THE KING'S SCHOOL

2003
Higher School Certificate
Trial Examination

Mathematics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Board-approved calculators may be used
- A table of standard integrals is provided at the back of this paper
- All necessary working should be shown in every question

Total marks – 120

- Attempt Questions 1-10
- All questions are of equal value

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Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

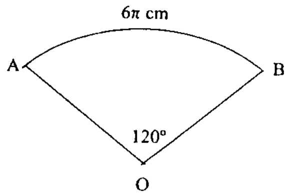
Marks

Question 1 (12 marks) Use a SEPARATE writing booklet.

(a) Find, correct to two decimal places, $\log_{12} 2003$ **2**

(b) Find the derivative of $12 - \cos 12x$ **2**

(c) In sector OAB, $\angle AOB = 120°$ and arc $AB = 6\pi$ cm. Find the radius of the sector. **2**



(d) Solve $\sqrt{2}x = 2\sqrt{3}$, expressing your solution in simplest form. **2**

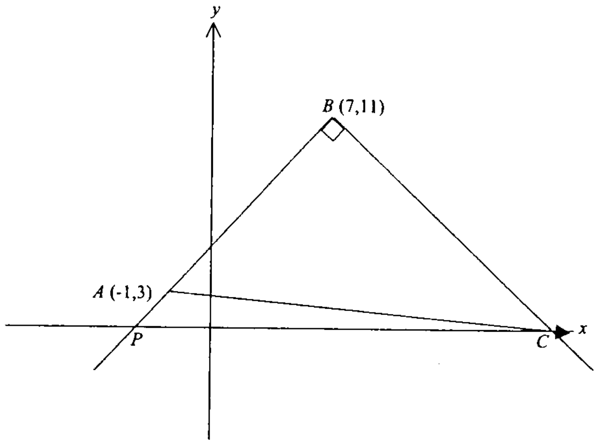
(e) Sketch the region in the number plane where $0 \le y \le e^{-x}$ **2**

(f) Simplify $\dfrac{x^2}{x + \dfrac{x}{x-1}}$ **2**

Marks

Question 2 (12 marks) Use a SEPARATE writing booklet.

(a)



In the diagram, PAB is a straight line where P is on the x axis.

ΔABC has vertices $A(-1,3)$, $B(7,11)$ and C, which is on the x axis. $\angle ABC = 90°$.

(i) Find the size of $\angle BPC$ **2**

(ii) Find the equation of BC **2**

(iii) State the coordinates of point C **1**

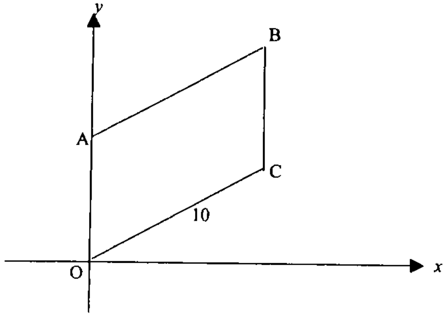
(iv) Find the area of ΔABC **2**

(v) Find the size of $\angle BAC$, nearest degree **2**

Marks

Question 2 (continued)

(b)



OABC is a parallelogram, O is the origin and A is on the y axis.
The equations of OC and AB are $y = 2x$ and $y = 2x + 5$, respectively.
The length of OC is 10 units.

Find the area of the parallelogram. **3**

Marks

Question 3 (12 marks) Use a SEPARATE writing booklet.

(a) Find, correct to 1 decimal place,

$$\int_0^{0.1} \sec^2(x+1)\,dx$$ **2**

(b) The probability that Max can correctly integrate a function is 0.7. Max is given 7 functions to integrate.

Find the probability that Max gets at least one integration wrong. Give your answer correct to 1 decimal place. **2**

(c) Find the sum of the arithmetic series

$$-7 \;+\; (-2) \;+\; 3 \;+\; \ldots \;+\; 2003$$ **3**

(d) (i) Sketch on the same diagram

$y = |x-2|$ and $y = 2x$,

showing the x and y intercepts. **2**

(ii) Hence, or otherwise,

solve $|x-2| = 2x$ **2**

(iii) Using (i), or otherwise,

find $\int_0^4 |x-2|\,dx$ **1**

Marks

Question 4 (12 marks) Use a SEPARATE writing booklet.

(a) Find the equation of the tangent to the curve $y = (x+1)e^x$ at the point where $x = 0$ **3**

(b) Prove that $\sec^2 A + \text{cosec}^2 A \equiv \sec^2 A \text{cosec}^2 A$ **3**

(c) Find the centre and radius of the circle $x^2 + y^2 = 4y$ **3**

(d) The line $y = 2x + c$ is a tangent to the parabola $y = x^2 + x$.

Find the value of c. **3**

Marks

Question 5 (12 marks) Use a SEPARATE writing booklet.

(a) Consider the curve $y = x^3(x-4)$

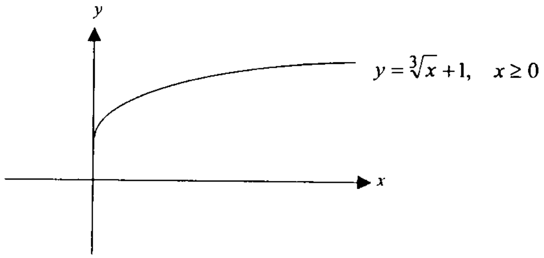
(i) State the x intercepts. 1

(ii) Show that there are stationary points at $x = 0$ and $x = 3$ 2

(iii) Show that the stationary point at $x = 0$ is a point of inflection. 2

(iv) Sketch the curve. 2

(b)



The diagram shows the sketch of $y = \sqrt[3]{x} + 1$ for $x \geq 0$

(i) Show that the line $y = \frac{1}{4}x + 1$ meets the curve $y = \sqrt[3]{x} + 1, \quad x \geq 0$, at $x = 0, \quad 8$ **1**

(ii) Copy the diagram into your booklet and include on it the line $y = \frac{1}{4}x + 1$ **1**

(iii) Find the area enclosed between the line and the curve on your diagram. **3**

Marks

Question 6 (12 marks) Use a SEPARATE writing booklet.

(a) A quantity Q is decreasing at the rate $\frac{dQ}{dt} = kQ$, k a constant.

Q is in grams and t is time measured in hours.

Initially, $Q = 30$ and 3 hours later, $Q=9$

(i) Show that $Q = 30e^{kt}$ satisfies both the initial condition and the equation $\frac{dQ}{dt} = kQ$ **2**

(ii) Find the one significant figure value for k. **2**

(iii) How much of the quantity, correct to one significant figure, will be left after a further one hour has elapsed? **2**

(b) From P, a ship sails on a bearing of 070° to A, a distance of 150 km. Also, from P, another ship sails on a bearing of 330° to B, a distance of 300 km.

(i) Draw a diagram to show the above information. **1**

(ii) Find the distance from A to B, correct to the nearest kilometre. **2**

(iii) Find the bearing of B from A, correct to the nearest degree. **3**

Marks

Question 7 (12 marks) Use a SEPARATE writing booklet.

(a) Solve the equation $(3x-1)^4 - 2(3x-1)^2 - 8 = 0$ **4**

(b) A bag contains six discs. Two of the discs have the number 0 on them and the other four discs have the number 1 on them.

Three discs are withdrawn at random.

(i) Find the probability that all of the three discs drawn have the number 1 on them. **2**

(ii) Find the probability that the product of the numbers on the three discs drawn is 0. **1**

(c) Maggie borrows \$10 000 from a bank. This loan plus interest and charges are to be repaid at the end of each month in equal monthly instalments, \$$M$, over five years. Interest of 12% p.a. on the balance owing at the start of each month is added to the account at the end of each month. Additionally, at the end of each month a management charge of \$10 is added to the account.

Let \$$A_n$ be the amount owing after n months.

(i) Show that $A_1 = 10\,000 \times 1.01 - (M - 10)$ **1**

(ii) Show that $A_2 = 10\,000 \times 1.01^2 - (M - 10)(1 + 1.01)$ **1**

(iii) Find \$$M$, correct to the nearest cent. **3**

Marks

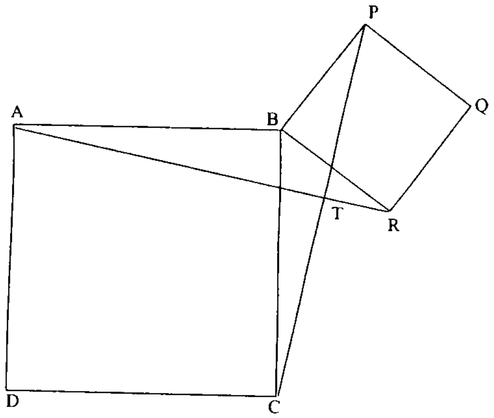
Question 8 (12 marks) Use a SEPARATE writing booklet.

(a) Find

(i) $\int \frac{4x^4}{4x^5+1}\,dx$ **2**

(ii) $\int \frac{4x^5+1}{4x^4}\,dx$ **3**

(b) In the diagram, ABCD and BPQR are squares. AR intersects PC at T.



(i) Copy the diagram into your booklet.

(ii) Prove $\Delta\text{ABR} \equiv \Delta\text{CBP}$ **3**

(iii) Why does $\angle\text{BAR} = \angle\text{PCB}$? **1**

(iv) Prove that $\text{AR} \perp \text{PC}$ **3**

Marks

Question 9 (12 marks) Use a SEPARATE writing booklet.

(a) (i) Sketch the curve $y = 2\sin\left(\frac{x}{2}\right)+1, \quad 0 \le x \le 3\pi$ **2**

(ii) The region bounded by the curve in (i) and the x axis from $x=0$ to $x=\pi$ is revolved about the x axis.

Write down a definite integral which would give the volume of the solid of revolution. **1**

(iii) Use Simpson's Rule with 3 function values to give a one decimal place approximation to the volume in (ii). **3**

(b) A particle moves on the x axis with its velocity, v m/s, given at any time, t seconds, $t \ge 0$, by $v = \frac{1}{\sqrt{2t+1}}$

Initially the particle is at the origin.

(i) Find the initial velocity and the velocity after 12 seconds. **1**

(ii) Sketch the velocity-time graph. **1**

(iii) Find the acceleration of the particle after 12 seconds. **2**

(iv) Find the displacement of the particle as a function of time. **2**

Marks

Question 10 (12 marks) Use a SEPARATE writing booklet.

(a) Find the equation of the directrix of the parabola $(x+1)^2 = 4y+2$ **2**

(b) A circle and two equal squares are to have a total perimeter of 200 cm.

Let the radius of the circle be $4x$ cm.

(i) Show that each side of the squares is $25-\pi x$ cm. **2**

(ii) Deduce that $0 \le x \le \frac{25}{\pi}$ **1**

(iii) Show that the total area, A cm^2, of the circle and the two squares is given by

$$A = 2\pi(8+\pi)x^2 - 100\pi x + 1250$$ **2**

(iv) Find the exact value for x for which A is a minimum. **3**

(v) Find the exact value of the minimum area in simplest form. **1**

(vi) Find the exact value for x for which A is a maximum. Give reasons. **1**

End of Paper

TKS TRIAL HSC 2003 SOLUTIONS

Mathematics

Qn 1

(a) $\log_{12} 2003 = \dfrac{\log_{10} 2003}{\log_{10} 12}$ or $\dfrac{\ln 2003}{\ln 12} = \boxed{3 \cdot 06}$

(b) $\dfrac{d}{dx}(12 - \cos 12x) = - -\sin 12x \times 12 = \boxed{12 \sin 12x}$

(c) $120^\circ = \dfrac{2\pi}{3}$ radians , $l = r\theta$

$\therefore \dfrac{2\pi}{3} \times r = 6\pi$

$\Rightarrow r = 6\pi \times \dfrac{3}{2\pi} = 9$

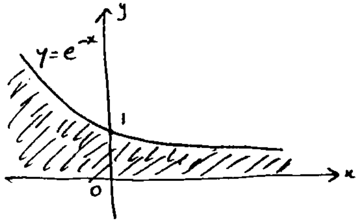
ie radius is $\boxed{9 \text{ cm}}$

OR, alternatively, $120^\circ = \frac{1}{3} \times 360^\circ$

$\Rightarrow \frac{1}{3} \times 2\pi r = 6\pi \quad \ldots \; r = 9$

(d) $x = \dfrac{2\sqrt{3}}{\sqrt{2}} = \sqrt{2}\,\sqrt{3} = \boxed{\sqrt{6}}$

(e)



(f) $\dfrac{x^2}{x + \dfrac{x}{x-1}} = \dfrac{x^2(x-1)}{x(x-1)+x}$

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

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

Qn 2

(a) (i) gradient of $AB = \dfrac{11-3}{7--1} = \dfrac{8}{8} = 1$

$\Rightarrow \tan \angle BPC = 1 \quad \therefore \boxed{\angle BPC = 45^\circ}$

(ii) gradient of $BC = -1 \quad [BC \perp AB]$

$\therefore BC$ is $y - 11 = -(x-7) = -x + 7$

ie. $\boxed{y = -x + 18}$

(iii) at C, $y = 0 \Rightarrow -x + 18 = 0$, $x = 18 \quad \therefore \boxed{C = (18, 0)}$

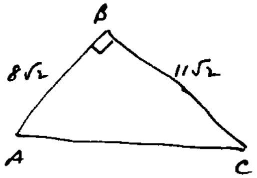
(iv) $AB = \sqrt{(7--1)^2 + (11-3)^2} = \sqrt{8^2+8^2} = 8\sqrt{2}$

$BC = \sqrt{(18-7)^2 + (11-0)^2} = \sqrt{11^2+11^2} = 11\sqrt{2}$

$\therefore$ Area $= \frac{1}{2} . 8\sqrt{2} . 11\sqrt{2}$ u² $= \boxed{88 \text{ u}^2}$

(There are alternatives, of course)

(v)



$\therefore \tan \angle BAC = \dfrac{11\sqrt{2}}{8\sqrt{2}} = \dfrac{11}{8}$

$\Rightarrow \boxed{\angle BAC = 54^\circ}$

(b) AB is $2x - y + 5 = 0$

$\therefore$ perpendicular distance from $(0,0)$ to AB

$= \dfrac{0 - 0 + 5}{\sqrt{2^2+1^2}} = \dfrac{5}{\sqrt{5}} = \sqrt{5}$

$\therefore$ Area $= 10 \times \sqrt{5}$ u² $= \boxed{10\sqrt{5}}$ units²

[There are many alternatives]

Qn 3

(a) $\int_0^{0.1} \sec^2(x+1)\,dx = \left[\tan(x+1)\right]_0^{0.1} = \tan 1.1 - \tan 1$

$= \boxed{0.4}$

(b) $P(\text{at least } 1 \text{ wrong}) = 1 - P(\text{none wrong})$

$= 1 - (0.7)^7 = \boxed{0.9}$

(c) In usual notations, $a = -7,\ d = -2 - (-7) = 5$

$\Rightarrow -7 + (n-1)5 = 2003$

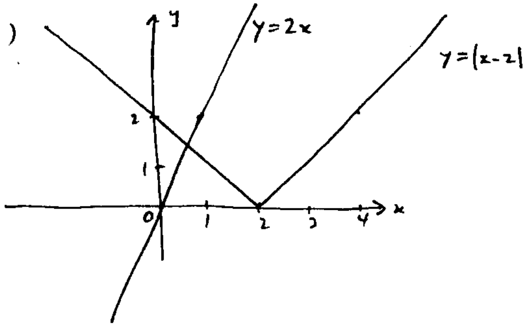
$5(n-1) = 2010$

$n - 1 = 402$

ie. $n = 403$, the number of terms

$\therefore -7 + \dots + 2003 = \frac{403}{2}(-7 + 2003) = \boxed{402194}$

(d) (i)



(ii) The diagram indicates $2x = -(x-2)$

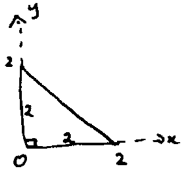
ie $2x = -x + 2$

$\therefore 3x = 2$

or, $\boxed{x = \frac{2}{3}}$

(iii) The diagram indicates $\int_0^4 |x-2|\,dx$ is twice

$= 2 \times \frac{1}{2} . 2 . 2 = \boxed{4}$



Qn 4

(a) $\frac{dy}{dx} = (x+1)e^x + e^x(1) = e^x(x+2)$

at $x = 0,\ y = 1,\ \frac{dy}{dx} = 2$

$\therefore$ tangent is $y - 1 = 2(x - 0)$ ie $\boxed{y = 2x + 1}$

(b) $\sec^2 A + \operatorname{cosec}^2 A = \frac{1}{\cos^2 A} + \frac{1}{\sin^2 A}$

$= \frac{\sin^2 A + \cos^2 A}{\cos^2 A \sin^2 A}$

$= \frac{1}{\cos^2 A \sin^2 A} = \sec^2 A \operatorname{cosec}^2 A$

(c) Rewrite as $x^2 + y^2 - 4y = 0$

$\therefore x^2 + (y-2)^2 - 4 = 0$

or $x^2 + (y-2)^2 = 4$

$\therefore$ $\boxed{\text{Centre} = (0, 2), \text{ radius is } 2}$

(d) Solving simultaneously,

$x^2 + x = 2x + c$

ie $x^2 - x - c = 0$

For the line to be a tangent we need $\Delta = 0$

$\Delta = 1 - 4(-c) = 1 + 4c = 0$ if $\boxed{c = -\frac{1}{4}}$

Alternatively, for $y = x^2 + x$, $\frac{dy}{dx} = 2x + 1$

For $y = 2x + c$, the gradient is 2

$\therefore$ we need $2x + 1 = 2$

$\Rightarrow x = \frac{1}{2}$

& $y = (\frac{1}{2})^2 + \frac{1}{2} = \frac{3}{4}$

$\therefore$ for line to be a tangent,

$\frac{3}{4} = 2 \times \frac{1}{2} + c \Rightarrow c = -\frac{1}{4}$

Qu 5

(a) (i) $\boxed{x = 0,\ 4}$

(ii) $y = x^4 - 4x^3$

$\therefore \frac{dy}{dx} = 4x^3 - 12x^2 = 4x^2(x-3)$

$= 0$ if $x = 0, 3$

i.e. there are stationary points at $x = 0, 3$

(iii) $\frac{d^2y}{dx^2} = 12x^2 - 24x = 12x(x-2)$

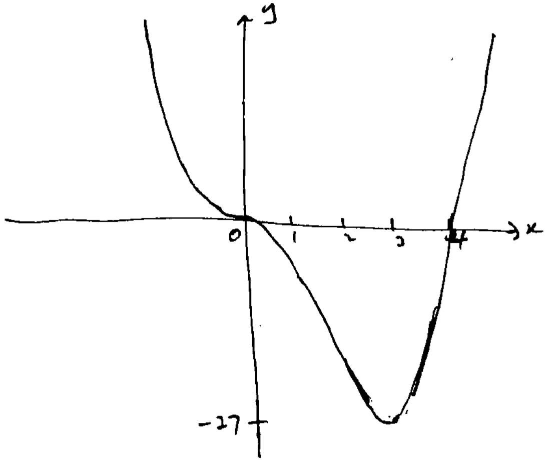
If $x = 0$, $\frac{d^2y}{dx^2} = 0$

$$\left.\begin{array}{l} \text{and if } x = -1, \ \frac{d^2y}{dx^2} = -12(-3) > 0 \\ \text{if } x = 1, \ \frac{d^2y}{dx^2} = 12(-1) < 0 \end{array}\right\} \Rightarrow \text{a change in concavity}$$

$\therefore$ at $x = 0$ there is a (horizontal) point of inflection

(iv) If $x = 3$, $y = 27(-1) = -27$

$\therefore$ combining (i), (ii), (iii) we must have



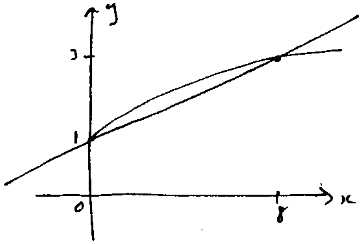
Qu 5

(b) (i) For the line, if $x = 0, 8$ then $y = 1, 3$

For the curve if $x = 0, 8$ then $y = 1, \sqrt[3]{8} + 1 = 3$

$\therefore$ result

(ii)



(iii) $A = \int_0^8 \sqrt[3]{x} + 1 - (\frac{1}{4}x + 1)\, dx$

$= \int_0^8 x^{\frac{1}{3}} - \frac{1}{4}x \quad dx$

$= \left[\frac{3x^{\frac{4}{3}}}{4} - \frac{1}{4} \cdot \frac{x^2}{2}\right]_0^8$

$= \frac{3}{4} \cdot 16 - \frac{1}{8} \cdot 64 - (0)$

$= \boxed{4\ u^2}$

Qu 6

(a) (i) if $t = 0$, $Q = 30e^0 = 30$ ∴ initial condition satisfied

Next, $\frac{dQ}{dt} = 30ke^{kt} = k(30e^{kt}) = kQ$

∴ equation $\frac{dQ}{dt} = kQ$ is satisfied

(ii) $t = 3$, $Q = 9 \Rightarrow 9 = 30e^{3k}$

or $e^{3k} = \frac{9}{30} = 0{\cdot}3$

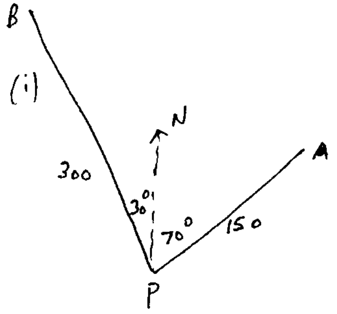
∴ $3k = \ln 0{\cdot}3$

or $k = \frac{1}{3}\ln 0{\cdot}3 = \boxed{-0{\cdot}4}$

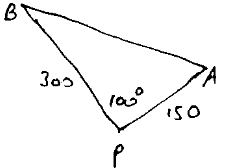
(iii) when $t = 4$, $Q = 30e^{-0\cdot4\times4} = 30e^{-1\cdot6}$

$= \boxed{6\ g}$

(b) (i)



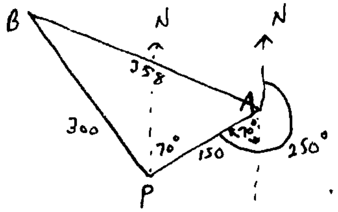
(ii)



$AB^2 = 300^2 + 150^2 - 2 \times 300 \times 150 \cos 100°$

$\Rightarrow \boxed{AB = 358\ km}$

(iii)



In ΔPAB,

$\cos A = \frac{150^2 + 358^2 - 300^2}{2.150.358}$

$\Rightarrow \hat{A} = 56°$, nearest degree

∴ bearing of B from A is

$250° + 56° = \boxed{306°}$

Q 7

(a) Put $u = (3x-1)^2$

Then, $u^2 - 2u - 8 = 0$

$(u+2)(u-4) = 0$

$\Rightarrow u = -2, 4$

∴ $(3x-1)^2 = -2$ or 4

& so, $(3x-1)^2 = 4$ only since $(3x-1)^2 \geqslant 0$

∴ $3x - 1 = 2$ or -2

Thus, $\boxed{x = 1 \text{ or } -\frac{1}{3}}$

(b) (i) $P(1\ 1\ 1) = \frac{4}{6} \times \frac{3}{5} \times \frac{2}{4} = \boxed{\frac{1}{5}}$

(ii) The product will be 0 unless all the dice are 1

∴ $P(\text{zero product}) = 1 - \frac{1}{5} = \boxed{\frac{4}{5}}$

(c) (i) 12% p.a. = 1% p.m = ·01

∴ $A_1 = 10000 + {\cdot}01 \times 10000 - M + 10$

$= 10000 \times 1{\cdot}01 - (M - 10)$

(ii) $A_2 = A_1 \times 1{\cdot}01 - M + 10$

$= 10000 \times 1{\cdot}01^2 - (M-10)\,1{\cdot}01 - (M-10)$

$= 10000 \times 1{\cdot}01^2 - (M-10)(1 + 1{\cdot}01)$

(iii) From (i), (ii),

$A_n = 10000 \times 1{\cdot}01^n - (M-10)(1 + 1{\cdot}01 + \cdots + 1{\cdot}01^{n-1})$

& if $n = 5 \times 12 = 60$, $A_n = 0$

∴ $(M-10)(1 + 1{\cdot}01 + \cdots + 1{\cdot}01^{59}) = 10000 \times 1{\cdot}01^{60}$

or $(M-10)\left(\frac{1{\cdot}01^{60} - 1}{{\cdot}01}\right) = 10000 \times 1{\cdot}01^{60}$

i.e. $M - 10 = \frac{10000 \times 1{\cdot}01^{60} \times {\cdot}01}{1{\cdot}01^{60} - 1}$ $\Rightarrow \boxed{\$M = \$232{\cdot}44}$

Qu 8

(a) (i) $\int \frac{4x^4}{4x^5+1}\,dx = \frac{1}{5}\int \frac{20x^4}{4x^5+1}\,dx = \boxed{\frac{1}{5}\ln(4x^5+1) + c}$

(ii) $\int \frac{4x^5+1}{4x^4}\,dx = \int \frac{4x^5}{4x^4} + \frac{1}{4x^4}\,dx$

$= \int x + \frac{1}{4}x^{-4}\,dx$

$= \frac{x^2}{2} + \frac{1}{4}\cdot\frac{x^{-3}}{-3} + c = \boxed{\frac{x^2}{2} - \frac{1}{12x^3} + c}$

(b) (i) In Δs ABR, CBP

$AB = BC$, sides of square $ABCD$

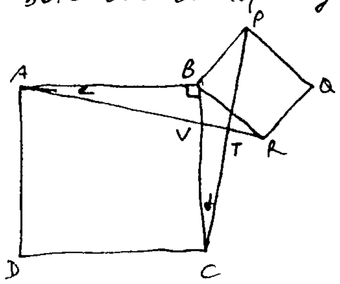
$BR = BP$, sides of square $BPQR$

$A\hat{B}R = P\hat{B}C$, both 90° plus (common) angle RBC (angle in a square)

$\therefore \Delta ABR \equiv \Delta CBP$, SAS

(ii) both are corresponding angles in congruent Δs in (i)

(iii)



Let AR meet BC at V + $\angle BAR = \alpha$

Then, $\angle BVR = 90° + \alpha$, exterior $\angle$ theorem

$\therefore \Delta ABV$ ($\angle B = 90°$, angle in a square)

$\therefore \angle VTC = 90° + \alpha - \angle VCT$, ext. $\angle$ thm in ΔVTC

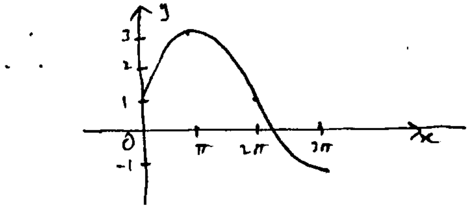
But $\angle VCT = \alpha$ (ii)

$\therefore \angle VTC = 90° \Rightarrow AR \perp PC$

Qu 9

(a) (i)

x	0	π	2π	3π
y	1	3	1	-1



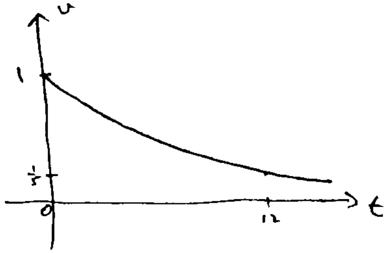
(ii) $V = \pi \int_0^{\pi} \left(2\sin\left(\frac{x}{2}\right) + 1\right)^2\,dx$

(iii) $V \simeq \pi \cdot \frac{1}{6} \cdot \pi \left[1^2 + 3^2 + 4\left(2\sin\frac{\pi}{4} + 1\right)^2\right]$ u^3

$= \boxed{54.8 \text{ u}^3}$, 1 d.p.

(b) (i) $t = 0$, $v = \boxed{1}$ m/s ; $t = 12$, $v = \frac{1}{\sqrt{25}}$ m/s $= \boxed{\frac{1}{5}}$ m/s

(ii)



(iii) $v = (2t+1)^{-\frac{1}{2}}$

$\therefore \ddot{x} = -\frac{1}{2}(2t+1)^{-\frac{3}{2}}\cdot 2 = -\frac{1}{(2t+1)^{3/2}}$

$t = 12$, $\ddot{x} = -\frac{1}{25^{3/2}}$ m/s^2 $= \boxed{-\frac{1}{125}\text{ m/s}^2}$

(iv) $x = \int (2t+1)^{-\frac{1}{2}}\,dt = \frac{2(2t+1)^{\frac{1}{2}}}{2} + c = \sqrt{2t+1} + c$

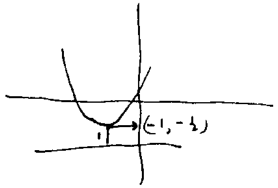
$t = 0$, $x = 0 \Rightarrow 0 = 1 + c$, $c = -1$ $\boxed{\therefore x = \sqrt{2t+1} - 1}$

Qu 10

(a) Rewrite as $(x+1)^2 = 4(y+\frac{1}{2})$

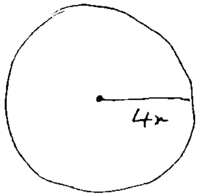
$\therefore$ Vertex $= (-1, -\frac{1}{2})$, focal length $= 1$

$\therefore$



$\Rightarrow$ directrix is $\boxed{y = -1\frac{1}{2}}$

(b)



(i) Circumference of circle $= 2\pi(4x)$
$= 8\pi x$

$\therefore$ each side of the squares

$= \dfrac{200 - 8\pi x}{8} = 25 - \pi x$

(ii) We must have $4x \geq 0$ and $25 - \pi x \geq 0$

$\Rightarrow x \geq 0$ and $\pi x \leq 25$
ie $x \leq \frac{25}{\pi}$

$\therefore \quad 0 \leq x \leq \frac{25}{\pi}$

(iii) $A = \pi(4x)^2 + 2(25 - \pi x)^2$

$= 16\pi x^2 + 2(625 - 50\pi x + \pi^2 x^2)$

$= 16\pi x^2 + 1250 - 100\pi x + 2\pi^2 x^2$

$= 2\pi(8+\pi)x^2 - 100\pi x + 1250$

(iv) $\dfrac{dA}{dx} = 4\pi(8+\pi)x - 100\pi$

$= 0$ if $x = \dfrac{100\pi}{4\pi(8+\pi)} = \dfrac{25}{8+\pi}$

$\dfrac{d^2A}{dx^2} = 4\pi(8+\pi) > 0$ for all x

$\therefore$ curve for A (a parabola) is concave upward

$\therefore$ least A occurs when $x = \dfrac{25}{8+\pi}$

(v) minimum $A = 2\pi(8+\pi)\dfrac{625}{(8+\pi)^2} - 100\pi \cdot \dfrac{25}{8+\pi} + 1250$

$= \dfrac{1250\pi}{8+\pi} - \dfrac{2500\pi}{8+\pi} + 1250$

$= 1250 - \dfrac{1250\pi}{8+\pi}$

$= \dfrac{1250(8+\pi) - 1250\pi}{8+\pi} = \dfrac{10000}{8+\pi}$

(vi) From (ii) and (iv), maximum area occurs when $x = 0$ or $x = \frac{25}{\pi}$

The axis of symmetry of the parabola $A = 2\pi(8+\pi)x^2 - 100\pi x + 1250$

is $x = \dfrac{25}{8+\pi} \simeq 2.24$

and $\dfrac{25}{\pi} \simeq 7.96$, further from 2.24 than 0

$\Rightarrow$ maximum A occurs when $x = \dfrac{25}{\pi}$