QUESTION 1 [12 marks] **Marks**

(a.) Evaluate, correct to three significant figures **2**

$$\sqrt{\frac{(2.044)^3}{35.5-1.2^2}}$$

(b.) Solve for x: $x^3 = 6x^2$ **2**

(c.) Differentiate with respect to x **2**

$$y = e^{x^2-4x}$$

(d.) Solve the pair of simultaneous equations **2**

$$2x+3y=-1$$
$$3x-y=15$$

(e.) Find a primitive of $\sin\frac{x}{2}$ **1**

(f.) Solve $|7-3x| \geq 2$ and graph your solution on the number line **3**

QUESTION 2 [12 marks]

(a.) If $\cos\theta = \frac{2}{5}$ and $\tan\theta < 0$, find the exact value of $\sin\theta$ **2**

(b.) Differentiate

i.) $x^2 \ln x$ **2**

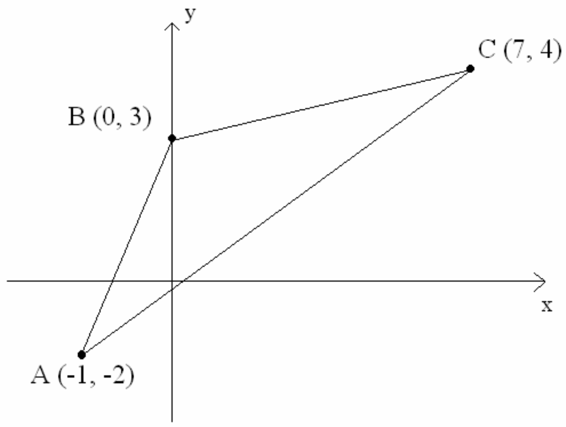
ii.) $\frac{\sqrt{x}}{3x-2}$ **2**

(c.) Find $\int \frac{x^2}{x^3+5}\,dx$ **2**

(d.) Evaluate $\int_0^{\ln 3} e^{2x}\,dx$ **2**

(e.) Solve $e^{\log_e x^3} = 27$ **2**

QUESTION 3 [12 marks] **Marks**



Not to scale

The diagram shows ΔABC with vertices A(-1, -2), B(0, 3) and C(7, 4).
Copy the diagram onto your answer sheet.

(a.) E is the midpoint of AC. Find the coordinates of E **1**

(b.) Find the gradient of AC **1**

(c.) A line l is drawn through B, perpendicular to AC. **2**
Show that the equation of line l is $4x+3y-9=0$

(d.) What is the angle that l makes with the positive x axis? **1**

(e.) Find the perpendicular distance of B from AC **2**

(f.) Find the area of ΔABC **2**

(g.) AC is the diameter of a circle

i.) Calculate the radius of the circle **1**

ii.) Hence find the equation of the circle **2**

QUESTION 4 [12 marks]

(a.) Given the parabola $y=2x^2-8x+1$, find:

i.) focal length **1**

ii.) vertex **1**

iii.) focus **1**

iv.) directrix **1**

QUESTION 4 (continued) **Marks**

(b.) The third term and the tenth term of an arithmetic series are 10 and 31 respectively. Find the:

i.) first term and the common difference **2**

ii.) sum of the first ten terms of the series **1**

(c.) Using Simpson's Rule with three function values, find an approximate value for the area represented by the definite integral **3**

$$\int_2^3 \cos^2 x \, dx$$

(d.) One hundred tickets are sold in a raffle. Two different tickets are to be drawn for first and second prizes. Bianca buys 15 tickets.
What is the probability that she:

i.) wins first prize **1**

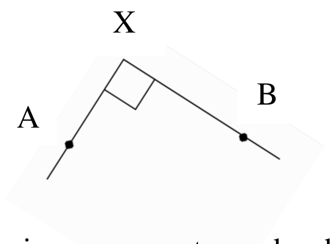
ii.) wins at least one prize **1**

QUESTION 5 [12 marks]

(a.) Find the equation of the tangent to the curve $y = \ln(x^2 + 2)$ at the point where $x = 1$. Answer in general form **4**

(b.) The gradient of the curve $y = f(x)$ is given by $f'(x) = \dfrac{2x^2 + 1}{x}$. **3**
Find the equation of the curve if it passes through the point (1, 5)

(c.)



Two athletes are jogging on separate roads which meet at right angles at town X. Athlete A is 8km from X and is travelling at 5km/h away from X. Athlete B is 10km from X and is travelling at 6km/h and travelling towards X.

i.) Show that the distance apart, P km, after t hours is given by **2**

$$P = \sqrt{61t^2 - 40t + 164}$$

ii.) Hence find their minimum distance apart . **3**

QUESTION 6 [12 marks] **Marks**

(a.) Consider the curve $y = x(x-3)^3$

i.) Find the coordinates of any stationary points and determine their nature **4**

ii.) Find the point(s) of inflexion **2**

iii.) Sketch the curve, showing clearly all features **1**

(b.) If α, β are roots of the quadratic equation $6x^2 - x + 5 = 0$, find:

i.) $\alpha + \beta$ **1**

ii.) $\alpha \times \beta$ **1**

iii.) $\alpha^2 + \beta^2$ **1**

(c.) Solve $\log_{27} 32 = x \log_3 2$ without the aid of a calculator. **2**
Show all working

QUESTION 7 [12 marks]

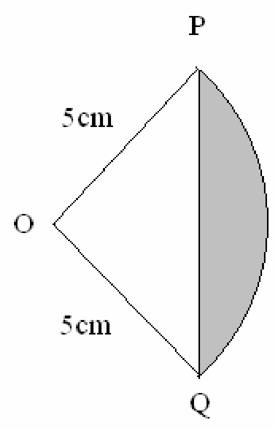
(a.) **i.)** Draw a neat sketch of the function $y = 1 - 2\sin x$ for $0 \le x \le 2\pi$ **2**

ii.) Determine the exact values where the graph cuts the x-axis in the given domain **2**

iii.) Calculate the area bounded by the curve $y = 1 - 2\sin x$, **2**

the x-axis and the lines $x = 0$ and $x = \dfrac{\pi}{2}$

(b.) In the diagram PQ is an arc of a circle with centre O and radius 5cm. The chord PQ has length 6cm.



i.) Find the size of $\angle$POQ in radians **2**

ii.) Calculate the shaded area **2**

QUESTION 7 (continued) **Marks**

(c.) Find the values of K for which the equation **2**

$(2-K)x^2 - 4(K-2)x - 5 = 0$, has two real distinct roots

QUESTION 8 [12 marks]

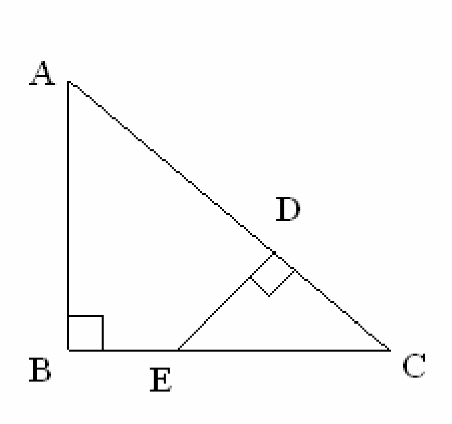
(a.) A particle, initially at rest at the origin, moves in a straight line with velocity V m/s so that $V = 5t(4-t)$ where t is the time in seconds. Find:

i.) the acceleration of the particle after 4 seconds **2**

ii.) an expression for the displacement x metres of the particle in terms of t **2**

iii.) the total distance travelled in the first 6 seconds **2**

(b.)



Not to scale

ABC is right angled at B and DE is perpendicular to AC.

i.) Prove that ΔABC and ΔCDE are similar **2**

ii.) Prove that BC × CE = AC × CD **2**

iii.) Prove that $DE^2 = AD \times DC - BE \times EC$ **2**

QUESTION 9 [12 marks] **Marks**

(a.) A bottle of solvent is open and the solvent evaporates in such a way that the amount remaining, V ml, in the bottle is given by $V = 2000e^{-0.005t}$, where t is time in hours.

i.) How much solvent is in the bottle initially? **1**

ii.) How much solvent has evaporated out of the bottle after 30 hours? **1**

iii.) How long is it before half the initial amount of solvent has evaporated from the bottle? **1**

iv.) If the solvent continues to evaporate will the bottle ever become empty? Explain. **1**

(b.) Boxes in a storeroom are stacked in a pile such that there are 25 on the bottom row, 22 on the next, 19 on the next, and so on until 117 boxes are on the pile altogether.

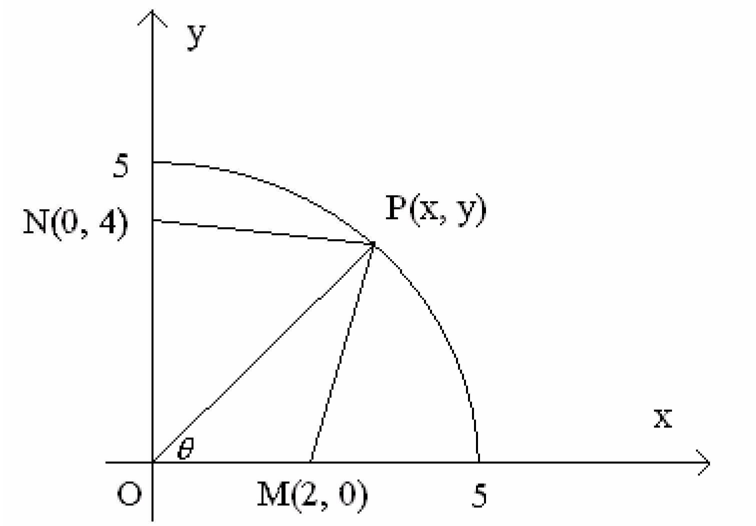
i.) How many rows of boxes are there? **2**

ii.) How many boxes are there on the top row? **1**

(c.) By expressing $1.2\dot{5}$ as the sum of an infinite geometric series, find the simple equivalent fraction for $1.2\dot{5}$. **2**

(d.) The graph $y = e^{x} - 1$ is rotated about the x-axis from $x = 1$ to $x = 3$. Find the volume generated. **3**

QUESTION 10 [12 marks] **Marks**



(a.) The diagram shows a part of the circle $x^2 + y^2 = 25$. The point P(x, y) is on the circle and O is the origin. Given M (2, 0) and N (0, 4) and $\angle$MOP is θ radians.

i.) Show that the area A, of the quadrilateral OMPN is given by **2**

$A = 5\sin\theta + 10\cos\theta$

ii.) Find the value of $\tan\theta$ for which A is maximum **3**

iii.) Hence find (in surd form) the coordinates of P for which A is maximum **2**

(b.) Alice is retiring tomorrow and her Super Fund contains $450,000. The fund is earning 15% p.a. compound interest, compounded monthly. Alice wishes to withdraw a regular amount of $6000 per month to cover her expenses.

i.) Show that after 1 month she will have an amount A in her account where $A_1 = 450000 \times 1.0125 - 6000$ **1**

ii.) Find an expression for the amount remaining after n months **1**

iii.) How many years will the money last? **2**

iv.) If she wishes to withdraw $6000 per month from her account for 30 years, use your calculator to approximate the required interest rate. **1**

End of Paper

Yr. 12 TRIAL 2007 - Answers - TOTAL (120)

Question 1 (12)

(a) $0.5007 = 0.501$ (3s.f.) (1) (1)

b) $x^3 = 6x^2$

$x^3 - 6x^2 = 0$

$x^2(x-6) = 0$

$x = 0$ (1) $\quad x = 6$ (1)

c) $y = e^{x^2-4x}$

$y' = (2x-4)\cdot e^{x^2-4x}$ (1) (1)

d) $2x + 3y = -1$

$3x - y = 15$

$x = 4$ (1) $\quad y = -3$ (1)

e) $\int \sin\frac{x}{2}\,dx = -\frac{1}{\frac{1}{2}}\cos\frac{x}{2} + c$

$= -2\cos\frac{x}{2} + c$ (1)

f) $|7-3x| \geq 2$

$7 - 3x \geq 2 \qquad 7 - 3x \leq -2$

$5 \geq 3x \qquad 9 \leq 3x$

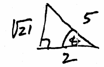
$\frac{5}{3} \geq x \qquad 3 \leq x$

$\frac{5}{3} \quad 3$ (1)

answer ∴ $x \leq \frac{5}{3}$, $x \geq 3$ (2)

Question 2 (12)

(a) $\cos\theta = \frac{2}{5}$ $\quad \tan\theta < 0$



∴ $\sin\theta = (-)\frac{\sqrt{21}}{5}$ (1) (1)

(b) i) $\frac{d}{dx}\left(x^2\ln x^2\right) = 2x\cdot\ln x^2 + x^2\cdot\frac{2x}{x^2}$ (1) (1)

$= 2x\cdot\ln x^2 + 2x$

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

(c) $\int \frac{x^2}{x^3+5}\,dx = \underbrace{\frac{1}{3}\ln(x^3+5)}_{(1)} + c$ (1)

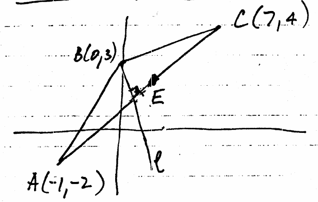
(d) $\int_0^{\ln 3} e^{2x}\,dx = \frac{1}{2}\left[e^{2x}\right]_0^{\ln 3} = 4$ (1) (1)

e) $e^{\log_e x^3} = 27$

$x^3 = 27$ (1)

$x = 3$ (1)

Question 3 (12)



(a) $E(3,1)$ (1)

(b) $m_{AC} = \frac{6}{8} = \frac{3}{4}$ (1)

(c) $m_\perp = -\frac{4}{3}$ (1)

∴ l is $y - 3 = -\frac{4}{3}(x-0)$ (1)

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

$4x + 3y - 9 = 0$ ∴ shown

(d) $\tan\theta = m_l = -\frac{4}{3}$

∴ $\theta = 126°52'$ (1)

e) $B(0,3)$

line AC ∴ $y - 4 = \frac{3}{4}(x-7)$

$3x - 4y - 5 = 0$ (1)

$d = \frac{|3\times 0 - 4\times 3 - 5|}{\sqrt{3^2+(-4)^2}} = \frac{17}{5}$ (1)

f) $\text{Area}_\Delta = \frac{1}{2}AC \times d$

$AC = \sqrt{100} = 10$ (1)

$\text{Area} = \frac{1}{2}\times 10 \times \frac{17}{5} = 17$ units^2 (1)

g) i) $r = \frac{1}{2}AC = 5$ (1)

ii) $E(3,1)$ centre (1) $r = 5$

∴ $(x-3)^2 + (y-1)^2 = 5^2$ (1)

Question 4 (12)

(a) $y = 2x^2 - 8x + 1$

$(x-m)^2 = 4a(y-n)$

$(x-2)^2 = \frac{1}{2}(y+7)$

i) focal length $a = \frac{1}{8}$ (1)

ii) vertex $(2, -7)$ (1)

iii) focus $(2, -6\frac{7}{8})$ (1)

iv) directrix $y = -7\frac{1}{8}$ (1)

(b) $T_3 = a + 2d = 10$

i) $T_{10} = a + 9d = 31$

$d = 3$ (1) $\quad a = 4$ (1)

ii) $S_{10} = 175$ (1)

(c) $\int_2^3 \cos^2 x\,dx$

x	2	2.5	3
$\cos^2 x$	0.17318	0.64183	0.98009

(1)

$A \doteqdot \frac{0.5}{3}\left[0.17318 + 4\times 0.64183 + 0.98009\right]$

$= 0.62009 \doteqdot \underline{0.62}$ (1)

(d) i) $P = \frac{15}{100}$ (1)

ii) $P = 1 - P(\text{no prize})$

$= 1 - \frac{85}{100}\times\frac{84}{99}$

$P = 0.2\dot{7}\dot{8}$ or $\frac{143}{500}$ (1)

Question 5 (12)

(a) $y = \ln(x^2+2)$

$y' = \frac{2x}{x^2+2}$ (1)

$m = \frac{2}{3}$ (1) $y = \ln 3$ (1)

$\therefore \; y - \ln 3 = \frac{2}{3}(x-1)$

$0 = 2x - 3y - 2 + 3\ln 3$ (1)

or

$0 = 2x - 3y - 2 + \ln 27$

(b) $f'(x) = \frac{2x^2+1}{x}$

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

$= \int 2x + \frac{1}{x}\,dx$

$f(x) = x^2 + \ln x + c$ (1)

$5 = 1 + 0 + c \therefore c = 4$ (1)

$\therefore f(x) = x^2 + \ln x + 4$

(c)(i) $d = \sqrt{(8+5t)^2 + (10-6t)^2}$ (1)

$= d = \sqrt{64 + 80t + 25t^2 + 100 - 120t + 36t^2}$

$P = \sqrt{61t^2 - 40t + 164}$ (1)

(ii) $P' = \frac{1}{2}(61t^2 - 40t + 164)^{-\frac{1}{2}} \times (122t - 40)$

$0 = \frac{122t - 40}{2(61t^2 - 200t + 164)^{\frac{1}{2}}}$

$0 = 122t - 40$

$\therefore t = 0.327\ldots$ (1)

$\doteqdot 0.33$ hours

showing min. (1)

t	0.3	0.33	0.4
P'	-1.7 ⊖	0	4.4 ⊕

$\therefore$ Min.

(ii) Distance Apart $= \sqrt{61(0.33)^2 - 40(0.33) + 164}$

$= 12.5$ km. (1)

Question 6 (12)

(a) $y = x(x-3)^3$

(i) $y' = 1(x-3)^3 + x \cdot 3(x-3)^2$ (1)

$0 = (x-3)^2\left[\frac{x - 3 + 3x}{4x-3}\right]$

$x = 3$ or $x = \frac{3}{4}$ ← (1) (both)

$y = 0$ ← (1) → $y = -\frac{2187}{256} = -8.54$

$y'' = 2(x-3)(4x-3) + (x-3)^2 \cdot 4$

$y'' = 2(x-3)[6x-9]$ ⊕ concavity change

$y''(3) = 0 \therefore (3,0)$ horizontal pt. of infl.

$y''\left(\frac{3}{4}\right) = \frac{81}{4} > 0 \therefore \left(\frac{3}{4}, -8.54\right)$ Min. turning (1)

(ii) $y'' = 2(x-3)[6x-9] = 0$

both (1) $\begin{cases} x = 3 \\ y = 0 \end{cases}$ $\begin{bmatrix} x = \frac{3}{2} \\ y = -\frac{81}{16} \end{bmatrix}$

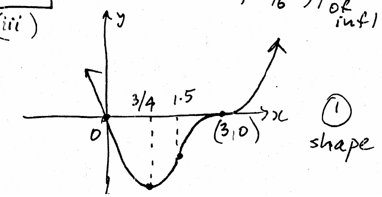
$(3,0)$ horiz. pt. of inflexion

x	1	$\frac{3}{2}$	2
y''	12	0	-6

(1) concavity changes

$\therefore \left(\frac{3}{2}, -\frac{81}{16}\right)$ pt. of infl.

(iii)



(1) shape

Question 6 cont.

(b) $6x^2 - x + 5 = 0$

(i) $\alpha + \beta = -\frac{b}{a} = \frac{1}{6}$ (1)

(ii) $\alpha \cdot \beta = \frac{c}{a} = \frac{5}{6}$ (1)

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

$= \left(\frac{1}{6}\right)^2 - 2 \times \frac{5}{6} = -\frac{59}{36}$ (1)

(c) $\log_{27} 32 = x \cdot \log_3 2$

(1) → $\frac{\log_3 32}{\log_3 27} = \log_3 2^x$

$\frac{\log_3 32}{3} = \log_3 2^x$

$\frac{1}{3}\log_3 32 = \log_3 2^x$

$\log_3 32^{\frac{1}{3}} = \log_3 2^x$

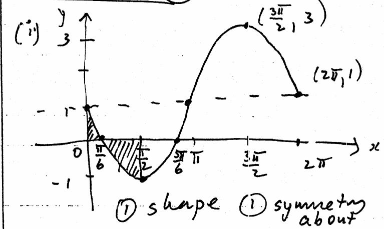
$32^{\frac{1}{3}} = 2^x$

$(2^5)^{\frac{1}{3}} = 2^x$

$\frac{5}{3} = x$ (1)

Question 7 (12)

(i)



(1) shape (1) symmetry about $y = 1$

(ii) cuts x-axis $\therefore y = 0$

$0 = 1 - 2\sin x$

$2\sin x = 1$

$\sin x = \frac{1}{2} \therefore x = \frac{\pi}{6}, \frac{5\pi}{6}$ (1) (1)

(iii) Area $= \underbrace{\int_0^{\frac{\pi}{6}} 1 - 2\sin x\,dx + \left|\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} 1 - 2\sin x\,dx\right|}$

$= \left[x + 2\cos x\right]_0^{\frac{\pi}{6}}$ (1) $+ \left|\left[x + 2\cos x\right]_{\frac{\pi}{6}}^{\frac{\pi}{2}}\right|$

$= \underbrace{\frac{\pi}{6} + 2\cos\frac{\pi}{6} - 0 - 2\cos 0}_{0.255649} + \left|\underbrace{\frac{\pi}{2} + 2\cos\frac{\pi}{2} - \frac{\pi}{6} - 2\cos\frac{\pi}{6}}_{-0.68485}\right|$

$= \underline{0.94}$ (1) [the correct answer includes the knowledge of the abs. value]

(b) i) $\cos(\angle POQ) = \frac{5^2 + 5^2 - 6^2}{2 \times 5 \times 5}$ (1)

$\theta = \angle POQ = 1.287$ radians (1)

ii) $A = \frac{1}{2}r^2\theta - \frac{1}{2}r^2\sin\angle POQ$ (1)

$= \frac{1}{2} \times 5^2 \times \theta - \frac{1}{2}5^2\sin\theta = 4.0875$ (1)

Q.7 cont.

$(2-k)x^2 - 4(k-2)x - 5 = 0$

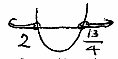
$\Delta = b^2 - 4ac > 0$

$[4(k-2)]^2 - 4\times(2-k)(-5) > 0$ ①

$16(k-2)^2 - 20(k-2) > 0$

$4(k-2)[4(k-2) - 5] > 0$

$4(k-2)[4k - 13] > 0$



$k < 2$ or $k > \frac{13}{4}$ ①

Question 8 (12)

a) $v = 5t(4-t) = 20t - 5t^2$

$t=0 \quad v=0 \quad x=0$

i) $a = \frac{dv}{dt} = 20 - 10t$ ①

$a(t=4) = -20\,m/s^2$ ①

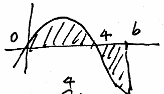
ii) $x = \int v\,dt = \int 20t - 5t^2\,dt$

$x = 10t^2 - \frac{5}{3}t^3 + c$ ①

$0 = 0 - 0 + c \therefore c = 0$ ①

$\therefore x = 10t^2 - \frac{5}{3}t^3$

iii) $v = 20t - 5t^2 = 5t(4-t)$



①

$d = \int_0^4 (20t - 5t^2)dt + \left|\int_4^6 20t - 5t^2 dt\right|$

$\therefore d = \left[10t^2 - \frac{5}{3}t^3\right]_0^4 + \left|\left[10t^2 - \frac{5}{3}t^3\right]_4^6\right|$

$\frac{160}{3} + \left|-\frac{160}{3}\right| =$

$d = \frac{320}{3} = 106.\dot{6}\,m$ ①

(b) i) $\angle C$ in common

$\angle ABC = \angle EDC = 90^\circ$ (given) ①

$\therefore \triangle ABC \parallel\parallel \triangle CDE$ (matching $\angle$'s =) ①

(ii) $\frac{EC}{AC} = \frac{CD}{BC}$ ① (matching sides in the same ratio) ①

$\therefore BC \times CE = AC \times CD$

(iii) using (i) ②

$BC \times CE = AC \times CD$

$(BE + EC) \times CE = (AD + DC) \times CD$

$BE \cdot EC + EC^2 = AD \cdot DC + DC^2$

$EC^2 - DC^2 = AD \cdot DC - BE \cdot EC$

Pythagoras

$DE^2 = AD \times DC - BE \times EC$

$\therefore$ shown

Question 9 (12)

(a) $V = 2000e^{-0.005t}$

i) $t = 0 \therefore V = 2000\,mL$ ①

ii) $V = 2000e^{-0.005\times 30} = 1721.41$

$\therefore$ evaporated $2000 - 1721.41$

$= 278.58\,mL$ ①

iii) $1000 = 2000e^{-0.005t}$

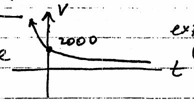
$\ln\frac{1}{2} = -0.005t$

$t = 138.629$ hours

①

Q.9 cont.

(a) iv) since



explanation ①

$V \neq 0 \therefore$ the bottle will never become empty

(b) i) $T_1 = a = 25$, $T_2 = 22$, $T_3 = 19$ — A.P $a = 25$, $d = -3$

$\therefore S_n = 117 = \frac{n}{2}(2\times 25 - (n-1)\times 3)$

or $117 = 25 + 22 + 19 + 16 + 13 + 10 + 7 + 4 + 1 \therefore$ 9 rows ②

ii) 1 box only ①

(c) $1.2\dot{5} = 1.2 + \frac{5}{100} + \frac{5}{1000} + \ldots$ ①

or $1 + \frac{2}{10} + \frac{5}{100} + \frac{5}{1000} + \ldots$

$\therefore 1.2\dot{5} = 1.2 + S_\infty \quad a = \frac{5}{100}$

$= 1.2 + \frac{a}{1-r} \quad r = \frac{1}{10}$

$1.2\dot{5} = 1.2 + \frac{50}{900} = \frac{113}{90}$ ①

(d) $V = \pi\int_1^3 (e^x - 1)^2\,dx$

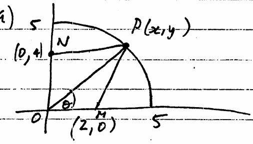
$V = \pi\int_1^3 e^{2x} - 2e^x + 1\,dx$ ①

$= \pi\left[\frac{1}{2}e^{2x} - 2e^x + x\right]_1^3$ ①

$= \pi \times 165.285 = 519.26$ ①

Question 10 (12)

a)



i) $A_{\Delta OMP} = \frac{1}{2}OM \times OP \times \sin\theta$

$= \frac{1}{2}\times 2\times 5\times\sin\theta$

$= 5\sin\theta$ ①

$A_{\Delta OPN} = \frac{1}{2}ON \times OP \times \underbrace{\sin(90^\circ - \theta)}_{\cos\theta}$ ①

$= \frac{1}{2}\times 4\times 5\times\cos\theta$

$= 10\cos\theta$

$\therefore A = 5\sin\theta + 10\cos\theta$

ii) $A' = 5\cos\theta - 10\sin\theta$ ①

$0 = 5\cos\theta - 10\sin\theta$

$10\sin\theta = 5\cos\theta$

$\tan\theta = \frac{1}{2}$ ①

showing Max: $\therefore \tan\theta = \frac{1}{2} \therefore \theta = 26.56^\circ$

$A'' = -5\sin\theta - 10\cos\theta$ ①

$A''(\theta = 26.56) = -11.18 < 0 \therefore$ Max.

iii) since $\tan\theta = \frac{1}{2} = m_{OP}$

$\therefore \frac{1}{2} = \frac{y}{x}$

and $PO = 5 = \sqrt{x^2 + y^2}$ ①

some working even different way

$\therefore \frac{1}{2} = \frac{y}{x}$

$25 = x^2 + y^2$

$x = \sqrt{20} = 2\sqrt{5}$

$y = \frac{\sqrt{20}}{2} = \sqrt{5}$

$\therefore P(2\sqrt{5}, \sqrt{5})$ ①

Q.10 cont.

b) i) $A_1 = 450\,000 \times \left(1 + \frac{1.25}{100}\right) - 6000$ ①

$= 450000 \times 1.0125 - 6000$

(ii) $A_2 = A_1 \times 1.0125 - 6000$

$= 450\,000 \times 1.0125^2 - 6000 \times 1.0125 - 6000$

$\therefore A_n = 450000 \times 1.0125^n - 6000 \times 1.0125^{n-1} - \ldots - 6000$ ①

OR $A_n = 450\,000 \times 1.0125^n - 6000\left[1.0125^{n-1} + \ldots + 1\right]$

iii) $0 = 450\,000 \times 1.0125^n - 6000 \times \left(\frac{1.0125^n - 1}{1.0125 - 1}\right)$ ①

$0 = 450000 \times 1.0125^n - 480000\left(1.0125^n - 1\right)$

$0 = 450000 \times 1.0125^n - 480000 \times 1.0125^n + 480000$

$\therefore 30\,000 \times 1.0125^n = 480000$

$1.0125^n = 16$

$n = \frac{\ln 16}{\ln 1.0125}$

① $\left\{ \begin{array}{l} n = 223.19 \text{ months} \\ \quad = 18.59 \text{ yrs } (18\text{yrs } 7.2 \text{ months}) \end{array} \right.$

(iv) Try $r = 16\%$ $\therefore r = \frac{.16}{100}$

$\therefore 450000 \times (1.013^{\cdot})^{360} = 6000 \frac{\left((1.013^{\cdot})^{360} - 1\right)}{(1.013^{\cdot} - 1)}$

$\therefore 450000 \times (1.013^{\cdot})^{360} = 6000 \times (8753.\ldots)$

$\frac{450000 \times (1.013^{\cdot})^{360}}{8753.\ldots} \doteq 6052 \doteq 6000$ ①