Student No: ____________________

ROSEVILLE COLLEGE

HSC MATHEMATICS
HALF-YEARLY EXAMINATION

2004

Time allowed: 3 hours + 5 minutes reading time

DIRECTIONS TO CANDIDATES:

- **Attempt all questions**
- **Board approved calculators may be used**
- **All questions are of equal value. The part marks for each section are shown on the right hand side of the page**
- **Please start each question in a new writing booklet.**
- **All necessary working should be shown. You may not be awarded the marks for an answer unsupported by working or badly arranged work.**

Question 1 *Begin a new page with your number written clearly at the top*

a) Solve $4x - 8 = 12$ **1**

b) Find the value of $\dfrac{\sqrt{12 \cdot 35 - 8 \cdot 66}}{6 \cdot 5}$ correct to two decimal places. **2**

c) Factorise fully:

i. $a^2 - b^2 + 3a + 3b$ **2**

ii. $8p^3 + 64$ **2**

d) Write down the next two terms of the following series:

i. $-1, 4, 9, \ldots$ **1**

ii. $4, 3, \dfrac{9}{4}, \ldots$ **1**

e) Express $\dfrac{2}{4 + \sqrt{3}}$ with a rational denominator. **2**

f) At Octopus Communications' annual sale, all mobile phones were discounted by 40%. Cedric paid $630 for a mobile phone at the sale. What was the original price of the phone? **1**

Question 2 *Begin a new page with your number written clearly at the top*

a) Solve the equation $\dfrac{x-6}{3} = \dfrac{4x}{5}$. **2**

b) Find the values of x for which $6x^2 - x - 2 = 0$. **2**

c) Graph the solution of $|\,2x + 3\,| \geq 2$ on the number line. **2**

d) Solve for n:

i. $n^2 - 15n + 16 = 0$ (correct to 2 decimal places). **2**

ii. $|3n - 5| = 4n - 7$. **2**

e) Find the values of **tan *x*** when $\tan^2 x + \sec^2 x = 7$. **2**

Question 3 *Begin a new page with your number written clearly at the top*

a)

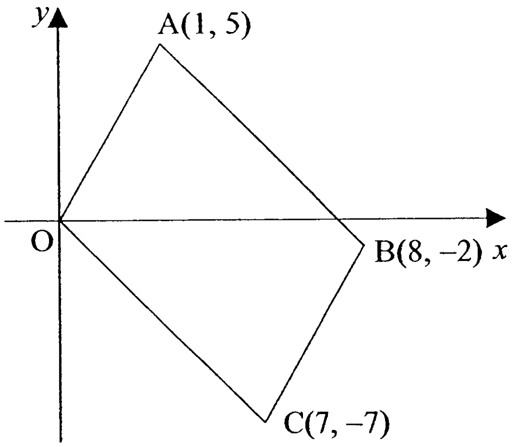
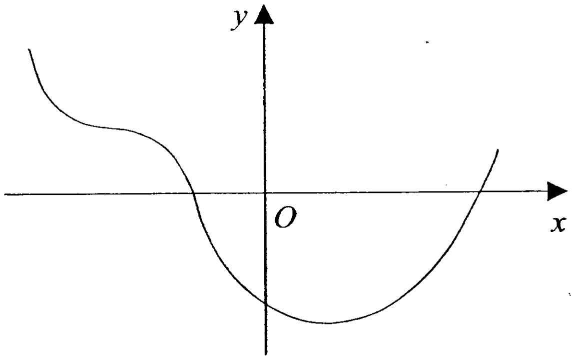


DIAGRAM NOT DRAWN TO SCALE

In the diagram O(0, 0), A(1, 5), B(8, −2) and C(7, −7) are the vertices of quadrilateral OABC.

i.	Find the midpoint of the interval joining AC.	**1**
ii.	Find the gradient of AB.	**1**
iii.	Show that the equation of AB is $x + y = 6$.	**1**
iv.	Find the exact length of AB in simplest surd form.	**1**
v.	Show that AB is parallel to OC.	**1**
vi.	Explain why OABC is a parallelogram.	**2**
vii.	Find the exact perpendicular distance from O to AB.	**2**
viii.	Hence find the area of parallelogram OABC.	**1**

b) The graph shows the graph of $y = f(x)$.



i.	Copy this graph onto your answer sheet.	
ii.	On the same set of axes, sketch the graph of its derivative, $f'(x)$.	**2**

Question 4 *Begin a new page with your number written clearly at the top*

a) If $\cos\alpha = -\frac{3}{5}$ and $\sin\alpha < 0$, find the exact value of $\tan\alpha$. **1**

b) The function $f(x)$ is defined as: $f(x) = \begin{cases} 2x & \text{for } -4 \le x < 0 \\ \sqrt{9-x^2} & \text{for } 0 \le x \le 3 \end{cases}$

- i. Find the value of $f(0)$. **1**
- ii. Sketch $y = f(x)$. **2**
- iii. State the range of $y = f(x)$. **1**

c) Differentiate with respect to x:

- i. $2x^3 + 4\sqrt{x} - 1$ **1**
- ii. $\frac{\cos x}{x}$ **2**

d) Given the equation $3x^2 + 4x - 3 = 0$ has roots α and β, evaluate the following without finding α or β:

- i. $\alpha + \beta$ **1**
- ii. $\alpha\beta$ **1**
- iii. $2\alpha^2 + 2\beta^2$ **2**

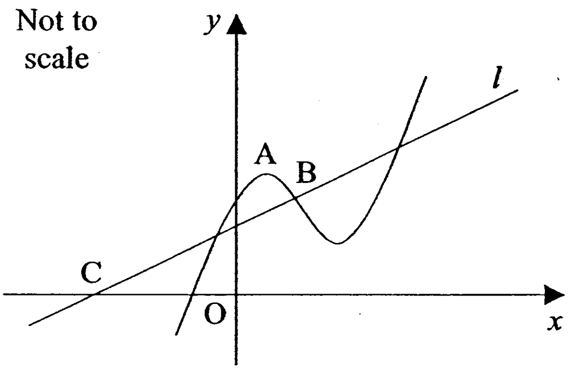
Question 5 *Begin a new page with your number written clearly at the top*

a) The equation of a parabola is $(x-3)^2 = -12(y-1)$. Find the:

- i. coordinates of its vertex. **1**
- ii. equation of its directrix. **2**

b) Show that $\sum_{x=1}^{x=10} (4x+1)$ is an arithmetic series and hence evaluate this summation. **2**

c)

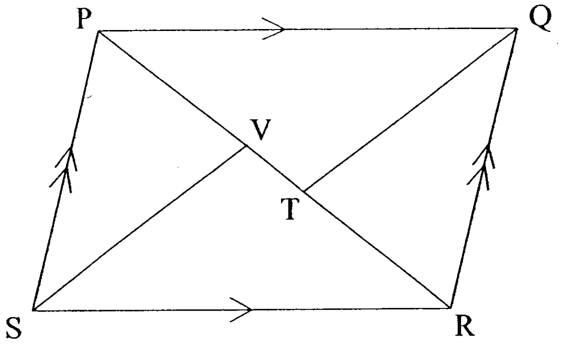


The diagram shows a sketch of the curve $y = x^3 - 6x^2 + 9x + 4$.
The curve has a local maximum point at A and a point of inflexion at B.
The line l is a normal to the curve at point B and meets the x axis at a point C.

- i. Find the coordinates of point A. **2**
- ii. Show that the coordinates of point B is (2, 6). **2**
- iii. Show that the equation of the line l is $x - 3y + 16 = 0$. **2**
- iv. Find the coordinates of point C. **1**

Question 6 *Begin a new page with your number written clearly at the top*

a)



NOT TO SCALE

PQRS is a parallelogram. TQ bisects ∠ PQR and VS bisects ∠ PSR.

- i. Copy this diagram onto your answer booklet.
- ii. State why ∠ PQR = ∠ PSR. 1
- iii. Prove that Δ PVS and Δ RTQ are congruent. 3
- iv. Hence find the length of TV if PR = 20 cm and TR = 8 cm. 1

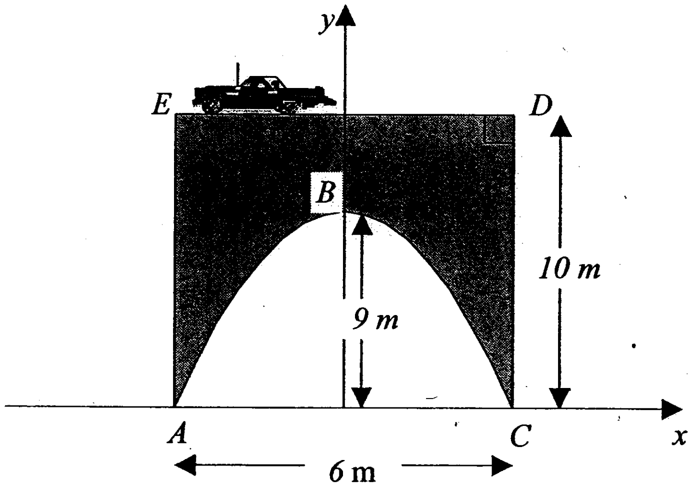
b) The table below gives the values of $f(t)$ for $0 \leq t \leq 2$. 3

t	0	0.5	1	1.5	2
$f(t)$	0	0·30	0·37	0·33	0·27

Use the Trapezoidal Rule with 5 function values to evaluate:

$\int_0^2 f(t)dt$ correct to 1 decimal place.

c)



NOT TO SCALE

The diagram represents the span of a bridge, 10 metres high and 6 metres wide. The curved part of the span is a parabola with vertex 9 metres above the ground. Using the axes shown in the diagram, find:

- i. the equation of the arc ABC; 1
- ii. the shaded area ABCDE. 3

Question 7 *Begin a new page with your number written clearly at the top*

a) Find the limiting sum of the series $1 + \frac{3}{4} + \frac{9}{16} + \frac{27}{64} + \dots$ **2**

b) Find:

i. $\int (4x^3 + x^2 + 3)dx$ **1**

ii. $\int x\sqrt{x}\, dx$ **1**

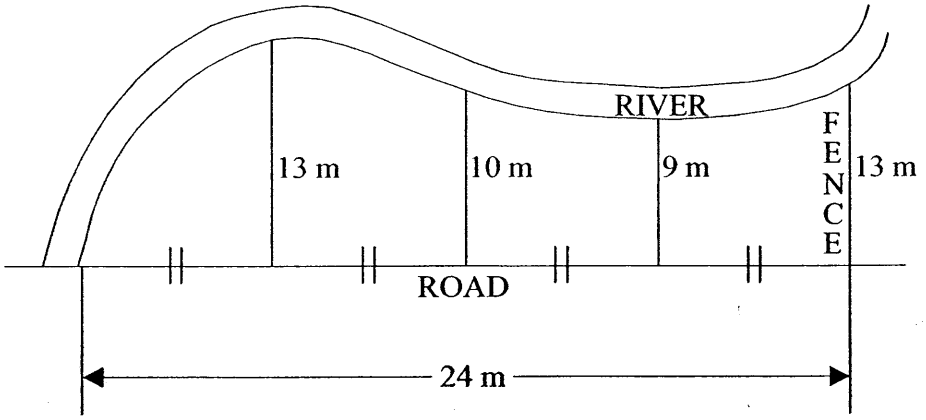
iii. $\int \sin\ 3x\, dx$ **1**

iv. $\int \frac{dx}{(2x+3)^2}$ **2**

c) Evaluate $\int_0^{\frac{\pi}{4}} \sec^2 3x\, dx$. **2**

d)

Wasteland bordering a river bank and a straight road was fenced off and used as a recreational park. Perpendicular distances from the road to the river bank are shown on the diagram. Use Simpson's Rule, with 5 function values, to approximate the area of the recreational park. **3**



NOT TO SCALE

Question 8 *Begin a new page with your number written clearly at the top*

a)

A card is chosen at random from the four cards in group A, then a second card is chosen at random from the three cards in group B. What is the probability that:

i. both of the cards chosen are numbered 2? **1**

ii. exactly one of the two cards chosen is numbered 2? **1**

iii. the number on the card from group A followed by the number on the card from group B will form a two digit number greater than 40? **1**

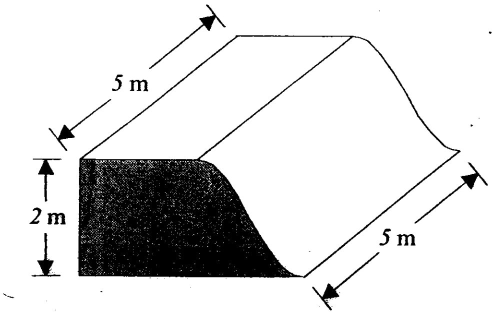
b) A number of electrical components are wired together in an alarm so that it will operate if at least one of the components works. The probability that each one of these components will work is 0·6. If an alarm had three components wired together, find the probability that at least one of the components will work. **1**

c) To calculate the area of the region bounded by the curve $y = x^2 - 2x$ and the x axis between the ordinates $x = 0$ and $x = 4$, Ernie used $\int_0^4 (x^2 - 2x)\, dx$.

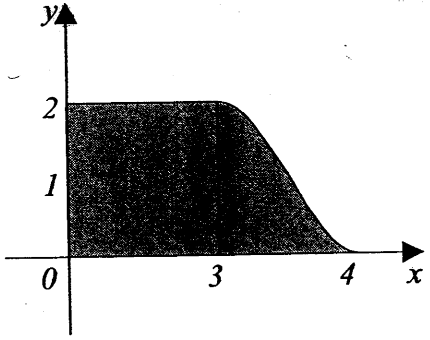
i. Explain why Ernie's method of calculating this area is incorrect. **1**

ii. Find the area of the required region. **3**

d)



The diagram shows a sketch of a skateboard ramp which is 2 metres high and 5 metres wide. The cross section of the ramp was determined by using the graph of $y = f(x)$.



NOT TO SCALE

$$f(x) = \begin{cases} 2 & 0 \le x \le 3 \\ 1 - \cos \pi x & 3 \le x \le 4 \end{cases}$$

i. Find the area of the cross section of the ramp, the shaded area in the diagrams. **3**

ii. The ramp is solid concrete. How much concrete was used to make the ramp? **1**

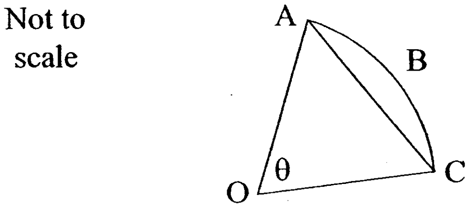
Question 9 *Begin a new page with your number written clearly at the top*

a)

i. On the same number plane, sketch the curves $y = \sin x$ and $y = \tan\frac{x}{2}$ in the domain $0 \le x \le 2\pi$. **2**

ii. Hence find the number of real solutions to the equation $\sin x = \tan\frac{x}{2}$ for $0 \le x \le 2\pi$. **1**

b)

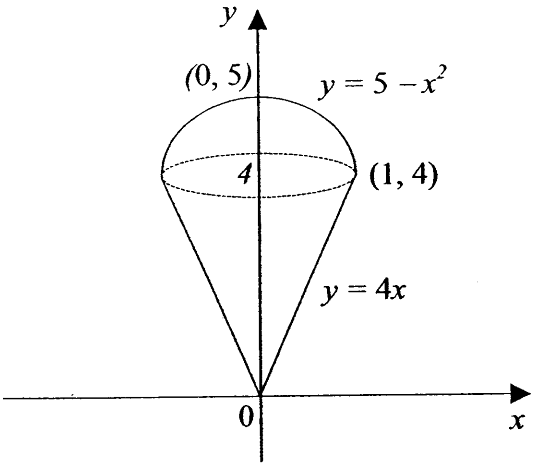


The diagram shows a sector OAC with area of $90\pi\,\text{cm}^2$ and OA = 15 cm.

i. Find the exact size of θ in radians. **2**

ii. Find the perimeter of the segment ABC. **3**
Give your answer correct to the nearest cm.

c) The diagram shows a cone and a paraboloid. It represents an ice-cream cone which is completely full of ice-cream and which has an additional scoop of ice-cream on top.



(All measurements in cm)
FIGURE NOT TO SCALE

To calculate the volume of ice-cream, the area bounded by the section of the line $y = 4x$ between (0, 0) and (1, 4), the part of the parabola between (1, 4) and (0, 5) and the y axis, was rotated about the y axis.

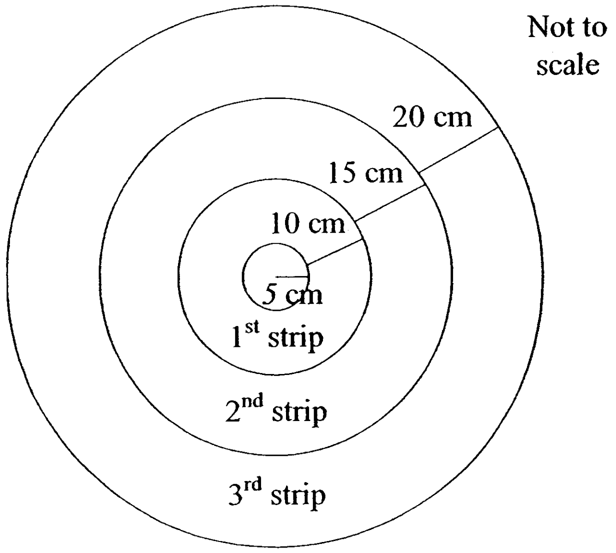
i. Determine the total quantity of ice-cream contained in the cone and the scoop on top. **3**

ii. How many of these ice-creams can be made from a 1 litre container of ice-cream? **1**
(All measurements are in cm and $1000\text{ cm}^3 = 1$ litre).

Question 10 *Begin a new page with your number written clearly at the top*

a) How much will \$6000 accumulate to at the end of five years if it is invested in a fund which pays an interest rate of 4% p.a. compounded quarterly? **1**

b)



Beginning with a circular piece of fabric of radius 5 cm, Le sewed together circular strips of different coloured fabrics which increased in width to make a circular tablecloth. The finished width of the first strip was 10 cm, the second was 15 cm, the third was 20 cm and so on.

i. Show that the width of the tenth strip was 55 cm. **2**

ii. The radius of the table cloth was 455 cm. How many strips were sewn to the edge of the first circular piece? **3**

c) When Jack left school, he borrowed \$15 000 to buy his first car. The interest rate on the loan was 18% p.a. and Jack planned to pay back the loan in 60 equal monthly instalments of \$M.

i. Show that immediately after making his first monthly instalment, Jack owed $\$[15\,000 \times 1{\cdot}015 - M]$. **1**

ii. Show that immediately after making his third monthly instalment, Jack owed $\$[15\,000 \times 1{\cdot}015^3 - M(1 + 1{\cdot}015 + 1{\cdot}015^2)]$. **2**

iii. Calculate the value of M. **3**

Year 12 Mathematics
Half Yearly 2004

uestion ①.

) $4x - 8 = 12$
$4x = 20$
$x = 5$ (1)

) $\frac{\sqrt{12{\cdot}35 - 8{\cdot}66}}{6{\cdot}5}$
$= 0{\cdot}2955\ldots \doteqdot 0{\cdot}30$ (2)

) (i) $a^2 - b^2 + 3a + 3b$
$= (a-b)(a+b) + 3(a+b)$
$= (a+b)(a-b+3)$ (2)

(ii) $8p^3 + 64$
$8(p^3+8)$
$= 8(p+2)(p^2-2p+4)$ (2)

) (i) $-1, 4, 9, \underline{14}, \underline{19}$ (1)

(ii) $4, 3, \frac{9}{4}, \frac{27}{16}, \frac{81}{64}$ (1)

$\frac{2}{4+\sqrt{3}} \times \frac{4-\sqrt{3}}{4-\sqrt{3}}$

$= \frac{8-2\sqrt{3}}{13}$ (2)

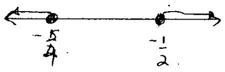
) $60\% = 630$.
$100\% = \frac{630}{60} \times 100$. (1)
$\therefore$ cost = \$1050

Question (2).

(a) $\frac{x-6}{3} = \frac{4x}{5}$
$5x - 30 = 12x$
$-30 = 7x$.
$x = \frac{-30}{7}$ (2)

(b) $6x^2 - x - 2 = 0$.
$(3x-2)(2x+\cancel{3}^{1}) = 0$.
$x = \frac{2}{3}, \frac{-1}{2}$ (2)

(c) $|2x+3| \geqslant 2$.
$2x+3 \geqslant 2 \qquad 2x+3 \leqslant -2$
$2x \geqslant -1 \qquad 2x \leqslant -5$
$x \geqslant \frac{-1}{2} \qquad x \leqslant \frac{-5}{4}$ (2)



(d) (i) $n^2 - 15n + 16 = 0$.
$n = \frac{15 \pm \sqrt{225-64}}{2}$.
$= \frac{15 \pm \sqrt{161}}{2} \qquad \therefore n \doteqdot 13{\cdot}84\ \&\ 1{\cdot}16$ (2)

(ii) $|3n-5| = 4n-7$
$3n-5 = 4n-7 \quad$ or $\quad 3n-5 = 7-4n$
$-n = -2 \qquad 7n = 12$
$n = 2 \qquad n = \frac{12}{7}$. (2)
No solution.
$\therefore n = 2$.

(e) $\tan^2 x + (1+\tan^2 x) = 7$. $\quad \tan^2 x = 3$ (2)
$2\tan^2 x = 6 \qquad \tan x = \pm\sqrt{3}$

uestion (3)

) $A(1,5) \quad C(7,-7) \qquad B(8,-2)$.

(i) $\left(\frac{1+7}{2}, \frac{5-7}{2}\right)$
$= (4, -1)$ (1)

(ii) $m_{AB} = \frac{5+2}{1-8}$
$= \frac{\cancel{12}}{\cancel{-6}} \quad \frac{+\cancel{0}7}{-7}$ (1)
$= -\cancel{2} \quad -1$.

(iii) $y - 5 = -\frac{\cancel{10}^{1}}{\cancel{7}}(x-1)$ (1)
$y - 5 = -x + 1$
$x + y = 6$.

(iv) $\sqrt{(8-1)^2 + (-2-5)^2}$
$= \sqrt{49 + 49}$
$= \sqrt{98}$
$= 7\sqrt{2}$ (1)

v) $m_{OC} = \frac{0+7}{0-7}$ (1)
$= -1$
$m_{AB} = m_{OC} \therefore$ parallel lines

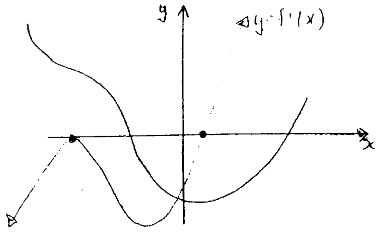
vi) $m_{OA} = \frac{5}{1} \qquad m_{AB} = -1$
$m_{CB} = \frac{5}{1} \qquad m_{OC} = -1$
$\therefore CB \parallel OA \qquad \therefore AB \parallel OC$

$\therefore$ ABCO is a parallelogram since it is a quadrilateral with opposite sides equal.

ii) $x + y - 6 = 0 \qquad (0,0)$.
$d = \frac{|0+0-6|}{\sqrt{2}}$
$= \frac{6}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = 3\sqrt{2}$ (2)

(iii) $A = \frac{6}{\sqrt{2}} \times 7\sqrt{2}$ $\quad$ base OC $= AB = 7\sqrt{2}$
$= 42\,u^2$ (1)

(b)

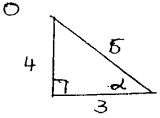


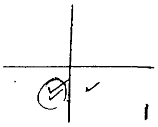
(2)

Question (4)

(a) $\cos\alpha = \frac{-3}{5} \qquad \sin\alpha < 0$

$\tan\alpha = \frac{4}{3}$.



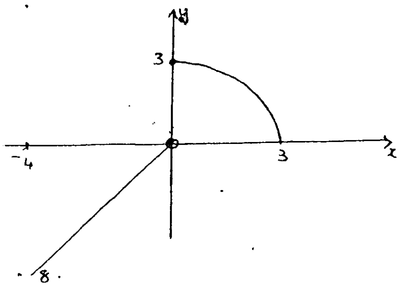


1

(b) $f(x) = \begin{cases} 2x & -4 \leqslant x < 0 \\ \sqrt{9-x^2} & 0 \leqslant x \leqslant 3 \end{cases}$

(i) $f(0) = \sqrt{9}$
$= 3$ 1

(ii)



2

(iii) range $-8 \leqslant y < 3$ 1

) (i) $y = 2x^3 + 4x^{\frac{1}{2}} - 1$

$y' = 6x^2 + 2x^{-\frac{1}{2}}$

$= 6x^2 + \frac{2}{\sqrt{x}}$ 1

(ii) $y = \frac{\cos x}{x}$

$y' = \frac{u'v - v'u}{v^2}$

$= \frac{-\sin x . x - 1.\cos x}{x^2}$

$= \frac{-x\sin x - \cos x}{x^2}$ 2

(iii) ~~$y = (3x^2+2)^{\frac{1}{2}}$~~

~~$y' = \frac{1}{2}(3x^2+2)^{-\frac{1}{2}}.6x$~~

~~$= 3x(3x^2+2)^{-\frac{1}{2}}$~~

1) $3x^2 + 4x - 3$.

(i) $\alpha + \beta = \frac{-4}{3}$ 1

(ii) $\alpha\beta = -1$ 1

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

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

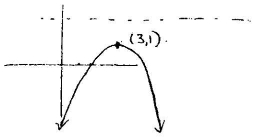
$= 2[(\alpha+\beta)^2 - 2(\alpha\beta)]$

$= 2[\frac{16}{9} + 2]$

$= 2$ . . . 2

Question (5).

(a) $(x-3)^2 = -12(y-1)$ $a=3$.



(i) vertex $(3,1)$ (1)

(ii) directrix. $y = 4$ (2)

$4a = 12$

$a = 3$

(b) $\sum_{x=1}^{10} 4x + 1$

$= 5 + 9, + 13, + 18$

$9 - 5 = 13 - 9$ (1)

$\therefore$ A.P.

$S_{10} = \frac{10}{2}[5 + 41]$ (1)

$= 5(46)$.

$= 230$

(c)(i) $y = x^3 - 6x^2 + 9x + 4$

$y' = 3x^2 - 12x + 9$

$y'' = 6x - 12$

S.P. at $3x^2 - 12x + 9 = 0$

$x^2 - 4x + 3 = 0$

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

$x = 1, 3$

From diagram A is where $x = 1$.

$y = 1 - 6 + 9 + 4$

$= 8$

$\therefore$ A is $(1, 8)$ (2)

(ii) B occurs at $y'' = 0$.

$6x - 12 = 0$. (1)

$x = 2$

when $x = 2$ $y = 6$

$\therefore$ B is $(2, 6)$ (2)

i) $y' = 3x^2 - 12x + 9$

at $x = 2$

$y' = 12 - 24 + 9$

$m_T = -3$ $m_n = 1/3$.

$\therefore$ Equation is

$y - 6 = \frac{1}{3}(x - 2)$

$3y - 18 = x - 2$.

$x - 3y + 16 = 0$.

) $x - 3y + 16 = 0$

when $y = 0$.

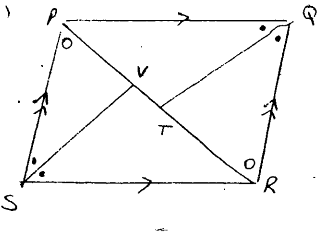
$x + 16 = 0$

$x = -16$.

$(-16, 0)$.

Question (6)

a) (i)



(ii) Opposite ∠'s of parallelogram PQRS 1

(iii) in Δs PVS and RTQ

∠PSV = ∠RQT (given data bisected ∠'s)

PS = QR (equal sides parm PQRS)

∠SPV = ∠QRT (Alt ∠'S, PS // QR)

$\therefore \Delta PVS \equiv \Delta RTQ$ (A A S) 3

(iv) PR = 20 TR = 8 = PV (matching sides of cong. Δs)

$\therefore$ TV = 20 − 16

= 4cm 1

(b) $\int_0^2 f(t)\,dt \doteqdot \frac{0.5}{2}[0 + 2(0.3) + 2(0.37) + 2(0.33) + 0.27$

$\doteqdot \frac{1}{4}[2.27]$

$\doteqdot 0.0567$

$\doteqdot 0.6$ sq units 3

(c) (i) $y = 9 - x^2$ 1

(ii) $A = 60 - (2\int_0^3 (9 - x^2)\,dx$!

$= 60 - 2\left[9x - \frac{x^3}{3}\right]_0^3$

$= 60 - 2[(\overset{27}{18} - 9)]$

$= 60 - 2(18)$

$= 4 24m^2$ 3

estion (7).

) $1 + \frac{3}{4} + \frac{9}{16} + \frac{27}{64} + \dots$

G.P. with $a = 1$, $r = \frac{3}{4}$ 1

$S_\infty = \frac{9}{1-r}$

$= \frac{1}{1/4}$ 1 (2)

$= 4$

b) (i) $\int 4x^3 + x^2 + 3 \, dx$

$= x^4 + \frac{x^3}{3} + 3x + C$ (1)

(ii) $\int x^{\frac{3}{2}} \, dx$

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

(iii) $\int \sin 3x \, dx$

$= -\frac{1}{3} \cos 3x + C$ (1)

(iv) $\int (2x+3)^{-2} \, dx$

$= \frac{(2x+3)^{-1}}{-2} + C$ 1 $= \frac{-1}{2(2x+3)} + c$ 1 (2)

(c) $\int_0^{\frac{\pi}{4}} \sec^2 3x \, dx$

$\int_0^{\frac{\pi}{4}} \frac{1}{3}$ ~~[illegible]~~ dx $\quad \frac{1}{3}\tan 3x$ 1 $= \frac{1}{3} \tan \frac{3\pi}{4} - 0$ (2)

$= -\frac{1}{3}$ 1

(d) $A = \frac{6}{3}\left[0 + 4(13) + 2(10) + 4(9) + 13\right]$

$= 2\left[88 + 20 + 13\right]$

$= 242 m^2$

Question (8)

(i) $P(2, 2)$

$= \frac{1}{4} \times \frac{1}{3}$

$= \frac{1}{12}$ 1

(ii) $P(2, \bar{2})$ or $P(\bar{2}, 2)$

$\left(\frac{1}{4} \times \frac{2}{3}\right) + \left(\frac{3}{4} \times \frac{1}{3}\right)$

$= \frac{1}{6} + \frac{1}{4}$

$= \frac{10}{24} = \frac{5}{12}$ 1

(iii) $P(4, \text{all})$

$= \frac{1}{4}$ 1

(b) $P(W) = 0.6$

$P(\text{at least one}) = 1 - P(\bar{W}\bar{W}\bar{W})$

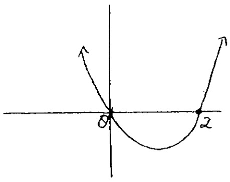
$= 1 - (0.4)^3$

$= 1 - 0.064$ 1

$= 0.936$

(c)

a) $x(x-2)$.



i) Some area above x axis and some below 1

i) $A = \int_0^2 x^2 - 2x \, dx + \int_2^4 x^2 - 2x \, dx$

$1\frac{1}{2}$ $\quad 1\frac{1}{2}$

$\left[\frac{x^3}{3} - x^2\right]_0^2 + \left[\frac{x^3}{3} - x^2\right]_2^4$

$= \left|\left(\frac{8}{3} - 4\right)\right| + \left(\frac{64}{3} - 16 - \frac{8}{3} + 4\right)$ 3.

) (i) $A = (2 \times 3) + \int_3^4 1 - \cos \pi x \, dx$

$= 6 + \left[x - \frac{1}{\pi} \sin \pi x\right]_3^4$ 1 correct integration

$= 6 + \left[4 - \frac{1}{\pi} \sin 4\pi - 3 + \frac{1}{\pi} \sin 3\pi\right]$

$= 6 + 1$ 1 for sub and answer

$= 7 u^2$ 3

1 final answer

(ii) 7×5

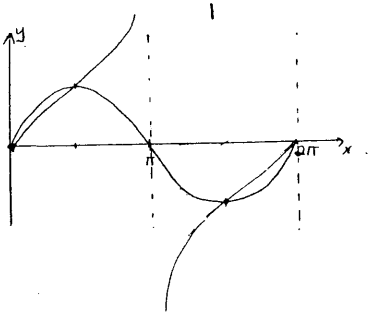
$= 35 m^3$ 1

Question (9)

Period $= 2\pi$.

(a) $y = \sin x$ $\quad y = \tan \frac{x}{2}$

1 1



(2)

(ii) 4 (1) cf PA

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

$90\pi = \frac{1}{2} \times 225 \times \theta$

$\frac{180\pi}{225} = \theta$

$\theta = \frac{4\pi}{5}$ (2)

(ii) $AC = r.\theta$

$= 15 \times \frac{180\pi}{225}$

line $(AC)^2 = 15^2 + 15^2 - 2 \times 15 \times 15 \times \cos \frac{180\pi}{225}$

$= 814.0576\dots$

$AC = 28.53$ 1 (3)

Total Perimeter $\doteqdot 25.85\dots + 12\pi$

$\doteqdot 66.23$

$= 66 cm$

(d) (i) $y = 4x$ $\qquad y = 5 - x^2$

$x = \frac{y}{4}$ $\qquad x^2 = 5 - y$

$x^2 = \frac{y^2}{16}$

$$V = \pi \int_0^4 \frac{y^2}{16}\, dy + \pi \int_4^5 5 - y\, dy$$

$$= \pi \left[\frac{y^3}{48} \right]_0^4 + \pi \left[5y - \frac{y^2}{2} \right]_4^5$$

$$= \pi \left[\frac{64}{48} \right] + \pi \left[\left(25 - \frac{25}{2}\right) - \left(20 - \frac{16}{2}\right) \right]$$

$$= \frac{4\pi}{3} + \pi \left[12\tfrac{1}{2} - 12 \right]$$

$$= \frac{4\pi}{3} + \frac{\pi}{2}$$

$$= \frac{8\pi + 3\pi}{6}$$ (3)

$$= \frac{11\pi}{6}\ u^3$$

(ii) $1000 \div \frac{11\pi}{6}$

$\therefore$ 173 cones (1)

<u>Question(10)</u>

(a) $6000(1.01)^{20}$ 1

$=$ ~~\$13440.74~~ \$7321.14

(b) 10, 15, 20,

(i) A.P. $a = 10$, $d = 5$

$T_{10} = a + (n-1)d$

$= 10 + 9 \times 5$

$= 55$ cm 2

(ii) $S_n = \frac{n}{2}[2a + (n-1)d]$

$450 = \frac{n}{2}[20 + (n-1).5]$

$900 = n[20 + 5n - 5]$

$900 = n(5n + 15)$

$900 = 5n^2 + 15n$

$n^2 + 3n - 180 = 0$

$(n + 15)(n - 12) = 0$

$\therefore n = 12$ since $n > 0$ 3

$\therefore$ 12 strips.

(c)(i) $15000(1.015) - M$ 1

(ii) $B_2 = 15000(1.015)^2 - M(1.015) - M$

$B_3 = 15000(1.015)^3 - M(1.015)^2 - M(1.015) - M$

$= 15000(1.015)^3 - M(1.015^2 + 1.015 + 1)$ 2

(iii) $B_{60} = 15000(1.015)^{60} - M(1 + 1.015 + \dots + 1.015^{59})$

$0 = 15000(1.015)^{60} - M\left(\frac{1.015^{60} - 1}{.015}\right)$ 3

$M = \frac{15000(1.015)^{60}.015}{1.015^{60} - 1}$

$M = \$380.90$