Centre No.	1	0	6	5	8	Paper Reference							Surname	Initial(s)
													Eloie	LE
Candidate No.	5	0	7	7		6	6	6	6	/	0	1	Signature L. Eloie	

Paper Reference(s)

6666/01

Edexcel GCE

Core Mathematics C4

Advanced

Tuesday 18 June 2013 – Morning

Time: 1 hour 30 minutes

ND030607189

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	7
2	9
3	8
4	8
5	10
6	11
7	12
8	9
Total	74

Materials required for examination
Mathematical Formulae (Pink)

Items included with question papers
Nil

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation or symbolic differentiation/integration, or have retrievable mathematical formulae stored in them.

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer for each question in the space following the question.
When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 8 questions in this question paper. The total mark for this paper is 75.
There are 32 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. (a) Find $\int x^2 e^x dx$.

(5)

(b) Hence find the exact value of $\int_0^1 x^2 e^x dx$.

(2)

(a) $\int x^2 e^x \, dx$ let $u = x^2$ $\frac{dv}{dx} = e^x$

$\frac{du}{dx} = 2x$ $v = e^x$

$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx.$

$\int x^2 e^x dx = x^2 e^x - \int 2xe^x dx$

let $u_2 = 2x$ $\frac{dv_2}{dx} = e^x$

$\frac{du_2}{dx} = 2$ $v = e^x$

$\therefore = x^2 e^x - \left[2xe^x - \int 2e^x dx \right]$

$= x^2 e^x - 2xe^x + 2e^x + C$

(b) $\left[x^2 e^x - 2xe^x + 2e^x \right]_0^1$

$= ((1)^2 e^{(1)} - 2(1)e^{(1)} + 2e^{(1)}) - ((0)^2 e^{(0)} - 2(0)e^{(0)} + 2e^{(0)})$

$= (e - 2e + 2e) - (2)$

$= \boxed{e - 2}$

1 Q01aM1
1 Q01aA1
1 Q01aM2
1 Q01aA2
1 Q01aA3
1 Q01bM
1 Q01bA

P 4 3 1 3 7 A 0 2 3 2

3857689/2

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Question 1 continued

Q1

(Total 7 marks) 7

P 4 3 1 3 7 A 0 3 3 2

Turn over

3857689/3

2. (a) Use the binomial expansion to show that

$$\sqrt{\left(\frac{1+x}{1-x}\right)} \approx 1+x+\frac{1}{2}x^2, \quad |x|<1$$

(6)

(b) Substitute $x = \frac{1}{26}$ into

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

to obtain an approximation to $\sqrt{3}$

Give your answer in the form $\frac{a}{b}$ where a and b are integers.

(3)

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1 Q02aB
1 Q02aM1
1 Q02aA1
1 Q02aA2
1 Q02aM2
1 Q02aA3
1 Q02bM
1 Q02bB
1 Q02bA

(a)

$$\sqrt{\frac{1+x}{1-x}} = \frac{\sqrt{1+x}}{\sqrt{1-x}} = \frac{(1+x)^{1/2}}{(1-x)^{1/2}}$$

$$= (1+x)^{1/2}(1-x)^{-1/2}$$

$$(1+x)^{1/2} = 1 + (\tfrac{1}{2})(x) + \frac{(\tfrac{1}{2})(\tfrac{1}{2}-1)(x)^2}{2!}$$

$$= 1 + \frac{x}{2} - \frac{x^2}{8}$$

$$(1-x)^{-1/2} = 1 + (-\tfrac{1}{2})(-x) + \frac{(-\tfrac{1}{2})(-\tfrac{1}{2}-1)(-x)^2}{2!}$$

$$= 1 + \frac{x}{2} + \frac{3}{8}x^2$$

$$(1+x)^{1/2}(1-x)^{-1/2} = \left(1+\frac{x}{2}-\frac{x^2}{8}\right)\left(1+\frac{x}{2}+\frac{3x^2}{8}\right).$$

$$= 1 + \frac{x}{2} + \frac{3x^2}{8} + \frac{x}{2} + \frac{x^2}{4} + \frac{3x^3}{16} - \frac{x^2}{8} - \frac{x^3}{16} - \frac{3x^4}{64}$$

ignore powers $n > 2$.

$$= 1 + \frac{x}{2} + \frac{3x^2}{8} + \frac{x}{2} + \frac{x^2}{4} - \frac{x^2}{8}$$

$$= \cancel{1+x+\frac{x^2}{2}} \quad 1 + x + \frac{x^2}{2}$$

$$\cancel{1+x+\frac{1}{2}x^2}$$

$$= \boxed{1 + x + \frac{1}{2}x^2}$$

Question 2 continued

(b) $\cancel{\left(1 + \frac{1}{26} + \frac{1}{2}\left(\frac{1}{26}\right)^2\right.}$

$\cancel{= 1 + \frac{1}{26} + \frac{1}{2}\left(\frac{1}{676}\right)}$

$\cancel{= 1 + \frac{1}{26} + \frac{1}{1352}}$

$\cancel{= \frac{1352}{1352} + \frac{52}{1352} + \frac{1}{1352}}$

$\cancel{= \frac{1405}{1352}} \quad \cancel{a = 1405,} \quad \cancel{b = 1352}$

$$\frac{1 + \frac{1}{26}}{1 - \frac{1}{26}} = \frac{27}{25} = 1.08$$

$$\sqrt{1.08} = k\sqrt{3}$$

$$k = \frac{3}{5}$$

$\cancel{\frac{3}{5}\left(1 + \frac{1}{26} + \frac{1}{2}\left(\frac{1}{26}\right)^2\right) = \frac{3}{5} + \frac{3}{130} + \frac{3}{6760}}$

$$\frac{5}{3}\left(1 + \frac{1}{26} + \frac{1}{2}\left(\frac{1}{26}\right)^2\right) = \frac{1405}{1352} \times \frac{5}{3}$$

$$= \boxed{\frac{7025}{4056}}$$

$$\boxed{\begin{aligned} a &= 7025 \\ b &= 4056 \end{aligned}}$$

Leave blank

Question 2 continued

Leave blank

Question 2 continued

(Total 9 marks)

Q2 9

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1 Q03aB
1 Q03bB
1 Q03bM
1 Q03bA
1 Q03cM1
1 Q03cA1
1 Q03cM2
1 Q03cA2

3.

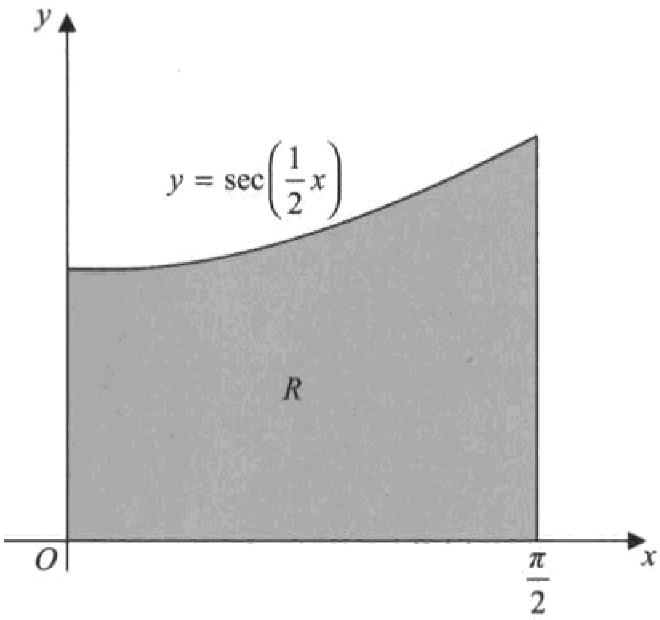

Figure 1

Figure 1 shows the finite region R bounded by the x-axis, the y-axis, the line $x = \frac{\pi}{2}$ and the curve with equation

$$y = \sec\left(\frac{1}{2}x\right), \quad 0 \leqslant x \leqslant \frac{\pi}{2}$$

The table shows corresponding values of x and y for $y = \sec\left(\frac{1}{2}x\right)$.

x	0	$\frac{\pi}{6}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
y	1	1.035276	1.154701	1.414214

(a) Complete the table above giving the missing value of y to 6 decimal places.
(1)

(b) Using the trapezium rule, with all of the values of y from the completed table, find an approximation for the area of R, giving your answer to 4 decimal places.
(3)

Region R is rotated through 2π radians about the x-axis.

(c) Use calculus to find the exact volume of the solid formed.
(4)

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Question 3 continued

(b) ~~f(x)~~ $\int y\,dx \approx \frac{1}{2} \times \frac{\pi}{6} \times (1 + 1.414214 + 2(1.035276 + 1.154701))$

≈ 1.7787

(c) $\pi \int_0^{\pi/2} y^2\,dx = \pi \int_0^{\pi/2} \sec^2(\frac{1}{2}x)\,dx$

$= \pi \left[2\tan\frac{1}{2}x \right]_0^{\pi/2}$

$= \pi[(2\tan\frac{\pi}{4}) - (2\tan 0)]$

$= \pi(2 - 0) = 2\pi$

Turn over

Leave blank

Question 3 continued

Leave blank

Question 3 continued

Q3

(Total 8 marks)

8

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4. A curve C has parametric equations

$$x = 2\sin t, \quad y = 1 - \cos 2t, \quad -\frac{\pi}{2} \leqslant t \leqslant \frac{\pi}{2}$$

(a) Find $\frac{dy}{dx}$ at the point where $t = \frac{\pi}{6}$

(4)

(b) Find a cartesian equation for C in the form

$$y = f(x), \quad -k \leqslant x \leqslant k,$$

stating the value of the constant k.

(3)

(c) Write down the range of $f(x)$.

(2)

1 Q04aM1
1 Q04aA1
1 Q04aM2
1 Q04aA2
1 Q04bM
1 Q04bA
1 Q04bB
1 Q04cB1
0 Q04cB2

(a) $x = 2\sin t, \quad y = 1 - \cos 2t$

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

$\frac{dy}{dt} = 2\sin 2t \qquad \frac{dx}{dt} = 2\cos t$

$\frac{dy}{dx} = 2\sin 2t \times \frac{1}{2\cos t} = \frac{2\sin 2t}{2\cos t} = \frac{\sin 2t}{\cos t}$

Sub, $t = \frac{\pi}{6} \Rightarrow dy/dx = \frac{\sin 2(\pi/6)}{\cos(\pi/6)} = 1$

(b) $y = 1 - \cos 2t$

$y = 1 - (\cos^2 t - \sin^2 t)$

$= 1 - \cos^2 t + \sin^2 t$

$= 1 - (1 - \sin^2 t) + \sin^2 t$

$= 2\sin^2 t \qquad x = 2\sin t$

$y = 2\left(\frac{x}{2}\right)^2 \qquad \sin t = \frac{x}{2}$

$y = \frac{2x^2}{4} = \frac{x^2}{2}$

$y = \frac{x^2}{2} \qquad -\frac{\pi}{2} \leq t \leq \pi/2$

$x = 2\sin t$

$x = 2\sin(-\pi/2) \qquad x = 2\sin\left(\frac{\pi}{2}\right)$

$= -2 \qquad = 2.$

Leave blank

Question 4 continued

$y = \frac{x^2}{2} \quad -2 \le x \le 2$

e) $y \ge 0 \quad y \in \mathbb{R}$

Leave blank

Question 4 continued

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Question 4 continued

Q4

8

(Total 9 marks)

5. (a) Use the substitution $x = u^2$, $u > 0$, to show that

$$\int \frac{1}{x(2\sqrt{x}-1)}\,dx = \int \frac{2}{u(2u-1)}\,du$$

(3)

(b) Hence show that

$$\int_1^9 \frac{1}{x(2\sqrt{x}-1)}\,dx = 2\ln\left(\frac{a}{b}\right)$$

where a and b are integers to be determined.

(7)

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1 Q05aB
1 Q05aM
1 Q05aA
1 Q05bM1
1 Q05bA1
1 Q05bM2
1 Q05bA2
1 Q05bB
1 Q05bM3
1 Q05bA3

(a) $\int \frac{1}{x(2\sqrt{x}-1)}\,dx$ $\quad x = u^2 \quad x^{1/2} = u$

$\frac{dx}{du} = 2u$

$dx = 2u\,du$

$= \int \frac{1}{u^2(2u-1)} \times 2u\,du$

$= \int \frac{2u}{u^2(2u-1)}\,du = \int \frac{2}{u(2u-1)}\,du$

(b) $\int_{x=1}^{x=9} \frac{1}{x(2\sqrt{x}-1)}\,dx$

$u = \sqrt{x}$ New limits $\Rightarrow$ $u = \sqrt{9} = 3$

$u = \sqrt{1} = 1.$

$\therefore = \int_{u=1}^{u=3} \frac{2}{u(2u-1)}\,du.$

$\frac{2}{u(2u-1)} = \frac{A}{u} + \frac{B}{2u-1}$

$2 = A(2u-1) + B(u)$

let $x = 0$, $2 = -1A$ $\qquad$ let $x = \frac{1}{2}$, $2 = A(1-1) + \frac{1}{2}B$

$A = -2$ $\qquad$ $B = 4$

P 4 3 1 3 7 A 0 1 6 3 2

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Question 5 continued

$$\therefore \frac{2}{u(2u-1)} = \frac{4}{2u-1} - \frac{2}{u}$$

$$\int_1^3 \frac{2}{u(2u-1)}\,du = \int_1^3 \frac{4}{2u-1}\,du - \int_1^3 \frac{2}{u}\,du$$

$$= 4\int_1^3 \frac{1}{2u-1}\,du - 2\int_1^3 \frac{1}{u}\,du$$

$$= 4\left[\tfrac{1}{2}\ln|2u-1|\right]_1^3 - 2\left[\ln|u|\right]_1^3$$

$$= 4\left[\left(\tfrac{1}{2}\ln|2(3)-1|\right) - \left(\tfrac{1}{2}\ln|2(1)-1|\right)\right] - 2\left[\ln|u|\right]_1^3$$

$$= 4\left[\tfrac{1}{2}\ln|5| - \tfrac{1}{2}\ln|1|\right] - 2\left[\ln|u|\right]_1^3$$

$$= 2\ln|5| - 2\ln|1| - 2\left[\ln|u|\right]_1^3$$

$$= \ln|25| - 0 - 2\left[\left(\ln|3| - \ln|1|\right)\right]$$

$$= \ln|25| - 2\ln|3|$$

$$= \ln|25| - \ln|9|$$

$$= \ln\left|\frac{25}{9}\right| = \ln\left(\frac{5}{3}\right)^2 = 2\ln\left(\frac{5}{3}\right)$$

$a = 5, \quad b = 3$

P 4 3 1 3 7 A 0 1 7 3 2

3857689/17

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Question 5 continued

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Question 5 continued

Q5

(Total 10 marks)

10

6. Water is being heated in a kettle. At time t seconds, the temperature of the water is θ °C.

The rate of increase of the temperature of the water at any time t is modelled by the differential equation

$$\frac{d\theta}{dt} = \lambda(120 - \theta), \qquad \theta \leqslant 100$$

where λ is a positive constant.

Given that $\theta = 20$ when $t = 0$,

(a) solve this differential equation to show that

$$\theta = 120 - 100e^{-\lambda t}$$

(8)

When the temperature of the water reaches 100 °C, the kettle switches off.

(b) Given that $\lambda = 0.01$, find the time, to the nearest second, when the kettle switches off.

(3)

(a) $\frac{d\theta}{dt} = \lambda(120-\theta)$

$= \frac{1}{120-\theta}\, d\theta = \lambda\, dt$

$= \int \frac{1}{120-\theta}\, d\theta = \int \lambda\, dt$

$= -\ln|120-\theta| = \lambda t + c$

$= \ln|120-\theta| = -\lambda t - c$

$= 120 - \theta = e^{-\lambda t - c}$

$= 120 - \theta = e^{-\lambda t} e^{-c}$

$= \theta = 120 - e^{-\lambda t} e^{-c}$ let $A = e^{-c}$

$= \theta = 120 - Ae^{-\lambda t}$

Sub $\theta = 20$ when $t = 0$.

$20 = 120 - Ae^{-\lambda(0)}$

$-100 = -A$

$A = 100$.

$\therefore \theta = 120 - 100e^{-\lambda t}$

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1 Q06aB
1 Q06aM1
1 Q06aA1
1 Q06aM2
1 Q06aA2
1 Q06aM3
1 Q06aM4
1 Q06aA3
1 Q06bM1
1 Q06bM2
1 Q06bA

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Question 6 continued

$100 = 120 - 100e^{-0.01t}$

$-20 = -100e^{-0.01t}$

$0.2 = e^{-0.01t}$

$\ln(0.2) = -0.01t$

$t = \frac{-\ln(0.2)}{0.01} = 160.94$ seconds

Nearest second = 161 seconds.

P 4 3 1 3 7 A 0 2 1 3 2

3857689/21

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Question 6 continued

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Question 6 continued

(Total 11 marks)

Q6

11

P 4 3 1 3 7 A 0 2 3 3 2

Turn over

3857689/23

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1 Q07aM1
1 Q07aA1
1 Q07aB
1 Q07aM2
1 Q07aA2
1 Q07bM1
1 Q07bA1
1 Q07bM2
1 Q07bM3
1 Q07bA2
1 Q07bM4
1 Q07bA3

7. A curve is described by the equation

$$x^2 + 4xy + y^2 + 27 = 0$$

(a) Find $\frac{dy}{dx}$ in terms of x and y. **(5)**

A point Q lies on the curve.

The tangent to the curve at Q is parallel to the y-axis.

Given that the x coordinate of Q is negative,

(b) use your answer to part (a) to find the coordinates of Q. **(7)**

(a) $x^2 + 4xy + y^2 + 27 = 0$

$\Rightarrow 2x + 4x\frac{dy}{dx} + 4y + 2y\frac{dy}{dx} = 0$

$= 4x\frac{dy}{dx} + 2y\frac{dy}{dx} = -2x - 4y$

~~$\frac{dy}{dx}(4x+2y)$~~

$\frac{dy}{dx}(4x+2y) = -2x - 4y$

$\frac{dy}{dx} = \frac{-2x-4y}{4x+2y} = \frac{2(-x-2y)}{2(2x+y)}$

$= \frac{-x-2y}{2x+y}$

(b) $\frac{dy}{dx} = \infty, \quad \frac{-x-2y}{2x+y} = \infty$

$-x-2y = \infty$

$x - 2y = \infty$

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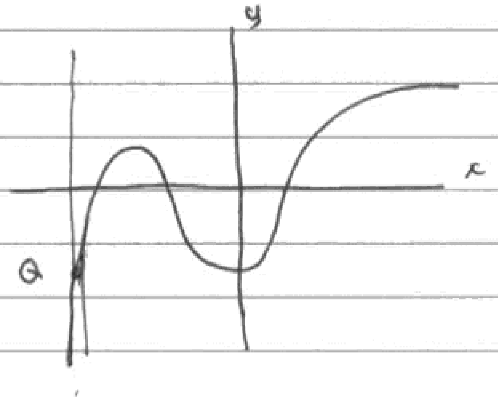
Question 7 continued



$$\frac{dy}{dx} = \infty = \frac{-x-2y}{2x+y}$$

$$2x + y = 0$$
$$y = -2x$$

$$x^2 + 4x(-2x) + (-2x)^2 + 27 = 0$$
$$x^2 - 8x^2 + 4x^2 + 27 = 0$$
$$-3x^2 = -27$$
$$x^2 = 9$$
$$x = \pm 3$$
$$y = -2(-3) = 6$$
$$y = -2(3) = -6.$$

x is negative so $Q = (-3, 6)$

Leave blank

Question 7 continued

Leave blank

Question 7 continued

(Total 12 marks)

Q7

12

Turn over

P 4 3 1 3 7 A 0 2 7 3 2

3857689/27

Leave blank

1 Q08aM1
1 Q08aA1
1 Q08aM2
1 Q08aA2
1 Q08bM1
1 Q08bA1
1 Q08bB
1 Q08bM2
1 Q08bA2

8. With respect to a fixed origin O, the line l has equation

$$\mathbf{r} = \begin{pmatrix} 13 \\ 8 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 2 \\ -1 \end{pmatrix}, \text{ where } \lambda \text{ is a scalar parameter.}$$

The point A lies on l and has coordinates $(3, -2, 6)$.

The point P has position vector $(-p\mathbf{i} + 2p\mathbf{k})$ relative to O, where p is a constant.

Given that vector $\overrightarrow{PA}$ is perpendicular to l,

(a) find the value of p.

(4)

Given also that B is a point on l such that $\angle BPA = 45°$,

(b) find the coordinates of the two possible positions of B.

(5)

(a) $\overrightarrow{PA} = \underline{a} - \underline{p} = \begin{pmatrix} 3 \\ -2 \\ 6 \end{pmatrix} - \begin{pmatrix} -p \\ 0 \\ 2p \end{pmatrix}$

$= \begin{pmatrix} 3+p \\ -2 \\ 6-2p \end{pmatrix}$ $\overrightarrow{PA}$

Perpendicular to l $\therefore$ $\overrightarrow{PA} \cdot \begin{pmatrix} 2 \\ 2 \\ -1 \end{pmatrix} = 0$.

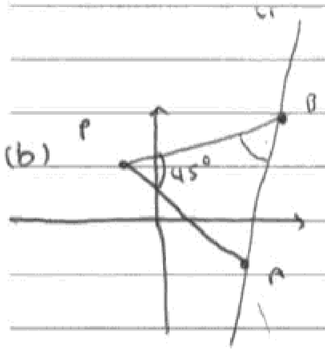
$\begin{pmatrix} 3+p \\ -2 \\ 6-2p \end{pmatrix} \cdot \begin{pmatrix} 2 \\ 2 \\ -1 \end{pmatrix} = 2(3+p) - 2(2) - 1(6-2p) = 0$

$6 + 2p - 4 - 6 + 2p = 0$

$4p = 4$

$\boxed{p = 1}$

(b)



$\overrightarrow{PB} \cdot \overrightarrow{PA} = |\overrightarrow{PB}||\overrightarrow{PA}| \cos 45$

$\overrightarrow{PB} = \underline{b} - \underline{p} = \begin{pmatrix} x \\ y \\ z \end{pmatrix} - \begin{pmatrix} -1 \\ 0 \\ 2 \end{pmatrix}$

$= \begin{pmatrix} x+1 \\ y \\ z-2 \end{pmatrix}$

Question 8 continued

$\overrightarrow{PA} = \begin{pmatrix} 4 \\ -2 \\ 4 \end{pmatrix}$ $\quad$ $\overrightarrow{PB} = \begin{pmatrix} x+1 \\ y \\ z-2 \end{pmatrix}$

$\overrightarrow{PA} \cdot \overrightarrow{PB} = |\overrightarrow{PA}||\overrightarrow{PB}| \cos 45$

$|\overrightarrow{PA}| = \sqrt{4^2 + (-2)^2 + 4^2} = 6$

$|\overrightarrow{PB}| = \sqrt{(x+1)^2 + y^2 + (z-2)^2}$

$\begin{pmatrix} 4 \\ -2 \\ 4 \end{pmatrix} \cdot \begin{pmatrix} x+1 \\ y \\ z-2 \end{pmatrix} = 4(x+1) - 2y + 4(z-2)$

$= 4x - 2y + 4z + 4 - 8$

$= 4x - 2y + 4z - 4$

$4x - 2y + 4z = 3\sqrt{2}\left(\sqrt{((x+1)^2 + y^2 + (z-2)^2)}\right)$

$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 13 \\ 8 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 2 \\ -1 \end{pmatrix}$

$x = 13 + 2\lambda$

$y = 8 + 2\lambda$

$z = 1 - \lambda$

$\cancel{4(13+2\lambda) - 2(8+2\lambda) + 4(1-\lambda) = 3\sqrt{2}(\sqrt{(x+1)^2 + y^2 + (z-2)^2})}$

$\cancel{40 = 3\sqrt{2}(\sqrt{(x+1)^2 + y^2 + (z-2)^2})}$

$\cancel{1600 = 18((x+1)^2 + y^2 + (z-2)^2)}$

$\cancel{\frac{800}{9} = (x+1)^2 + y^2 + (z-2)^2}$

$\cancel{\frac{800}{9} = (14+2\lambda)^2 + (8+2\lambda)^2 + (-1-\lambda)^2}$

$\cancel{\frac{800}{9} = 196 + 56\lambda + 4\lambda^2 + 64 + 32\lambda + 4\lambda^2 + 1 + 2\lambda + \lambda^2}$

$\cancel{\frac{1549}{9} \quad 9\lambda^2 + 90\lambda + \frac{1549}{9} = 0}$

$\cancel{x = \frac{-45 \pm \sqrt{\ldots}}{9}}$

$\cancel{x = 7.83 \quad y = 2.85 \quad z = 3.58}$

Question 8 continued

~~or $x = -1.85$ $y = -6.85$ $z = 8.42$~~

~~$B\begin{pmatrix} -1.85 \\ -6.85 \\ 8.42 \end{pmatrix}$ or $B\begin{pmatrix} 7.85 \\ 2.85 \\ 3.85 \end{pmatrix}$~~

$\angle BPA = 45^\circ$

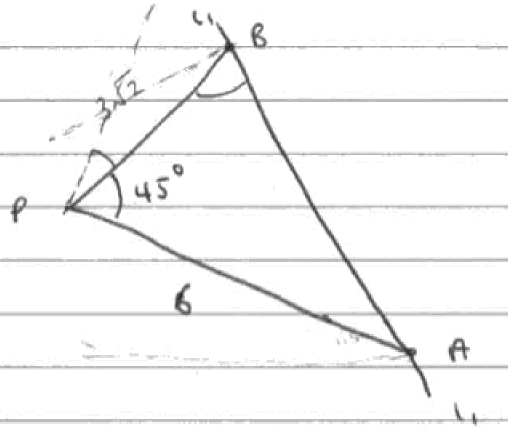
$B \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 13 \\ 8 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 2 \\ -1 \end{pmatrix}$

$x = 13 + 2\lambda$

$y = 8 + 2\lambda$

$z = 1 - \lambda$

$\vec{BP} \cdot \vec{AP} = |\vec{BP}||\vec{AP}| \cos 45$



~~$|\vec{AB}| = \sqrt{6}\ 2\ldots =$~~

$\vec{PB} = \underline{b} - \underline{p} = \begin{pmatrix} x \\ y \\ z \end{pmatrix} - \begin{pmatrix} -1 \\ 0 \\ 2 \end{pmatrix} = \begin{pmatrix} x + 1 \\ y \\ z - 2 \end{pmatrix}$

$|\vec{PA}| = \sqrt{4^2 + (-2)^2 + 4^2} = 6$

$\longrightarrow$

Leave blank

Question 8 continued

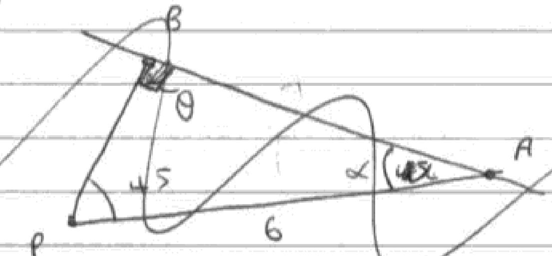
~~$|\vec{PB}| |\vec{BP}| |\vec{AP}| \cos 45 = \vec{AP} \cdot \vec{BA}$~~

$\vec{AP} = \underline{p} - a = \begin{pmatrix} -1 \\ 0 \\ 2 \end{pmatrix} - \begin{pmatrix} 3 \\ -2 \\ 6 \end{pmatrix} = \begin{pmatrix} -4 \\ 2 \\ -4 \end{pmatrix}$

$|\vec{AP}| = 6.$

$\vec{BP} = \underline{p} - b = \begin{pmatrix} -1 \\ 0 \\ 2 \end{pmatrix} - \begin{pmatrix} x \\ y \\ 2 \end{pmatrix} = \begin{pmatrix} -1-x \\ -y \\ z-2 \end{pmatrix}.$

$|\vec{PB}| = 6\cos 45 = 3\sqrt{2}$



$\vec{PA} \cdot \vec{PB} = 0$

$\begin{pmatrix} 4 \\ -2 \\ 4 \end{pmatrix} \cdot \begin{pmatrix} x+2 \\ y \\ z-2 \end{pmatrix} = 4(x+2) - 2y + 4(z-2) = 0$

$= 4x + 8 - 2y + 4z - 8 = 0$

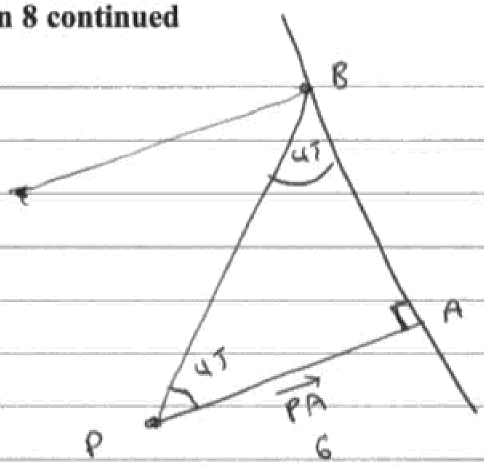
~~$: 4x - 2y + 4z = 0$~~

~~$4(3+2\lambda) - 2(8+2\lambda) + 4(1-\lambda) = 0$~~

~~$12 + 8\lambda - 16 - 4\lambda + 4 - 4\lambda = 0$~~

⟶ Turn over

Question 8 continued



$\underline{\cancel{8}\sin\theta}$ $\cancel{a}$. $\frac{\sin A}{a} = \frac{\sin B}{b}$

$\frac{\sin 45}{6} = \frac{\sin 90}{|PB|}$

$|\overrightarrow{PB}| = 6\sqrt{2}.$

$|\overrightarrow{PB}| = \left| \begin{pmatrix} x+1 \\ y \\ z-2 \end{pmatrix} \right| = \sqrt{(x+1)^2 + y^2 + (z-2)^2}$

$6\sqrt{2} = \sqrt{(x+1)^2 + y^2 + (z-2)^2}$

$72 = (x+1)^2 + y^2 + (z-2)^2$

$72 = (\cancel{13}\ 13 + 2\lambda + 1)^2 + (8+2\lambda)^2 + (1-\lambda-2)^2$

$72 = (2\lambda + 14)^2 + (2\lambda + 8)^2 + (-\lambda - 1)^2$

$\cancel{72 = 4\lambda^2 + 60\lambda + \overset{196}{225} + 4\lambda^2 + 32\lambda + 64 + \lambda^2 + 2\lambda + 1}$

$\cancel{72 = 9\lambda^2 + 94\lambda + 290}$

$\cancel{9\lambda^2 + 94\lambda + 218 = 0}$

$72 = 4\lambda^2 + 56\lambda + 196 + 4\lambda^2 + 32\lambda + 64 + \lambda^2 + 2\lambda + 1$

$72 = 9\lambda^2 + 90\lambda + 261$

$9\lambda^2 + 90\lambda + 189 = 0$

$\lambda^2 + 10\lambda + 21 = 0$

$(\lambda + 3)(\lambda + 7)$

$\lambda = -3$ or 7

Q8 9

(Total 9 marks)

TOTAL FOR PAPER: 75 MARKS

END

ADDITIONAL ANSWER SHEET

GCSE, GCE, VCE and GNVQ Examining Bodies

Examining body	Edexcel	Centre number	10658
Candidate name	Liam Eloie	Candidate number	5077
Paper reference	6666/01	Sheet number	33

Question number | Leave blank

8b $\lambda^2 + 10\lambda + 21 = 0$

$(\lambda + 3)(\lambda + 7) = 0$

$\lambda = -3$ or -7.

$x = 13 + 2\lambda$

$y = 8 + 2\lambda$

$z = 1 - \lambda$

When $\lambda = -3$, $x = 13 + 2(-3) = 7$

$y = 8 + 2(-3) = 2$

$z = 1 - (-3) = 4$

When $\lambda = -7$ $x = 13 + 2(-7) = -1$

$y = 8 + 2(-7) = -6$

$z = 1 - (-7) = 8$

Therefore $\boxed{B = \begin{pmatrix} 7 \\ 2 \\ 4 \end{pmatrix} \text{ or } \begin{pmatrix} -1 \\ -6 \\ 8 \end{pmatrix}}$

ASL1

Question number

Leave blank