AQA

Please write clearly in block capitals.

Centre number | | | | | Candidate number | | | |

Surname ______________________

Forename(s) ANSWERS

Candidate signature ______________________

A-level
MATHEMATICS

Unit Pure Core 4

A

Friday 17 June 2016 Afternoon Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

Answer **all** questions.

Answer each question in the space provided for that question.

1 (a) Express $\dfrac{19x-3}{(1+2x)(3-4x)}$ in the form $\dfrac{A}{1+2x}+\dfrac{B}{3-4x}$.

[3 marks]

(b) (i) Find the binomial expansion of $\dfrac{19x-3}{(1+2x)(3-4x)}$ up to and including the term in x^2.

[7 marks]

(ii) State the range of values of x for which this expansion is valid.

[1 mark]

QUESTION PART REFERENCE

Answer space for question 1

1a) $19x-3 = A(3-4x)+B(1+2x)$

$x=3/4 \rightarrow 19(3/4)-3 = B(1+2(3/4))$

$57/4 - 3 = 10/4\,B$

$45/4 = 10/4\,B$

$B = 9/2$ OR 4.5

$x=-1/2 \rightarrow 19(-1/2)-3 = A(3-4(-1/2))$

$-19/2 - 3 = 5A$

$-25/2 = 5A$

$A = -5/2$ OR -2.5

$$\frac{19x-3}{(1+2x)(3-4x)} = \frac{-2.5}{(1+2x)} + \frac{4.5}{(3-4x)}$$

$$= \frac{-5}{2(1+2x)} + \frac{9}{2(3-4x)}$$

QUESTION PART REFERENCE | **Answer space for question 1**

b)i) $-\frac{5}{2}(1+2x)^{-1} + \frac{9}{2}(3-4x)^{-1}$

$-\frac{5}{2}(1+2x)^{-1} = -\frac{5}{2}\left[1 + (-1)(2x) + \frac{(-1)(-2)(2x)^2}{2}\right]$

$= -\frac{5}{2}(1 - 2x + 4x^2)$

$\frac{9}{2}(3-4x)^{-1} = \frac{9}{2}(3)^{-1}\left(1 - \frac{4}{3}x\right)^{-1}$

$= \frac{3}{2}\left[1 + (-1)(-4/3x) + \frac{(-1)(-2)(-4/3)^2}{2}\right]$

$= \frac{3}{2}\left(1 + 4/3x + 16/9x^2\right)$

$-\frac{5}{2}(1 - 2x + 4x^2) + \frac{3}{2}(1 + 4/3x + 16/9x^2)$

$-\frac{5}{2} + 5x - 10x^2 + \frac{3}{2} + 2x + \frac{8}{3}x^2$

$-1 + 7x - \frac{22}{3}x^2$

ii) valid for $|2x| < 1$ OR $|-4/3x| < 1$

$|x| < 1/2$ $|x| < 3/4$

$\therefore -1/2 < x < 1/2$

2 By forming and solving a suitable quadratic equation, find the solutions of the equation

$$3\cos 2\theta - 5\cos\theta + 2 = 0$$

in the interval $0° < \theta < 360°$, giving your answers to the nearest $0.1°$.

[5 marks]

QUESTION PART REFERENCE

Answer space for question 2

2) $3\cos 2\theta - 5\cos\theta + 2 = 0$ $\quad 0 < \theta < 360°$.

$\boxed{\cos 2\theta = 2\cos^2\theta - 1}$

$3(2\cos^2\theta - 1) - 5\cos\theta + 2 = 0$

$6\cos^2\theta - 3 - 5\cos\theta + 2 = 0$

$6\cos^2\theta - 5\cos\theta - 1 = 0$

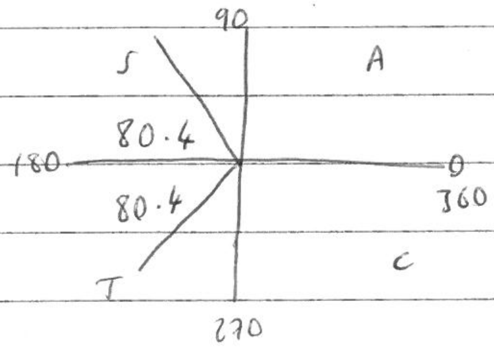
$(6\cos\theta + 1)(\cos\theta - 1) = 0$

$6\cos\theta + 1 = 0$ OR $\cos\theta - 1 = 0$

$\cos\theta = -1/6$ $\quad \cos\theta = 1$

$\theta = 99.59406...,$ $\quad \theta = 0° \rightarrow$ out of range

$260.4059...$



$\theta = \underline{99.6°}, \underline{260.4°}$ (nearest $0.1°$)

QUESTION PART REFERENCE	Answer space for question 2

3 (a) Express $\dfrac{3+13x-6x^2}{2x-3}$ in the form $Ax+B+\dfrac{C}{2x-3}$.

[4 marks]

(b) Show that $\displaystyle\int_3^6 \frac{3+13x-6x^2}{2x-3}\,dx = p+q\ln 3$, where p and q are rational numbers.

[4 marks]

QUESTION PART REFERENCE

Answer space for question 3

3a) $\dfrac{3+13x-6x^2}{2x-3} \rightarrow$

$$\begin{array}{r l} & -3x+2 \\ 2x-3 \,\big)\!\!\! & -6x^2+13x+3 \\ - & -6x^2+9x \\ \hline & 0+4x+3 \\ - & 4x-6 \\ \hline & 0+9 \end{array}$$

$$\frac{3+13x-6x^2}{2x-3} = -3x+2+\frac{9}{2x-3}$$

$A=-3,\ B=2,\ C=9$

b) $\displaystyle\int_3^6 -3x+2+\frac{9}{2x-3}\,dx$

$$\left[-\frac{3x^2}{2}+2x+\frac{9}{2}\ln(2x-3)\right]_3^6$$

$$\left(-\frac{3(6)^2}{2}+2(6)+\frac{9}{2}\ln(2(6)-3)\right)-\left(-\frac{3(3)^2}{2}+2(3)+\frac{9}{2}\ln(2(3)-3)\right)$$

$$\left(-42+\frac{9}{2}\ln 9\right)-\left(-\frac{15}{2}+\frac{9}{2}\ln 3\right)$$

$$-\frac{69}{2}+\frac{9}{2}\ln 3^2-\frac{9}{2}\ln 3$$

$$-\frac{69}{2}+\frac{18}{2}\ln 3-\frac{9}{2}\ln 3=-\frac{69}{2}+\frac{9}{2}\ln 3$$

$p=-\dfrac{69}{2},\ q=\dfrac{9}{2}$

QUESTION PART REFERENCE	Answer space for question 3

Turn over ▶

4 The mass of radioactive atoms in a substance can be modelled by the equation

$$m = m_0 k^t$$

where m_0 grams is the initial mass, m grams is the mass after t days and k is a constant. The value of k differs from one substance to another.

(a) (i) A sample of radioactive iodine reduced in mass from 24 grams to 12 grams in 8 days.

Show that the value of the constant k for this substance is 0.917004, correct to six decimal places.

[1 mark]

(ii) A similar sample of radioactive iodine reduced in mass to 1 gram after 60 days.

Calculate the initial mass of this sample, giving your answer to the nearest gram.

[2 marks]

(b) The half-life of a radioactive substance is the time it takes for a mass of m_0 to reduce to a mass of $\frac{1}{2}m_0$.

A sample of radioactive vanadium reduced in mass from exactly 10 grams to 8.106 grams in 100 days.

Find the half-life of radioactive vanadium, giving your answer to the nearest day.

[4 marks]

QUESTION PART REFERENCE | **Answer space for question 4**

4ai) $M = M_0 k^t$

$M_0 = 24, \quad M = 12, \quad t = 8$

$12 = 24 \times k^8$

$\frac{1}{2} = k^8$

$k = \sqrt[8]{1/2} = 0.9170040\ldots = \underline{0.917004}$ (6dp)

ii) $M = M_0 \times 0.917004^t$ $\qquad M = 1, \quad t = 60$

$1 = M_0 \times 0.917004^{60}$

$M_0 = \dfrac{1}{0.917004^{60}} = 181.0198477$

$= \underline{181g}$ (nearest g)

QUESTION PART REFERENCE	Answer space for question 4

b) $M = M_0 k^t \qquad M_0 = 10, \quad M = 8.106, \quad t = 100$

$8.106 = 10 \times k^{100}$

$k = \sqrt[100]{\dfrac{8.106}{10}} = 0.9979023$

$M = 5, \quad M_0 = 10, \quad k = 0.9979023\ldots$

$5 = 10 \times 0.9979023\ldots^{t}$

$0.5 = 0.9979023\ldots^{t}$

$\log 0.5 = t \log 0.9979023\ldots$

$t = \dfrac{\log 0.5}{\log 0.9979023}$

$t = 330.0852928$

$t = \underline{\underline{330}}$ days (nearest day)

Turn over ▶

tside
box

5 It is given that $\sin A = \dfrac{\sqrt{5}}{3}$ and $\sin B = \dfrac{1}{\sqrt{5}}$, where the angles A and B are both acute.

(a) (i) Show that the exact value of $\cos B = \dfrac{2}{\sqrt{5}}$.

[1 mark]

(ii) Hence show that the exact value of $\sin 2B$ is $\dfrac{4}{5}$.

[2 marks]

(b) (i) Show that the exact value of $\sin(A - B)$ can be written as $p(5 - \sqrt{5})$, where p is a rational number.

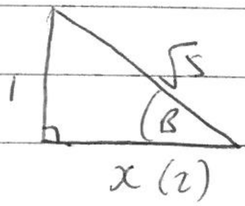
[4 marks]

(ii) Find the exact value of $\cos(A - B)$ in the form $r + s\sqrt{5}$, where r and s are rational numbers.

[3 marks]

QUESTION PART REFERENCE	**Answer space for question 5**

5) ai)



$x = \sqrt{(\sqrt{5})^2 - 1^2}$

$x = 2$

$\cos B = \dfrac{2}{\sqrt{5}}$ (as req)

or $\sin^2 B + \cos^2 B = 1$

$\left(\dfrac{1}{\sqrt{5}}\right)^2 + \cos^2 B = 1$

$\dfrac{1}{5} + \cos^2 B = 1$

$\cos^2 B = 4/5$

$\cos B = \sqrt{\dfrac{4}{5}} = \dfrac{2}{\sqrt{5}}$

ii) $\sin 2B = 2\sin B \cos B$

$= 2\left(\dfrac{1}{\sqrt{5}}\right)\left(\dfrac{2}{\sqrt{5}}\right)$

$= \dfrac{4}{5}$ (as req)

QUESTION PART REFERENCE	Answer space for question 5
b)i)	$\cos A = \sqrt{1-\left(\frac{\sqrt{5}}{3}\right)^2} = \sqrt{1-\frac{5}{9}} = \sqrt{4/9} = 2/3$
	$\sin A = \frac{\sqrt{5}}{3}, \quad \sin B = \frac{1}{\sqrt{5}}, \quad \cos A = \frac{2}{3}, \quad \cos B = \frac{2}{\sqrt{5}}$
	$\sin(A-B) = \sin A\cos B - \cos A\sin B$
	$= \left(\frac{\sqrt{5}}{3}\right)\left(\frac{2}{\sqrt{5}}\right) - \left(\frac{2}{3}\right)\left(\frac{1}{\sqrt{5}}\right)$
	$= \frac{2\sqrt{5}}{3\sqrt{5}} - \frac{2}{3\sqrt{5}} = \frac{2\sqrt{5}-2}{3\sqrt{5}} \times \frac{3\sqrt{5}}{3\sqrt{5}}$
	$= \frac{6(5)-6\sqrt{5}}{9(5)}$
	$= \frac{30-6\sqrt{5}}{45} = \frac{6(5-\sqrt{5})}{45}$
	$= \frac{2}{15}(5-\sqrt{5})$
	$p = 2/15$
ii)	$\cos(A-B) = \cos A\cos B + \sin A\sin B$
	$= \left(\frac{2}{3}\right)\left(\frac{2}{\sqrt{5}}\right) + \left(\frac{\sqrt{5}}{3}\right)\left(\frac{1}{\sqrt{5}}\right)$
	$= \frac{4}{3\sqrt{5}} + \frac{\sqrt{5}}{3\sqrt{5}} = \frac{4+\sqrt{5}}{3\sqrt{5}} \times \frac{3\sqrt{5}}{3\sqrt{5}}$
	$= \frac{12\sqrt{5}+3(5)}{9(5)} = \frac{12\sqrt{5}+15}{45}$
	$= \frac{4}{15}\sqrt{5} + \frac{1}{3}$ OR $\frac{1}{3} + \frac{4}{15}\sqrt{5}$
	$r = 1/3, \quad s = 4/15$

6 The line l_1 passes through the point $A(0, 6, 9)$ and the point $B(4, -6, -11)$.

The line l_2 has equation $\mathbf{r} = \begin{bmatrix} -1 \\ 5 \\ -2 \end{bmatrix} + \lambda \begin{bmatrix} 3 \\ -5 \\ 1 \end{bmatrix}$.

(a) The acute angle between the lines l_1 and l_2 is θ.

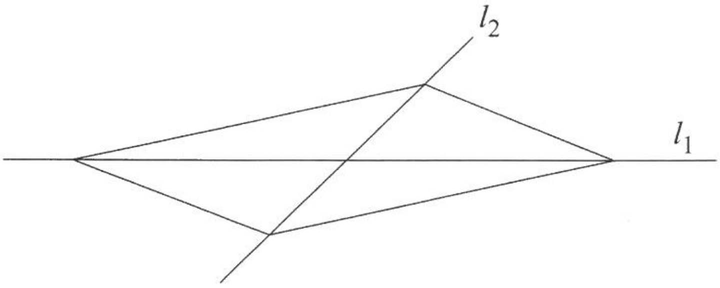
Find the value of $\cos\theta$ as a fraction in its lowest terms.

[5 marks]

(b) Show that the lines l_1 and l_2 intersect and find the coordinates of the point of intersection.

[5 marks]

(c) The points C and D lie on line l_2 such that $ACBD$ is a parallelogram.



The length of AB is three times the length of CD.

Find the coordinates of the points C and D.

[5 marks]

QUESTION PART REFERENCE	Answer space for question 6
6a)	$a = \begin{pmatrix} 4-0 \\ -6-6 \\ -11-9 \end{pmatrix} = \begin{pmatrix} 4 \\ -12 \\ -20 \end{pmatrix}$ $\quad b = \begin{pmatrix} 3 \\ -5 \\ 1 \end{pmatrix}$
	$a.b = 4 \times 3 + -12 \times -5 + -20 \times 1$
	$= 12 + 60 - 20 = 52$
	$\lvert a \rvert = \sqrt{(4)^2 + (-12)^2 + (-20)^2} = 4\sqrt{35}$
	$\lvert b \rvert = \sqrt{(3)^2 + (-5)^2 + (1)^2} = \sqrt{35}$
	$\lvert a \rvert \lvert b \rvert = 4\sqrt{35} \times \sqrt{35} = 140$
	$\cos\theta = \dfrac{a.b}{\lvert a \rvert \lvert b \rvert} = \dfrac{52}{140} = \dfrac{13}{35}$

QUESTION PART REFERENCE	**Answer space for question 6**
	$l_1 = l_2$
b)	$\begin{pmatrix}0\\6\\9\end{pmatrix} + \mu\begin{pmatrix}4\\-12\\-20\end{pmatrix} = \begin{pmatrix}-1\\5\\-2\end{pmatrix} + \lambda\begin{pmatrix}3\\-5\\1\end{pmatrix}$
	$0 + 4\mu = -1 + 3\lambda$ ①
	$6 - 12\mu = 5 - 5\lambda$ ②
	$9 - 20\mu = -2 + \lambda$ ③
	using ① and ② → $4\mu - 3\lambda = -1$ ① $(\times 3)$
	$-12\mu + 5\lambda = -1$ ②
	$+$ $12\mu - 9\lambda = -3$
	$-4\lambda = -4$
	$\lambda = 1$
	$4\mu - 3(1) = -1$
	$4\mu = 2$
	$\mu = 1/2$
	check in ③ → $9 - 20(1/2) = -2 + 1$
	$9 - 10 = -2 + 1$ ✓
	$\therefore$ intersect
	when $\lambda = 1$ → $\begin{pmatrix}-1\\5\\-2\end{pmatrix} + 1\begin{pmatrix}3\\-5\\1\end{pmatrix}$
	$= \begin{pmatrix}2\\0\\-1\end{pmatrix} = (2, 0, -1)$
	check, when $\mu = 1/2$ → $\begin{pmatrix}0\\6\\9\end{pmatrix} + 1/2\begin{pmatrix}4\\-12\\-20\end{pmatrix} = \begin{pmatrix}2\\0\\-1\end{pmatrix}$

QUESTION PART REFERENCE

Answer space for question 6

c) length AB $(l_1) = \sqrt{4^2+12^2+20^2} = 4\sqrt{35}$ OR $\sqrt{560}$

length CD $(l_2) = \frac{1}{3}\sqrt{560}$ OR $\frac{4}{3}\sqrt{35}$

midpoint of CD is $(2, 0, -1)$ (M)

$\therefore$ length CM $= \frac{2}{3}\sqrt{35}$

$$C = \begin{pmatrix} -1+3\lambda \\ 5+-5\lambda \\ -2+\lambda \end{pmatrix} \qquad M = \begin{pmatrix} 2 \\ 0 \\ -1 \end{pmatrix}$$

$$CM = \sqrt{(-1+3\lambda-2)^2+(5-5\lambda)^2+(-2+\lambda+1)^2}$$

$$\frac{2}{3}\sqrt{35} = \sqrt{(-3+3\lambda)^2+(5-5\lambda)^2+(-1+\lambda)^2}$$

$$\frac{2}{3}\sqrt{35} = \sqrt{9-18\lambda+9\lambda^2+25-50\lambda+25\lambda^2+1-2\lambda+\lambda^2}$$

$$\frac{2}{3}\sqrt{35} = \sqrt{35\lambda^2-70\lambda+35} \qquad (^2)$$

$$35\lambda^2-70\lambda+35 = \frac{140}{9}$$

$$315\lambda^2-630\lambda+315 = 140$$

$$315\lambda^2-630\lambda+175 = 0 \qquad (\div 35)$$

$$9\lambda^2-18\lambda+5 = 0$$

$$(3\lambda-1)(3\lambda-5) = 0$$

$$\lambda = 1/3, \quad \lambda = 5/3$$

when $\lambda = 1/3$:- $\quad$ when $\lambda = 5/3$:-

$C = (0, 10/3, -5/3)$ $\quad$ $D = (4, -10/3, -1/3)$

QUESTION PART REFERENCE	Answer space for question 6

7 A curve C is defined by the parametric equations

$$x = \frac{4 - e^{2-6t}}{4}, \qquad y = \frac{e^{3t}}{3t}, \qquad t \neq 0$$

(a) Find the exact value of $\frac{dy}{dx}$ at the point on C where $t = \frac{2}{3}$.

[5 marks]

(b) Show that $x = \frac{4 - e^{2-6t}}{4}$ can be rearranged into the form $e^{3t} = \frac{e}{2\sqrt{(1-x)}}$.

[2 marks]

(c) Hence find the Cartesian equation of C, giving your answer in the form

$$y = \frac{e}{f(x)[1 - \ln(f(x))]}$$

[2 marks]

QUESTION PART REFERENCE	Answer space for question 7

7a) $x = \frac{4 - e^{2-6t}}{4}$, $y = \frac{e^{3t}}{3t}$

$x = 1 - \frac{1}{4}e^{2-6t}$ $\qquad y = \frac{1}{3}t^{-1}e^{3t} \rightarrow u = \frac{1}{3}t^{-1}, \; v = e^{3t}$

$\boxed{\frac{dx}{dt} = \frac{3}{2}e^{2-6t}}$ $\qquad \frac{du}{dt} = -\frac{1}{3}t^{-2}, \; \frac{dv}{dt} = 3e^{3t}$

$\frac{dy}{dt} = \frac{e^{3t}}{t} - \frac{e^{3t}}{3t^2} = \boxed{\frac{3te^{3t} - e^{3t}}{3t^2}}$

$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$

$= \frac{3te^{3t} - e^{3t}}{3t^2} \times \frac{2}{3e^{2-6t}}$

$\frac{dy}{dx} = \frac{2(3te^{3t} - e^{3t})}{9t^2e^{2-6t}}$

when $t = 2/3$, $\frac{dy}{dx} = \frac{2(3(2/3)e^{3(2/3)} - e^{3(2/3)})}{9(2/3)^2e^{2-6(2/3)}}$

$= \frac{2(2e^2 - e^2)}{4e^{-2}} = \underline{\underline{\frac{1}{2}e^4}}$

QUESTION PART REFERENCE

Answer space for question 7

b) $x = \dfrac{4 - e^{2-6t}}{4}$

$4x = 4 - e^{2-6t}$

$e^{2-6t} = 4 - 4x$

$e^{2} \times e^{-6t} = 4 - 4x$

$\dfrac{e^2}{e^{6t}} = 4 - 4x$

$e^{6t} = \dfrac{e^2}{4-4x}$ $(\sqrt{\ })$

$\sqrt{e^{6t}} = \sqrt{\dfrac{e^2}{4-4x}}$

$e^{3t} = \dfrac{e}{\sqrt{4}\sqrt{1-x}} = \dfrac{e}{2\sqrt{(1-x)}}$ (as req)

c) $y = \dfrac{e^{3t}}{3t}$

$\boxed{e^{3t} = \dfrac{e}{2\sqrt{(1-x)}}}$

$3t \ln e = \ln\left(\dfrac{e}{2\sqrt{(1-x)}}\right)$

$3t = \ln e - \ln 2\sqrt{(1-x)}$

$\boxed{3t = 1 - \ln 2\sqrt{(1-x)}}$

$y = \dfrac{\dfrac{e}{2\sqrt{(1-x)}}}{1 - \ln 2\sqrt{(1-x)}}$

$= \dfrac{e}{(2 \times \sqrt{(1-x)})(1 - \ln 2\sqrt{(1-x)})}$

when $f(x) = 2\sqrt{(1-x)}$

8 It is given that $\theta = \tan^{-1}\left(\dfrac{3x}{2}\right)$.

(a) By writing $\theta = \tan^{-1}\left(\dfrac{3x}{2}\right)$ as $2\tan\theta = 3x$, use implicit differentiation to show that $\dfrac{d\theta}{dx} = \dfrac{k}{4+9x^2}$, where k is an integer.

[3 marks]

(b) Hence solve the differential equation

$$9y(4+9x^2)\frac{dy}{dx} = \operatorname{cosec} 3y$$

given that $x = 0$ when $y = \dfrac{\pi}{3}$. Give your answer in the form $g(y) = h(x)$.

[7 marks]

QUESTION PART REFERENCE	Answer space for question 8

8a) $\theta = \tan^{-1}\left(\frac{3x}{2}\right)$

$2\tan\theta = 3x$

$2\sec^2\theta \frac{d\theta}{dx} = 3$

$\frac{d\theta}{dx} = \frac{3}{2\sec^2\theta}$

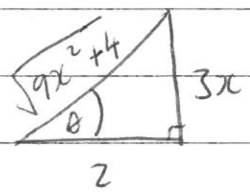
$\frac{d\theta}{dx} = \frac{3}{2\left(\frac{4+9x^2}{4}\right)}$

$= \frac{12}{2(4+9x^2)}$

$\frac{d\theta}{dx} = \frac{6}{4+9x^2}$

$k = 6$

$\tan\theta = \frac{3x}{2}$



$\sec\theta = \frac{1}{\cos\theta} = \frac{1}{\frac{2}{\sqrt{4+9x^2}}}$

$\sec\theta = \frac{\sqrt{4+9x^2}}{2}$

$\boxed{\sec^2\theta = \frac{4+9x^2}{4}}$

QUESTION PART REFERENCE

Answer space for question 8

b) $9y(4+9x^2)\frac{dy}{dx} = \operatorname{cosec} 3y$

$\int \frac{9y}{\operatorname{cosec} 3y}\,dy = \int \frac{1}{4+9x^2}\,dx$

$\int 9y \sin 3y\,dy = \frac{1}{6}\int \frac{6}{4+9x^2}\,dx$

$\int 9y\sin 3y\,dy = \frac{1}{6}\tan^{-1}\left(\frac{3x}{2}\right) + c$

$u = 9y \qquad \frac{dv}{dy} = \sin 3y$

$\frac{du}{dy} = 9$

$v = -\frac{1}{3}\cos 3y$

$-3y\cos 3y - \int -3\cos 3y\,dy = \frac{1}{6}\tan^{-1}\left(\frac{3x}{2}\right) + c$

$-3y\cos 3y + \int 3\cos 3y\,dy = \frac{1}{6}\tan^{-1}\left(\frac{3x}{2}\right) + c$

$-3y\cos 3y + \sin 3y = \frac{1}{6}\tan^{-1}\left(\frac{3x}{2}\right) + c$

$\sin 3y - 3y\cos 3y = \frac{1}{6}\tan^{-1}\left(\frac{3x}{2}\right) + c$

$x = 0$, when $y = \pi/3$

$\sin(3(\pi/3)) - 3(\pi/3)\cos(3(\pi/3)) = \frac{1}{6}\tan^{-1}(0) + c$

$\sin\pi - \pi\cos\pi = c$

$0 + \pi = c$

so, $\sin 3y - 3y\cos 3y = \frac{1}{6}\tan^{-1}\left(\frac{3x}{2}\right) + \pi$

Turn over ▶

QUESTION PART REFERENCE	Answer space for question 8

END OF QUESTIONS