frac{1}{5}a\right)r = a + 2\left(-\frac{1}{5}a\right)$$

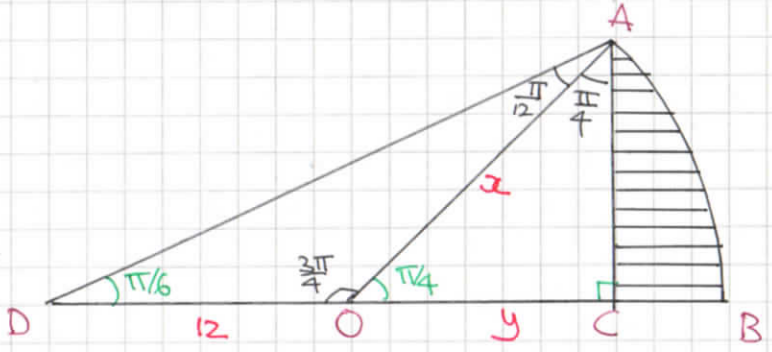
$$\Rightarrow \frac{4}{5}ar = \frac{3}{5}a$$

$$\Rightarrow 4ar = 3a$$

$$\Rightarrow r = \frac{3}{4}$$

IYGB – MP2 PAPER R – QUESTION 4

a) STARTING WITH A DIAGRAM



OBTAIN SOME ANGLES

- $D\hat{O}A = \pi - \frac{\pi}{4} = \frac{3\pi}{4}$ (straight line)
- $D\hat{A}O = \pi - \left(\frac{\pi}{6} + \frac{3\pi}{4}\right) = \frac{\pi}{12}$ (triangle $D\overset{\triangle}{A}O$)
- $O\hat{A}C = \pi - \left(\frac{\pi}{2} + \frac{\pi}{4}\right) = \frac{\pi}{4}$ (triangle $O\overset{\triangle}{A}C$)

BY THE SINE RULE ON $A\overset{\triangle}{O}D$

$$\frac{|OA|}{\sin\pi/6} = \frac{|OD|}{\sin\pi/12} \Rightarrow \frac{x}{\sin\pi/6} = \frac{12}{\sin\pi/12}$$

$$\Rightarrow x = \frac{12\sin\pi/6}{\sin\pi/12}$$

$$\Rightarrow x = 6\sqrt{6} + 6\sqrt{2}$$

(≈ 23.18)

b) AREA OF THE SECTOR $= \text{"}\frac{1}{2}r^2\theta^c\text{"}$

$$= \frac{1}{2}x^2 \times \frac{\pi}{4}$$

$$= \frac{1}{2}\left(6\sqrt{6} + 6\sqrt{2}\right)^2 \times \frac{\pi}{4}$$

$$= \frac{\pi}{8}\left[6\left(\sqrt{6} + \sqrt{2}\right)\right]^2$$

$$= \frac{\pi}{8} \times 6^2\left(\sqrt{6} + \sqrt{2}\right)^2$$

$$= \frac{\pi}{8} \times 36 \times \left(8 + 4\sqrt{3}\right)$$

$$= \frac{\pi}{8} \times 36 \times 4 \times \left(2 + \sqrt{3}\right)$$

$$= 18\pi\left(2 + \sqrt{3}\right)$$

≈ 211

c) NOW LOOKING AT $A\overset{\triangle}{O}C$

$$\frac{|OC|}{|OA|} = \cos\frac{\pi}{4} \Rightarrow \frac{y}{x} = \cos\frac{\pi}{4}$$

$$\Rightarrow y = x \times \frac{\sqrt{2}}{2}$$

$$\Rightarrow y = \left(6\sqrt{6} + 6\sqrt{2}\right) \times \frac{\sqrt{2}}{2}$$

$$\Rightarrow y = \left(3\sqrt{6} + 3\sqrt{2}\right) \times \sqrt{2}$$

$$\Rightarrow y = 3\sqrt{12} + 6$$

$$\Rightarrow y = 6 + 6\sqrt{3}$$

IYGB – MP2 PAPER R – QUESTION 4

FINALLY THE AREA OF THE TRIANGLE $\overset{\triangle}{OAC}$

$$\text{AREA} = \frac{1}{2}|OA||OC|\sin\frac{\pi}{4} = \frac{1}{2}xy \times \frac{\sqrt{2}}{2} = \frac{1}{4}\sqrt{2}\,xy$$

$$= \frac{1}{4}\sqrt{2}\left(6\sqrt{6}+6\sqrt{2}\right)\left(6+6\sqrt{3}\right)$$

$$= \frac{1}{4}\sqrt{2} \times 6\left(\sqrt{6}+\sqrt{2}\right) \times 6\left(1+\sqrt{3}\right) = 9\sqrt{2}\left(\sqrt{6}+\sqrt{2}\right)\left(1+\sqrt{3}\right)$$

$$= 9\sqrt{2}\left(2\sqrt{6}+4\sqrt{2}\right) = 9\sqrt{2} \times 2\left(\sqrt{6}+2\sqrt{2}\right)$$

$$= 18\left(\sqrt{12}+4\right) = 18\left(2\sqrt{3}+4\right) = 36\left(\sqrt{3}+2\right)$$

THE SHADED AREA IS GIVEN BY

AREA OF SECTOR – AREA OF TRIANGLE

$$= 18\pi\left(2+\sqrt{3}\right) - 36\left(2+\sqrt{3}\right)$$

$$= 18\left(2+\sqrt{3}\right)\left[\pi-2\right]$$

$$= 18\left(2+\sqrt{3}\right)\left(\pi-2\right)$$

IYGB - MP2 PAPER R - QUESTION 5

LOCATE THE CO-ORDINATES OF THE MINIMUM BY DIFFERENTIATION

$$f(x) = e^{nx} + ke^{-nx}$$
$$f'(x) = ne^{nx} - nke^{-nx}$$

SOLVE $f'(x) = 0$

$$\Longrightarrow ne^{nx} - nke^{-nx} = 0$$
$$\Longrightarrow e^{nx} - ke^{-nx} = 0 \qquad n \neq 0$$
$$\Longrightarrow e^{nx} = ke^{-nx}$$
$$\Longrightarrow e^{nx} = \frac{k}{e^{nx}}$$
$$\Longrightarrow (e^{nx})^2 = k$$
$$\Longrightarrow e^{nx} = +\sqrt{k} \qquad e^{nx} > 0$$

NEXT WE CAN FIND THE y CO-ORDINATE — WE DON'T REQUIRE x

$$\Longrightarrow y = e^{nx} + ke^{-nx}$$
$$\Longrightarrow y = e^{nx} + \frac{k}{e^{nx}}$$
$$\Longrightarrow y = \sqrt{k} + \frac{k}{\sqrt{k}}$$
$$\Longrightarrow y = \sqrt{k} + \sqrt{k}$$
$$\Longrightarrow y = 2\sqrt{k}$$

$\therefore$ THE RANGE IS $f(x) \geqslant 2\sqrt{k}$

IYGB - MP2 PAPER R - QUESTION 6

a) COLLECTING ALL THE INFORMATION

$$\frac{dV}{dt} = -kV^2$$

RATE DEPRECIATING PROPORTIONAL VALUE SQUARED

V = value in thousands
t = time, in years
t = 0 , V = 12

SOLVING BY SEPARATING VARIABLES

$$\Rightarrow dV = -kV^2\,dt$$

$$\Rightarrow -\frac{1}{V^2}\,dV = k\,dt$$

$$\Rightarrow \int -\frac{1}{V^2}\,dV = \int k\,dt$$

$$\Rightarrow \boxed{\frac{1}{V} = kt + C}$$

APPLY CONDITION $t=0$, $V=12$

$$\Rightarrow \frac{1}{12} = C$$

$$\Rightarrow \frac{1}{V} = kt + \frac{1}{12}$$

$$\Rightarrow V = \frac{1}{kt + \frac{1}{12}}$$

MULTIPLY TOP & BOTTOM OF THE FRACTION IN THE R.H.S BY 12

$$\Rightarrow V = \frac{12}{12kt + 1}$$

$$\Rightarrow \boxed{V = \frac{12}{at + 1}}$$

AS REQUIRED

IYGB - MP2 PAPER R - QUESTION 6

b) USING THE FINAL CONDITION

$t=0 \quad V=8 \quad \leftarrow$ £12000 - £4000

$$\Rightarrow 8 = \frac{12}{2a+1}$$

$$\Rightarrow 16a + 8 = 12$$

$$\Rightarrow 16a = 4$$

$$\Rightarrow a = \frac{1}{4}$$

REWRITING THE FORMULA

$$\Rightarrow V = \frac{12}{\frac{1}{4}t + 1}$$

$$\Rightarrow V = \frac{12}{\frac{1}{4}\times 12 + 1} \qquad \text{("A FURTHER PERIOD ....")}$$

$$\Rightarrow V = 3$$

$\therefore$ £3000

IYGB – MP2 PAPER R – QUESTION 7

a) FILL IN THE TABLE

x	$\frac{\pi}{6}$	$\frac{5\pi}{24}$	$\frac{\pi}{4}$	$\frac{7\pi}{24}$	$\frac{\pi}{3}$
y	3	4.1120	5.8284	8.6784	13.9282

BY THE TRAPEZIUM RULE

$$\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{(1+\sin x)^2}{\cos^2 x}\,dx \simeq \frac{\text{"THICKNESS"}}{2}\left[\text{FIRST} + \text{LAST} + 2\times(\text{SUM OF REST})\right]$$

$$\simeq \frac{\pi/24}{2}\left[3 + 13.9282 + 2(4.1120 + 5.8284 + 8.6784)\right]$$

$$\simeq 3.545$$

b) PROCEED BY DIRECT INTEGRATION

$$\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{(1+\sin x)^2}{\cos^2 x}\,dx = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{1+2\sin x+\sin^2 x}{\cos^2 x}\,dx$$

$$= \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{1}{\cos^2 x} + \frac{2\sin x}{\cos^2 x} + \frac{\sin^2 x}{\cos^2 x}\,dx = \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \sec^2 x + \frac{2\sin x}{\cos x}\times\frac{1}{\cos x} + \tan^2 x\,dx$$

$$= \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \sec^2 x + 2\tan x\sec x + (\sec^2 x - 1)\,dx$$

$$= \int_{\frac{\pi}{6}}^{\frac{\pi}{3}} 2\sec^2 x + 2\tan x\sec x - 1\,dx$$

IYGB - MP2 PAPER R - QUESTION 7

NOW WE NOTE THAT

$$\frac{d}{dx}(\tan x) = \sec^2 x \quad \& \quad \frac{d}{dx}(\sec x) = \sec x \tan x$$

HENCE WE FINALLY HAVE

$$\ldots = \Big[2\tan x + 2\sec x - x\Big]_{\frac{\pi}{6}}^{\frac{\pi}{3}}$$

$$= \left(2\tan\frac{\pi}{3} + 2\sec\frac{\pi}{3} - \frac{\pi}{3}\right) - \left(2\tan\frac{\pi}{6} + 2\sec\frac{\pi}{6} - \frac{\pi}{6}\right)$$

$$= \left(2\sqrt{3} + 4 - \frac{\pi}{3}\right) - \left(\frac{2}{\sqrt{3}} + \frac{4}{\sqrt{3}} - \frac{\pi}{6}\right)$$

$$= \left(2\sqrt{3} + 4 - \frac{\pi}{3}\right) - \left(\frac{6}{\sqrt{3}} - \frac{\pi}{6}\right)$$

$$= \left(\cancel{2\sqrt{3}} + 4 - \frac{\pi}{3}\right) - \left(\cancel{2\sqrt{3}} - \frac{\pi}{6}\right)$$

$$= 4 - \frac{\pi}{6}$$

IYGB - MP2 PAPER R - QUESTION 8

a) START BY REARRANGING THE EQUATION FOR x - THEN DIFFERENTIATE

$$\Rightarrow y = \frac{x}{y + \ln y}$$

$$\Rightarrow y^2 + y\ln y = x$$

$$\Rightarrow x = y^2 + y\ln y$$

$$\Rightarrow \frac{dx}{dx} = 2y + 1\times\ln y + y\times\frac{1}{y}$$

$$\Rightarrow \frac{dx}{dy} = 2y + \ln y + 1$$

$$\Rightarrow \frac{dy}{dx} = \frac{1}{2y + \ln y + 1}$$

SOLVING $\frac{dy}{dx} = 2$ YIELDS

$$\Rightarrow 2 = \frac{1}{2y + \ln y + 1}$$

$$\Rightarrow 4y + 2\ln y + 2 = 1$$

$$\Rightarrow 4y + 2\ln y + 1 = 0$$

$$\Rightarrow 2\ln y = -1 - 4y$$

$$\Rightarrow \ln y = -\frac{1}{2} - 2y$$

$$\Rightarrow \ln y = -\frac{1}{2}(4y+1)$$

$$\therefore y = e^{-\frac{1}{2}(4y+1)}$$ // AS REQUIRED

b) USING THE ITERATIVE FORMULA $y = e^{-\frac{1}{2}(4y+1)}$

STARTING WITH $y_1 = 0.3$

$y_2 = 0.33287\ldots$

$y_3 = 0.311691\ldots$

$y_4 = 0.325178\ldots$

IYGB - MP2 PAPER R - QUESTION 8

THE CONVERGENCE IS BY OSCILLATION BUT VERY SLOW

$y_5 = 0.316524\ldots$

$y_6 = 0.32205\ldots$

$y_7 = 0.31851\ldots$

$y_8 = 0.32077\ldots$

$y_9 = 0.31932\ldots$

$y_{10} = 0.32025\ldots$

$y_{11} = 0.31965\ldots$

$y_{12} = 0.32003\ldots$

$y_{13} = 0.31979\ldots$

$y_{14} = 0.31995\ldots$

$y_{15} = 0.31985\ldots$

$\therefore$ $y = 0.320$ (CORRECT TO 3 d.p)

USING $y = 0.3199$ IN $x = y^2 + y\ln y$ WE OBTAIN $x = -0.262$

$\therefore$ $P(-0.262, 0.320)$

IYGB – MP2 PAPER R – QUESTION 9

a) $$f(x) \equiv \frac{16x^2+3x-2}{x^2(3x-2)} \equiv \frac{A}{x^2} + \frac{B}{x} + \frac{C}{3x-2}$$

$$16x^2+3x-2 \equiv A(3x-2) + Bx(3x-2) + Cx^2$$

- IF $x=0$: $-2 = -2A$, $A = 1$
- IF $x = 2/3$: $\frac{64}{9} + \cancel{2} \cancel{-2} = C \times \frac{4}{9}$, $C = 16$
- IF $x = 1$: $17 = A + B + C$, $17 = 1 + B + 16$, $B = 0$

b) $$\frac{1}{3x-2} = -\frac{1}{2-3x} = -(2-3x)^{-1} = -(2)^{-1}\left[1-\frac{3}{2}x\right]^{-1}$$

$$= -\frac{1}{2}\left(1-\frac{3}{2}x\right)^{-1}$$

$$= -\frac{1}{2}\left[1 + \frac{-1}{1}\left(-\frac{3}{2}x\right)^1 + \frac{-1(-2)}{1\times 2}\left(-\frac{3}{2}x\right)^2 + \frac{(-1)(-2)(-3)}{1\times 2\times 3}\left(-\frac{3}{2}x\right)^3 + \dots\right]$$

$$= -\frac{1}{2}\left[1 + \frac{3}{2}x + \frac{9}{4}x^2 + \frac{27}{8}x^3 + \dots\right]$$

$$= -\frac{1}{2} - \frac{3}{4}x - \frac{9}{8}x^2 - \frac{27}{16}x^3 - \dots$$

c) METHOD A (ONLY UP TO x^3 IS DIRECTLY AVAILABLE)

$$\frac{16x^2+3x-2}{3x-2} = (-2+3x+16x^2)\left[-\frac{1}{2} - \frac{3}{4}x - \frac{9}{8}x^2 - \frac{27}{16}x^3 + \dots\right]$$

$$= 1 + \cancel{\frac{3}{2}x} + \cancel{\frac{9}{4}x^2} + \cancel{\frac{27}{8}x^3} + \dots$$

$$\cancel{-\frac{3}{2}x} \cancel{-\frac{9}{4}x^2} \cancel{-\frac{27}{8}x^3} + \dots$$

$$-8x^2 - 12x^3 + \dots$$

$$= 1 - 8x^2 - 12x^3 + \dots$$

IYGB - MP2 PAPER R - QUESTION 9

METHOD B (USING PREVIOUS PARTS)

$$\frac{16x^2+3x-2}{x^2(3x-2)} = \frac{1}{x^2} + \frac{16}{3x-2}$$

$$\frac{1}{x^2}\left(\frac{16x^2+3x-2}{3x-2}\right) = \frac{1}{x^2} + 16\left(\frac{1}{3x-2}\right)$$

$$\frac{16x^2+3x-2}{3x-2} = 1 + 16x^2\left(\frac{1}{3x-2}\right)$$

$$\frac{16x^2+3x-2}{3x-2} = 1 + 16x^2\left[-\frac{1}{2} - \frac{3}{4}x - \frac{9}{8}x^2 - \frac{27}{16}x^3 + O(x^4)\right]$$

$$\frac{16x^2+3x-2}{3x-2} = 1 - 8x^2 - 12x^3 - 18x^4 - 27x^5 + O(x^6)$$

IYGB – MP2 PAPER R – QUESTION 10

a) STARTING FROM THE L.H.S

$$\begin{aligned}
\text{LHS} &= \sin 3\theta \\
&= \sin(2\theta + \theta) \\
&= \sin 2\theta \cos\theta + \cos 2\theta \sin\theta \\
&= (2\sin\theta\cos\theta)\cos\theta + (1 - 2\sin^2\theta)\sin\theta \\
&= 2\sin\theta\cos^2\theta + \sin\theta + 2\sin^3\theta \\
&= 2\sin\theta(1-\sin^2\theta) + \sin\theta + 2\sin^3\theta \\
&= 2\sin\theta - 2\sin^3\theta + \sin\theta + 2\sin^3\theta \\
&= 3\sin\theta - 4\sin^3\theta \\
&= \text{RHS}
\end{aligned}$$

$\sin(A+B) \equiv \sin A\cos B + \cos A \sin B$

AS REQUIRED

b) DIFFERENTIATING THE IDENTITY W.R.T θ

$$\frac{d}{d\theta}\left[\sin 3\theta\right] = \frac{d}{d\theta}\left[3\sin\theta - 4\sin^3\theta\right]$$

$$\begin{aligned}
3\cos 3\theta &= 3\cos\theta - 12\sin^2\theta \times \cos\theta \\
\cos 3\theta &= \cos\theta - 4\cos\theta\sin^2\theta \\
\cos 3\theta &= \cos\theta - 4\cos\theta(1-\cos^2\theta) \\
\cos 3\theta &= \cos\theta - 4\cos\theta + 4\cos^3\theta \\
\cos 3\theta &= 4\cos^3\theta - 3\cos\theta
\end{aligned}$$

$\div 3$

AS REQUIRED

c) PROCEED AS FOLLOWS

$$\tan 3\theta = \frac{\sin 3\theta}{\cos 3\theta} = \frac{3\sin\theta - 4\sin^3\theta}{4\cos^3\theta - 3\cos\theta} = \frac{\frac{3\sin\theta}{\cos^3\theta} - \frac{4\sin^3\theta}{\cos^3\theta}}{\frac{4\cos^3\theta}{\cos^3\theta} - \frac{3\cos\theta}{\cos^3\theta}}$$

$$= \frac{\frac{3\sin\theta}{\cos\theta} \times \frac{1}{\cos^2\theta} - 4\tan^3\theta}{4 - \frac{3}{\cos^2\theta}} = \frac{3\tan\theta\sec^2\theta - 4\tan^3\theta}{4 - 3\sec^2\theta}$$

AS REQUIRED

IYGB - MP2 PAPER R - QUESTION 10

d) USING THE IDENTITY $1+\tan^2\theta \equiv \sec^2\theta$ WE HAVE

$$\tan 3\theta = \frac{3\tan\theta\sec^2\theta - 4\tan^3\theta}{4-3\sec^2\theta} = \frac{3\tan\theta(1+\tan^2\theta)-4\tan^3\theta}{4-3(1+\tan^2\theta)}$$

$$= \frac{3\tan\theta + 3\tan^3\theta - 4\tan^3\theta}{4-3-3\tan^2\theta} = \frac{3\tan\theta - \tan^3\theta}{1-3\tan^2\theta}$$

AS REQUIRED

IYGB - MP2 PAPER R - QUESTION 11

a) OBTAIN THE GRADIENT FUNCTION IN PARAMETRIC

- $\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{3\sin^2 t\cos t}{3\cos^2 t(-\sin t)} = -\frac{\cancel{3}\sin^{\cancel{2}} t\cancel{\cos t}}{\cancel{3}\cancel{\sin t}\cos^{\cancel{2}} t} = -\frac{\sin t}{\cos t}$

- $\left.\frac{dy}{dx}\right|_{t=\theta} = -\frac{\sin\theta}{\cos\theta}$

EQUATION OF NORMAL AT $(\cos^3\theta, \sin^3\theta)$ WITH GRADIENT $+\frac{\cos\theta}{\sin\theta}$

$\Rightarrow y - y_0 = m(x - x_0)$

$\Rightarrow y - \sin^3\theta = \frac{\cos\theta}{\sin\theta}(x - \cos^3\theta)$

$\Rightarrow y\sin\theta - \sin^4\theta = x\cos\theta - \cos^4\theta$

$\Rightarrow \cos^4\theta - \sin^4\theta = x\cos\theta - y\sin\theta$

$\Rightarrow \underbrace{(\cos^2\theta - \sin^2\theta)}_{\cos 2\theta}\underbrace{(\cos^2\theta + \sin^2\theta)}_{1} = x\cos\theta - y\sin\theta$

$\Rightarrow x\cos\theta - y\sin\theta = \cos 2\theta$

AS REQUIRED

b) WHEN $x=0$

$-y\sin\theta = \cos 2\theta$

$y = -\frac{\cos 2\theta}{\sin\theta}$

WHEN $y=0$

$x\cos\theta = \cos 2\theta$

$x = \frac{\cos 2\theta}{\cos\theta}$

AREA IS GIVEN BY

$$\frac{1}{2}\left| -\frac{\cos 2\theta}{\sin\theta} \times \frac{\cos 2\theta}{\cos\theta} \right| = \frac{\cos 2\theta\cos 2\theta}{2\sin\theta\cos\theta} = \frac{\cos 2\theta\cos 2\theta}{\sin 2\theta}$$

$$= \cot 2\theta\cos 2\theta$$