QUESTION ONE **(12 MARKS)**

(a) Factorise completely $y^3 - 3y^2 + y - 3$. 2

(b) Solve $x^2 - 2x - 3 \geq 0$. 2

(c) Find a and b if $\left(4 - 2\sqrt{7}\right)^2 = a + b\sqrt{7}$. 2

(d) Solve $|2x - 1| = 9$. 2

(e) Evaluate $\log_3 7$ correct to 3 significant figures. 2

(f) If the line $kx + 3y - 7 = 0$ has a gradient of 2, find the value of k. 2

END OF QUESTION ONE

QUESTION TWO - Start a new booklet. **(12 MARKS)**

(a) Solve the following simultaneous equations: 2

$$3x - y = 8$$
$$2x + 3y = -2$$

(b) Differentiate the following:

(i) $y = \left(5x^3 - 4\right)^5$. 2

(ii) $y = \dfrac{2x}{x-3}$. 2

(iii) $f(x) = 3xe^{2x}$. 2

(iv) $f(x) = \ln\left(3x^2 + 3x\right)$, giving your answer in simplest form. 2

(c) Find the exact value of $\sin 240^\circ \times \sec 45^\circ$. 2

END OF QUESTION TWO

QUESTION THREE- Start a new booklet. **(12 MARKS)**

(a) Find $\int \frac{x}{x^2+4}\,dx$. 2

(b) Evaluate $\int_0^{\frac{\pi}{6}} \sec^2 2x \; dx$, giving your answer in exact form. 3

(c) Evaluate $\int_0^{2} 2x\,e^{3x^2}\,dx$**,** giving your answer in exact form. 2

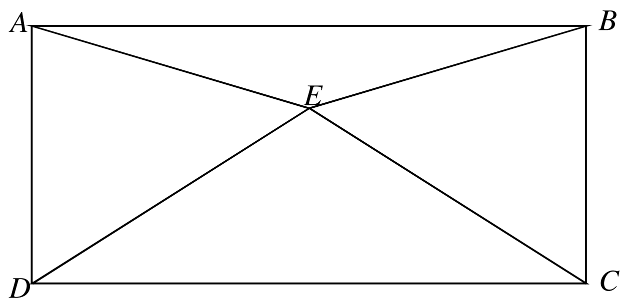
(d) Find k such that $\int_0^{k} (3+2x)\,dx = 4$. 3

(e) Evaluate $\sum_{r=1}^{10} 2^r$. 2

END OF QUESTION THREE

QUESTION FOUR- Start a new booklet. (12 MARKS)

(a) In the rectangle $ABCD$ below, $AE = EB$ and $\angle BAE = 15^\circ$.



Copy and label the diagram above into your booklet.

(i) Explain why $\angle DAE = \angle CBE$. 1

(ii) Prove $\Delta DAE \equiv \Delta CBE$. 2

(iii) Hence prove that ΔDEC is isosceles. 1

(b) (i) Express $y^2 - 2x - 8 = 0$, in the form $(y-k)^2 = 4a(x-h)$, and hence find: 1

(ii) the focal length. 1

(iii) the co-ordinates of the vertex. 1

(iv) the co-ordinates of the focus. 1

(v) the equation of the directrix. 1

(vi) the equation of the focal chord which also passes through the point (4, 4). 3

END OF QUESTION FOUR

QUESTION FIVE - Start a new booklet. **(12 MARKS)**

(a) A, B, and C are points (3, 2), (–2, 4), and (5, – 1) respectively.

(i) Draw a diagram in your booklet, representing A, B and C. 1

(ii) Find the gradient of BC. 2

(iii) Find the equation of BC in general form. 2

(iv) Find the perpendicular distance of A to BC, giving your answer in simplest surd form. 2

(b) Show that $\dfrac{\tan\theta\sec\theta}{1+\tan^2\theta} = \sin\theta$. 2

(c) (i) Find the locus of the point P (x, y), which moves so that the line PA is perpendicular to the line PB where A is (4, 3) and B is $(-2,-1)$. 2

(ii) Interpret this locus geometrically. 1

END OF QUESTION FIVE

QUESTION SIX - Start a new booklet. **(12 MARKS)**

(a) (i) On the same axes, sketch the graphs of $y = 3x^2 + 2$ and $y = 7x$. 1

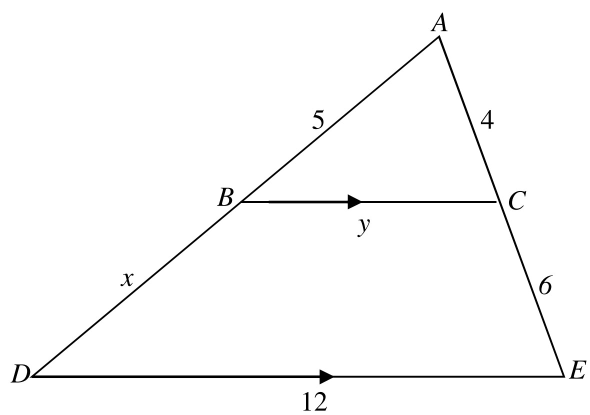
(ii) Find the x co-ordinates of the points of intersection. 2

(iii) Hence, use the graphs to solve the inequation $7x \geq 3x^2 + 2$. 1

(b) Sketch the region simultaneously defined by $y \geq |x-3|$ and $y < 3$, 2

labelling all intercepts, and points of intersection.

(c)



Not to scale

(i) Show that $\Delta ABC \;|||\; \Delta ADE$. 2

(ii) Hence find the values of x and y. 4

END OF QUESTION SIX

QUESTION SEVEN - Start a new booklet. **(12 MARKS)**

(a) Given that $y = 2x\log_e x$, find, giving your answers in exact form:

(i) $\dfrac{dy}{dx}$. 1

(ii) the co-ordinates of the stationary point, and determine its nature. 4

(b) Ayla is saving for a holiday. In the first month she saves \$30. In the second month she saves \$35. In each subsequent month her savings are \$5 more than the month before.

(i) How much will she save in the 17^{th} month? 1

(ii) How much money will she have saved in total by the 17^{th} month? 2

(iii) Ayla needs \$2100 to pay for her plane ticket. How long will it take her to save this amount? 2

(c) Rory decided to donate \$3000 to charity. A year later he donated $\dfrac{7}{8}$ of this amount to the same charity. He continued to donate in this way each succeeding year.

(i) In which year would Rory first make a donation of less than \$1000? 1

(ii) What is the greatest total amount that the charity can expect to receive? 1

END OF QUESTION SEVEN

QUESTION EIGHT - Start a new booklet. **(12 MARKS)**

(a) Use Simpson's Rule with 3 function values to find an approximation for 3

$\int_1^3 3\log_e x \, dx$, giving your answer correct to 2 decimal places.

(b) Solve $3\tan 2x = \sqrt{3}$, $0 \le x \le 2\pi$. 3

(c) A particle is travelling in a straight line, starting from rest at the origin, such that

$\frac{d^2x}{dt^2} = \frac{8}{(t+1)^2}$, where x is displacement in metres and t is time in seconds.

(i) Show that the acceleration is always positive. 1

(ii) Find an expression for the velocity. 2

(iii) Show that the distance covered between $t = 2$ seconds and $t = 5$ seconds is $(24 - 8\log_e 2)$ metres. 3

END OF QUESTION EIGHT

QUESTION NINE - Start a new booklet. **(12 MARKS)**

(a) A quadratic function is given by $f(x) = x^2 + mx - 3$, and $f(-1) = 5$.

(i) Find the value of m. 1

(ii) If the roots of the function are α and β, find the value of $\alpha^2 + \beta^2$. 2

(b) Calculate the volume of solid of revolution if the hyperbola $y = \frac{4}{x}$ is rotated about the x axis from $x = 1$ to $x = 4$. 2

(c) The number of bacteria in a culture is growing according to the formula $N = 300e^{kt}$, where t is time in hours.

(i) What was the initial number of bacteria in the culture? 1

(ii) If, after 8 hours, the number of bacteria has doubled, calculate the value of k correct to 4 decimal places. 2

(iii) How long would it take for the number of bacteria to rise to 3000? Give your answer correct to the nearest minute. 2

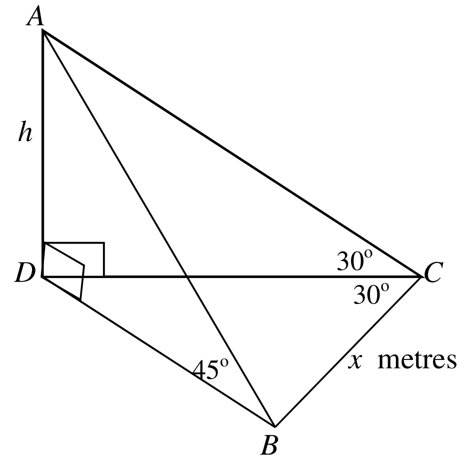
(iv) How many bacteria would there be after 16 hours? 1

(v) At what rate will the bacteria be increasing after 16 hours? 1

END OF QUESTION NINE

QUESTION TEN - Start a new booklet. **(12 MARKS)**

(a) AD, an upright tower of height h metres, is standing on level ground. The angles of elevation to the top of the tower from points C and B on the ground, are 30° and 45° respectively, and $\angle DCB = 30^{\circ}$.



(i) Find the lengths of BD and CD in terms of h. 2

(ii) By considering ΔDCB, show that $2h^2 = 3xh - x^2$. 3

(b) A sector AOB, with radius R and $\angle AOB = \theta$, has an area of 625cm^2.

(i) Show that $\theta = \dfrac{1250}{R^2}$. 1

(ii) Show that the perimeter (P) of the sector can be given by: $P = 2R + \dfrac{1250}{R}$. 1

(iii) Find the value of R that is required to give a minimum perimeter. 3

(c) Angus takes out a student loan of \$5000 at 2.25% interest per month, reducible monthly. Regular repayments are made at monthly intervals. What should each repayment be if he wishes to pay off the loan in 5 years? 2

END OF EXAMINATION

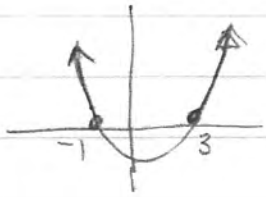
Solutions 2011 2UNIT TRIAL

Q1 (a) $y^3 - 3y^2 + y - 3 = y^2(y-3) + 1(y-3)$ (1)

$= (y^2+1)(y-3)$ (1)

(b) $x^2 - 2x - 3 \geq 0$

$(x+1)(x-3) \geq 0.$ (1)



$x \geq 3$ or $x \leq -1$ (1)

(c) $(4-2\sqrt{7})(4-2\sqrt{7}) = 16 - 16\sqrt{7} + 28$

$\therefore \quad a + b\sqrt{7} = 44 - 16\sqrt{7}$ (1)

$a = 44, \quad b = -16$ (1)

(d) $|2x-1| = 9$

$2x - 1 = 9$ or $2x - 1 = -9$

$2x = 10$ $\qquad$ $2x = -8$

(1) $\underline{x = 5}$ $\qquad$ (1) $\underline{x = -4}$

(e) $\log_3 7 = \dfrac{\log_{10} 7}{\log_{10} 3} = 1.77$ $(\underline{\underline{3}}\text{ sf})$

(1) (1)

(f) $kx + 3y - 7 = 0$

$3y = -kx + 7$

$y = \dfrac{-k}{3}x + \dfrac{7}{3}$ (1)

$\dfrac{-k}{3} = 2$ $\qquad$ $\underline{k = -6}$ (1)

Q2 (a) $3x - y = 8$ — ① $\times 3$ $9x - 3y = 24$

$2x + 3y = -2$ — ② $2x + 3y = -2.$

① + ② $11x = 22$ $y = 3(2) - 8$

$\underline{x = 2}$ (1) $\underline{= -2}$ (1)

(b) i/ $y = (5x^3 - 4)^5$

$y' = 5(5x^3 - 4)^4 (15x^2)$ (1)

$= 75x^2 (5x^3 - 4)^4$ (1)

ii/ $y = \dfrac{2x}{x-3}$

$y' = \dfrac{(x-3)2 - 2x(1)}{(x-3)^2}$ (1) $= \dfrac{2x - 6 - 2x}{(x-3)^2}$

$= \dfrac{-6}{(x-3)^2}$ (1)

(iii) $f(x) = 3xe^{2x}$

$f'(x) = e^{2x}.3 + 3x.2e^{2x}$ (1)

$= 3(e^{2x} + 2xe^{2x})$

$= \underline{3e^{2x}(1 + 2x)}$ (1)

(iv) $f(x) = \ln(3x^2 + 3x)$

$f'(x) = \dfrac{6x + 3}{3x^2 + 3x} = \dfrac{\cancel{3}(2x+1)}{\cancel{3}(x^2 + x)}$

$= \dfrac{2x+1}{x^2 + x}$

(c) $\cancel{\sin}\ 240 \times \sec 45 = -\dfrac{\sqrt{3}}{2} \times \sqrt{2}$ (1) $= \underline{\dfrac{-\sqrt{6}}{2}}$ (1)

Q3 (a) $\int \frac{x}{x^2+4}\,dx = \frac{1}{2}\int \frac{2x}{x^2+4}\,dx$ ①

$= \frac{1}{2}\ln(x^2+4)+C$ ①

(b) $\int_0^{\pi/6} \sec^2 2x\,dx = \left[\frac{\tan 2x}{2}\right]_0^{\pi/6}$ ①

$= \frac{1}{2}\left[\tan\frac{\pi}{3} - \tan 0\right]$ ①

$= \frac{1}{2}\left[\sqrt{3} - 0\right] = \frac{\sqrt{3}}{2}$. ①

(c) $\int_0^2 2x e^{3x^2}\,dx = \frac{1}{3}\int_0^2 6x e^{3x^2}\,dx$ ①

$= \frac{1}{3}\left[e^{3x^2}\right]_0^2$

$= \frac{1}{3}\left[e^{12} - e^0\right]$

$= \frac{e^{12}-1}{3}$ ①

(d) $\int_0^k (3+2x)\,dx = 4$

$\left[3x + x^2\right]_0^k = 4$ ①

$\left[(3k+k^2) - (0)\right] = 4$

$k^2 + 3k - 4 = 0$ ① $(k-1)(k+4) = 0$

$\therefore k = 1$ or -4

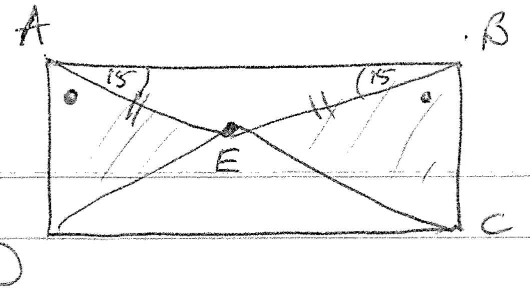
but $k > 0$ $\therefore k = 1$ ①

(e) $\sum_{r=1}^{10} 2^r = 2 + 2^2 + 2^3 + \dots 2^{10}.$ (1)

$\therefore$ a GP with $a = 2$, $r = 2$.

$S_{10} = \frac{2(2^{10}-1)}{2-1} = \underline{2046}$ (1)

4(a)



(i) $\angle EAB = \angle EBA$ (isos $\triangle$).
$\therefore \angle DAE = \angle CBE$ (right angles). (1)

(ii) In $\triangle$s DAE, CBE
AD = CB (opp sides rect)
$\angle DAE = \angle CBE$ (proved).
AE = BE (given). (1)

$\therefore \triangle DAE \equiv \triangle CBE$ (SAS) (1)

(iii) DE = EC (corr sides, cong $\triangle$s) (1)
$\therefore \triangle DEC$ is isos.

(b) (i) $y^2 - 2x - 8 = 0$ $\quad y^2 = 2x + 8$
$y^2 = 2(x + 4)$ (1)

(ii) $4a = 2 \quad \therefore \underline{a = \frac{1}{2}}$ (1)

(iii) Vertex $= (-4, 0)$ (1)

(iv) Focus $= (-3\frac{1}{2}, 0)$ (1)

(v) Dir: $\quad x = -4\frac{1}{2}$ (1)

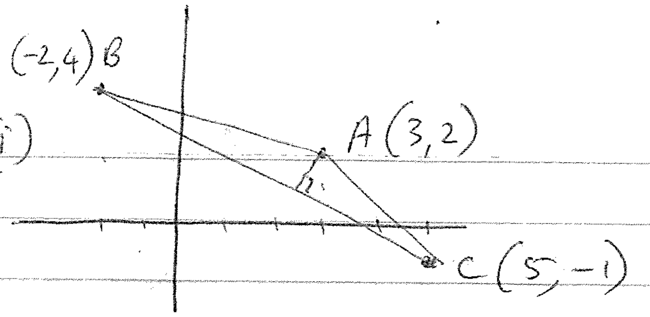
(vi) grad focal chord $= \dfrac{4-0}{4+3\frac{1}{2}} = \underline{\underline{\dfrac{8}{15}}}$ (1)

$\therefore$ Equ: $y - 0 = \dfrac{8}{15}(x + 3\frac{1}{2})$ (1)

$15y = 8x + 28$

$\therefore \underline{8x - 15y + 28 = 0}$ (1)

Q5 (a) (i)



①

(ii) $m(BC) = \frac{-1-4}{5--2} = \frac{-5}{7}$ ①

(iii) Equ BC $\quad y-4 = \frac{-5}{7}(x+2)$ ①

$7y - 28 = -5x - 10$

$\underline{5x + 7y - 18 = 0}$ ①

(iv) $d = \frac{|3\times 5 + 2\times 7 - 18|}{\sqrt{25+49}} = \frac{11}{\sqrt{74}}$ ①

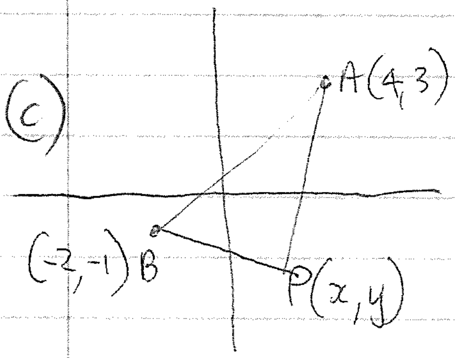
$d = \underline{\frac{11\sqrt{74}}{74}}$ ①

(b) $\frac{\tan\theta \sec\theta}{1+\tan^2\theta} = \frac{\tan\theta \cancel{\sec\theta}}{\sec^{\cancel{2}}\theta}$ ①

$= \frac{\sin\theta}{\cos\theta} \div \frac{1}{\cos\theta}$

$= \frac{\sin\theta}{\cancel{\cos\theta}} \times \cancel{\cos\theta} = \underline{\sin\theta}$ ①

(c)



$m(PA) = \frac{y-3}{x-4} \quad m(PB) = \frac{y+1}{x+2}$

$m_1 m_2 = -1$ ①

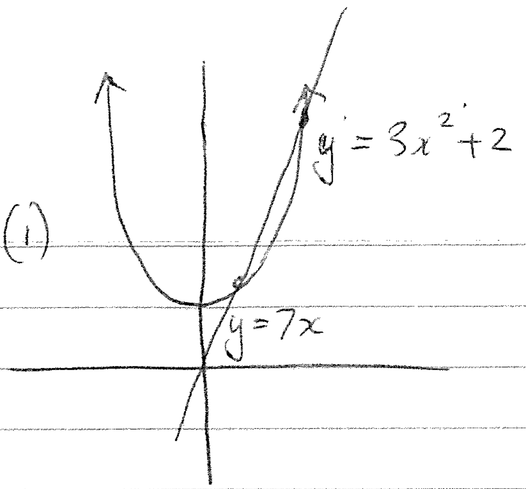
$\frac{y-3}{x-4} \times \frac{y+1}{x+2} = -1$

(i) $y^2 - 2y - 3 = -(x^2 - 2x - 8) \quad y^2 - 2y - 3 = -x^2 + 2x + 8$

$y^2 - 2y + x^2 - 2x = 11$

(ii) $(y-1)^2 + (x-1)^2 = 11 + 1 + 1$ ①

Q6 (a) (i)



①

(ii) $3x^2 + 2 = 7x$ $\qquad$ $3x^2 - 7x + 2 = 0.$

$(3x - 1)(x - 2) = 0$

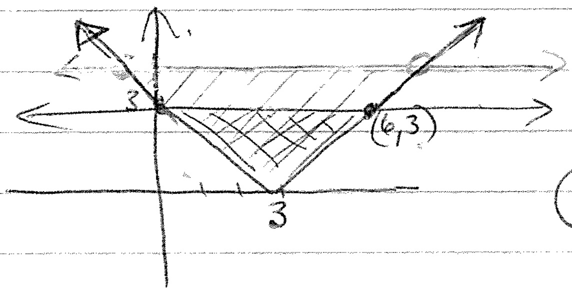
$x = \frac{1}{3}, \ 2$

$x = \frac{1}{3}, \quad y = \cancel{\frac{7}{3} = 2\frac{1}{3}}$ ①

$x = 2, \quad \cancel{y = 14}$

(iii) $7x \geq 3x^2 + 2$ $\qquad$ $\underline{\frac{1}{3} \leq x \leq 2}$ ①

(b) $y \geq |x - 3| \qquad y < 3$



②

(c) (i) In Δs ABC, ADE

$\angle ABC = \angle ADE$ (corr $\angle$'s, $\parallel$ lines)

$\angle BAC = \angle DAE$ (common) ①

$\therefore \Delta ABC \parallel\!\!| \Delta ADE$ (A A) ①

(ii) $\dfrac{5}{5+x} = \dfrac{4}{10} = \dfrac{y}{12}$

$50 = 20 + 4x$ ① $\qquad$ $48 = 10y$ ①

$30 = 4x$ $\qquad$ $\frac{48}{10} = y$

$\underline{7\frac{1}{2} = x}$ ①

$\underline{4.8 = y}$ ①

Q7 (a) $y = 2x \log x$

(i) $\frac{dy}{dx} = \log x . 2 + 2x \frac{1}{x}$

$= 2\log x + 2 = 2(\log x + 1)$ (1)

(ii) for SPs $\frac{dy}{dx} = 0$

$2(\log x + 1) = 0 \quad \therefore \log_e x = -1$

$e^{-1} = x$ (1)

$\therefore x = \frac{1}{e}, \quad y = \frac{2}{e} \log e^{-1}$

$= \frac{2}{e} . -1 = \frac{-2}{e}$ (1)

$\therefore$ SP at $\left(\frac{1}{e}, -\frac{2}{e}\right)$

Test Nature: $\frac{d^2y}{dx^2} = \frac{2}{x}$ (1)

at $x = \frac{1}{e}$ $\quad \frac{d^2y}{dx^2} = 2e > 0 \quad \therefore$ Min TP (1)

(b) $30 + 35 + 40 + \_\_\_\_$ AP with $a = 30, d = 5$

(i) $T_{17} = 30 + (16 \times 5) = \$110$ (1)

(ii) $S_{17} = \frac{17}{2}\left[60 + 16 \times 5\right] = \$1190$ (1) (1)

(iii) $S_n = 2100$ $\quad 2100 = \frac{n}{2}\left[60 + (n-1)5\right]$ (1)

$4200 = n\left[60 + 5n - 5\right]$

$4200 = 55n + 5n^2$

$$5n^2 + 55n - 4200 = 0$$

$(\div 5)$ $$n^2 + 11n - 840 = 0$$
$$(n + 35)(n - 24) = 0$$

$$\therefore n = \cancel{-35}, 24$$ (1)

$\therefore$ 24 months to get \$2100

(c) $a = 3000 \quad r = \frac{7}{8}$

(i) $T_n < 1000$

$$3000\left(\frac{7}{8}\right)^{n-1} < 1000$$
$$\left(\frac{7}{8}\right)^{n-1} < \frac{1}{3}.$$

Take logs $(n-1)\log\left(\frac{7}{8}\right) < \log\left(\frac{1}{3}\right)$

$$n-1 < \frac{\log 1/3}{\log 7/8}$$ (-ve) $\therefore$ change inequality

$$n-1 > 8.22$$
$$n > 9.22$$

$\therefore$ In the 10th year. (1)

(ii) $S_\infty = \frac{3000}{1-7/8} = \$24000$ (1)

Q8(a)

x	1	2	3
y	0	$3\ln 2$	$3\ln 3$

or Simpson's Rule

$$\int_1^3 3\ln x\,dx = \frac{1}{3}\left[0 + 4(3\ln 2) + 3\ln 3\right] \quad ①$$

$$= \frac{1}{3}\left[12\ln 2 + 3\ln 3\right] \quad ①$$

$$= 3.87 \ (2dp) \quad ①$$

(b) $3\tan 2x = \sqrt{3}$ $\qquad \tan 2x = \frac{\sqrt{3}}{3} = \frac{1}{\sqrt{3}}$

Let $u = 2x$ $\qquad \tan u = \frac{1}{\sqrt{3}}$ ①

$(0 \leq u \leq 4\pi)$

$$u = \frac{\pi}{6}, \frac{7\pi}{6}, \frac{13\pi}{6}, \frac{19\pi}{6} \quad ①$$

$$\therefore x = \frac{\pi}{12}, \frac{7\pi}{12}, \frac{13\pi}{12}, \frac{19\pi}{12} \quad ①$$

(c) $\frac{d^2x}{dt^2} = \frac{8}{(t+1)^2} = 8(t+1)^{-2}$

(i) $t > 0$, $(t+1)^2 > 0$ $\quad \therefore \frac{d^2x}{dt^2} > 0$ ①

(ii) $v = \int 8(t+1)^{-2}\,dt = \frac{8(t+1)^{-1}}{-1} + c$ ①

When $t = 0$, $v = 0$ $\qquad 0 = -8 + c \quad \therefore c = 8$

$$\therefore v = \frac{-8}{(t+1)} + 8 \quad ①$$

8c (iii)

$$x = \int_2^5 \left(\frac{-8}{t+1} + 8\right) dt$$

$$= -8\int_2^5 \frac{1}{t+1}\, dt + \int_2^5 8\, dt \quad (1)$$

$$= \Big[-8\ln(t+1)\Big]_2^5 + \Big[8t\Big]_2^5$$

$$= \Big[(-8\ln 6 + 8\ln 3)\Big] + \Big[(40-16)\Big] \quad (1)$$

$$= \Big[-8(\ln 6 - \ln 3)\Big] + 24$$

$$= -8\ln 2 + 24$$

$$= \underline{24 - 8\ln 2} \quad (1)$$

or $t=2$, $x = 16 - 8\ln 3$

$t = 5$ $x = 40 - 8\ln 6$

$$(40 - 8\ln 6) - (16 - 8\ln 3)$$

$$= 24 - 8(\ln 6 - \ln 3)$$

$$= 24 - 8\ln 2$$

Q9 (a) $f(x) = x^2 + mx - 3$

(i) $f(-1) = 5 \quad \therefore \quad 5 = 1 - m - 3$

$\underline{m = -7}$ (1)

(ii) $\left.\begin{array}{l}\alpha + \beta = 7 \\ \alpha\beta = -3 \quad (1)\end{array}\right\} \quad f(x) = x^2 - 7x - 3$

$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

$= 49 + 6$

$= \underline{55}$ (1)

(b) $V = \pi \int_1^4 \frac{16}{x^2}\, dx = \pi \int_1^4 16x^{-2}\, dx$ (1)

$= \pi \left[\frac{16x^{-1}}{-1}\right]_1^4 = \pi \left[\frac{-16}{x}\right]_1^4$

$= \pi \left[(-4) - (-16)\right] = \underline{\underline{12\pi \ u^3}}$ (1)

(c)

$N = 300e^{kt}$

(i) $t = 0, \ N = 300$ (1)

(ii) $t = 8, \ N = 600$

$600 = 300e^{8k}$ (1)

$2 = e^{8k}$

Take logs $\quad \ln 2 = 8k \ln e$

$\frac{\ln 2}{8} = k \quad \therefore \quad \underline{k = 0.0866}$ (1)

(iii) $3000 = 300e^{0.0866t}$

$10 = e^{0.0866t}$ (1)

$\ln 10 = 0.0866t \ln e$

$$t = \frac{\ln 10}{0.0866} = 26.5887\ldots$$

$$= \underline{26 \text{ hrs } 35 \text{ mins}}$$ 1

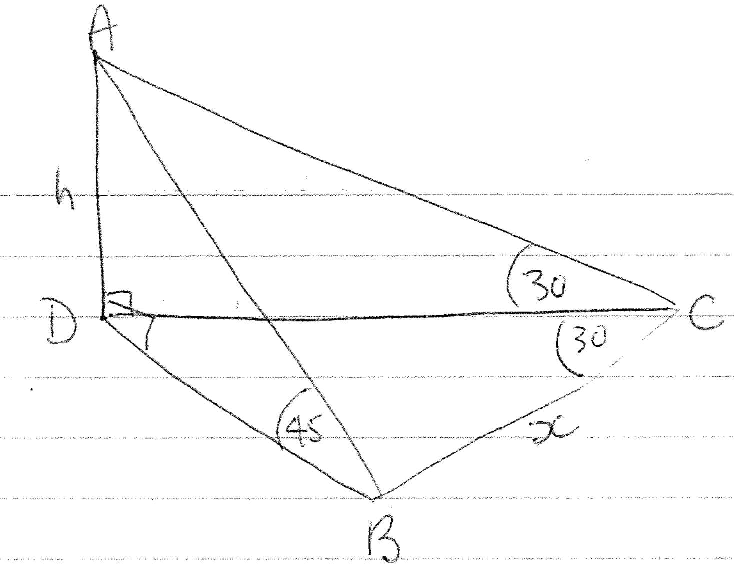
(iv) $t = 16$ $\quad N = 300e^{16 \times 0.0866}$

$$\underline{N = 1199}$$ 1

(v) $\frac{dN}{dt} = KN = 0.0866 \times 1199$

$$= \underline{103 \text{ bact/hr}}$$ 1

Q10 (a)



(i) To find BD

In $\triangle ABD$ $\quad \tan 45 = \dfrac{h}{BD}$

$$\therefore BD = \frac{h}{\tan 45} = h \quad (1)$$

To find CD

In $\triangle ACD$ $\quad \tan 30 = \dfrac{h}{DC}$

$$\therefore DC = \frac{h}{\tan 30} = \sqrt{3}\,h \quad (1)$$

(ii) In $\triangle DCB$ using Cosine Rule:

$$DB^2 = BC^2 + DC^2 - 2BC.DC \cos C \quad (1)$$

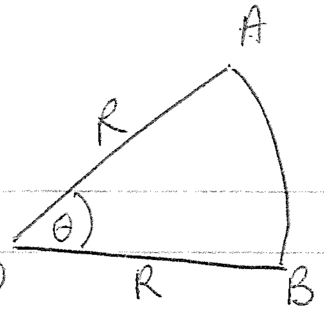
$$h^2 = x^2 + 3h^2 - 2x.\sqrt{3}h \cos 30$$

$$h^2 = x^2 + 3h^2 - \cancel{2}\sqrt{3}\,xh\,\frac{\sqrt{3}}{\cancel{2}} \quad (1)$$

$$h^2 = x^2 + 3h^2 - 3xh$$

$$\therefore 2h^2 = 3xh - h^2 \quad (1)$$

(b)



(i) $A = \frac{1}{2}R^2\theta$

$625 = \frac{1}{2}R^2\theta$

$\underline{\frac{1250}{R^2} = \theta}$ (1)

(ii)

$P = 2R + l$ and $l = R\theta$

$P = 2R + R\theta$ but $\theta = \frac{1250}{R^2}$

$\underline{P = 2R + \frac{1250}{R}}$ (1)

(iii) $P = 2R + 1250R^{-1}$

$\frac{dP}{dR} = 2 - 1250R^{-2}$

$= 2 - \frac{1250}{R^2}$ (1)

for SPs $\frac{dP}{dR} = 0$ $\frac{1250}{R^2} = 2$

$R^2 = 625$

$R = \sqrt{625}$

$\underline{= 25}$ (1)

<u>Test Nature</u>

$\frac{d^2P}{dR^2} = 2500R^{-3} = \frac{2500}{R^3} > 0$

$\therefore$ <u>MIN TP when $R = 25$</u> (1)

10(c) loan = \$5000 @ 2.25% p.m

$$A_n = 5000(1.0225)^{60} - \frac{m(1.0225^{60} - 1)}{0.0225} \quad 1$$

$A_n = 0$

$$\therefore \frac{m(1.0225^{60} - 1)}{0.0225} = 5000(1.0225)^{60}$$

$$\therefore M = \frac{5000(1.0225)^{60} \times 0.0225}{1.0225^{60} - 1}$$

$$= \underline{\$152.68} \quad 1$$