St George Girls' High School

Trial Higher School Certificate Examination

2002

Mathematics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black 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

Students are advised that this is a Trial Examination only and does not necessarily reflect the content or format of the Higher School Certificate Examination.

Question 1 (12 marks)

a) Evaluate $\dfrac{23.97-(3.62)^2}{\sqrt{4.51}}$ correct to 2 decimal places 1

b) Solve: $\dfrac{x}{3}-\dfrac{2x+1}{4}=5$ 2

c) Sketch $y=\sin 2x$ for $0\le x\le 2\pi$ 2

d) Solve: $|1-2x|<4$ 3

e) Evaluate $\log_e 3.5$, correct to 2 decimal places 1

f) If $\dfrac{dy}{dx}=x^2+8x$ and when $x=3$, $y=0$ find y in terms of x 3

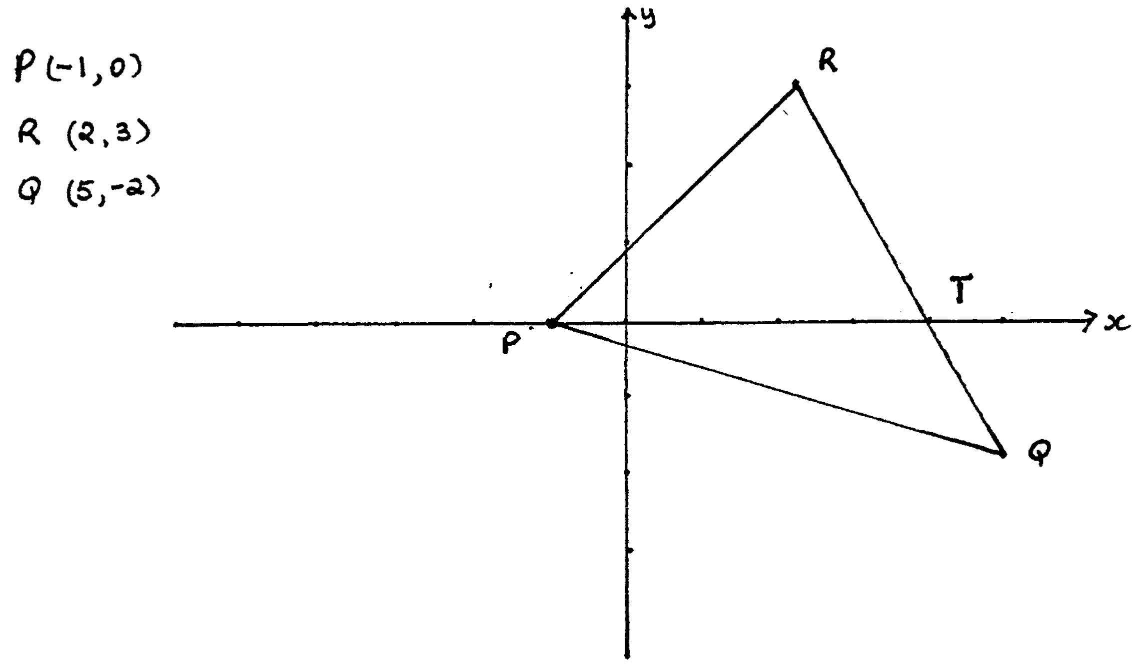
Question 2 (12 marks)

a) Differentiate:

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

(ii) $y=e^{2x}\sin x$ 2

b) Using the information on the following diagram



(i) Show that the equation of the line *PQ* is $x+3y+1=0$ 2

(ii) Find the length of PQ 1

(iii) Find the perpendicular distance from *R* to *PQ* 2

(iv) Find the area of ΔPRQ 1

(v) Find the size of the angle *RTP* correct to nearest degree 2

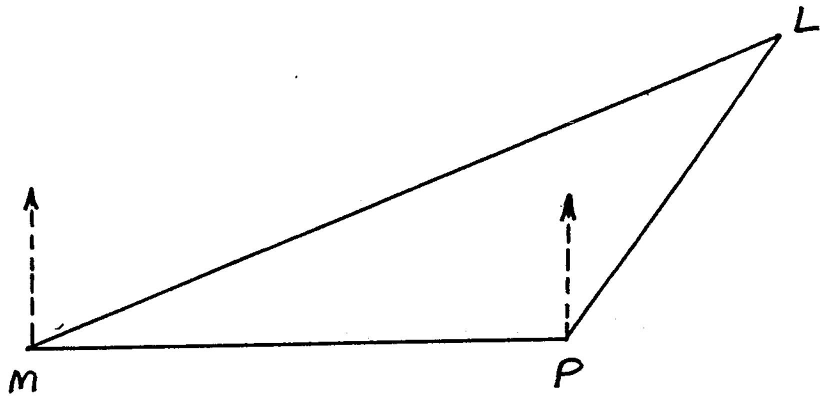
Question 3 (12 marks)

a) Prove $\operatorname{cosec} x \cos x \tan x = 1$ 1

b) Given that $\cot\beta = \frac{3}{2}$ and $\sin\beta < 0$ find exact value of $\cos\beta$ 2

c) Solve $2\sin^2 x + \cos x = 2$ for $0° \le x° \le 360°$ 3

d) The bearing of a lighthouse L from a ship at M is $N55°E$. The ship then sails due East from M to a point P which is 10 nautical miles from L. The bearing of the lighthouse from P is $N25°E$.



(i) Copy the diagram into your answer booklet.

(ii) Deduce that $M\hat{L}P = 30°$ 1

(iii) Show that $MP = 5\operatorname{cosec} 35°$ and hence find MP correct to 1 decimal place. 3

(iv) If the ship continues to sail due East from P find its shortest distance from the lighthouse. 2

Question 4 (12 marks)

a) Find the primitive of:

(i) $3xe^{x^2}$ 2

(ii) $\tan x$ 2

b) (i) Sketch the curve $y = \ln(4 - x)$ showing the x and y intercepts 2

(ii) Find the equation of the tangent at the point where the curve crosses the x axis 2

(iii) Find the exact area bounded by the curve and the x and y axes 4

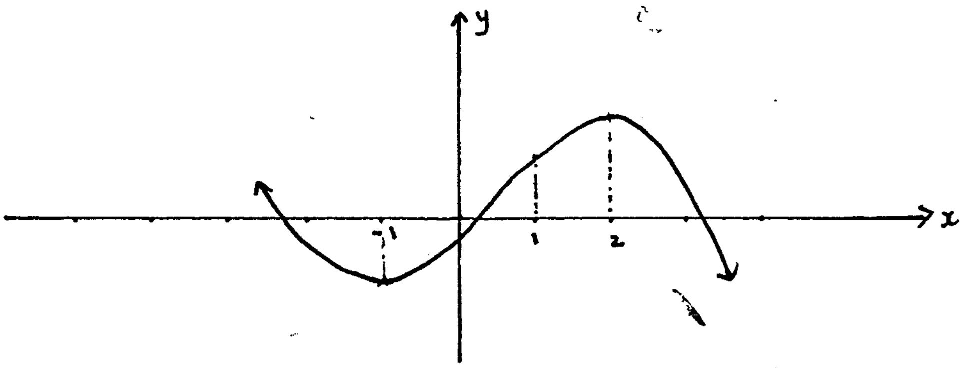
Question 5 (12 marks)

a) Using the following table of values find an approximation to the value of: 2

$\int_1^5 f(x)\,dx$ using Simpson's Rule with 5 function values

x	1	2	3	4	5
$f(x)$	1.74	3.9	4.2	7.89	10.2

b) The following is a graph of some function $y = f(x)$.



(i) In your answer booklet graph $y = f'(x)$ and $y = f''(x)$ if at $x = 1$ there is a point of inflexion. 3

(ii) Explain what happens to the curve at a point of inflexion. 1

c) (i) Determine the stationary points and their nature for the curve $y = x^3 - 6x^2 + 9x - 7$ 4

(ii) Sketch the curve 1

(iii) For what x values is the curve increasing? 1

Question 6 (12 marks)

a) Zinc is extracted from a mine at a rate that is proportional to the amount of zinc remaining in the mine. Hence the amount R remaining after t years is given by $R = R_0 e^{-kt}$ where k is a constant and R_0 is the initial amount of zinc. After 5 years, 50% of the initial amount of zinc remains.

(i) Find the value of k (correct to 4 decimal places) 2

(ii) How many more years will elapse before only 30% of the original amount remains? 3

b) Joanne decided to save for an overseas holiday. She decided to deposit \$500 into a special account at the beginning of each month for 3 years. The account paid 6% pa compounded monthly.

(i) How much is the first payment of \$500 worth at the end of 3 years? 1

(ii) Prove, by developing a geometric series, that the total value of all her deposits at the end of 3 years is given by

Total value = 100 500 $(1.005^{36}-1)$ 3

(iii) Calculate this value. 1

(iv) If Joanne had needed a lump sum of \$22 000 by the end of the third year what would she have had to save each month? (You may use any previous working). 2

Question 7 (12 marks)

a) The limiting sum of the infinite geometric series $1+5^x+5^{2x}+\ldots$ is 5. Find x (correct to 3 decimal places). **3**

b) Find the x values of the intersection points of the curves $x-y=4$ and $y=x^2-3x-4$. Hence, find the area between the two curves. **4**

c) (i) Write down the discriminant of: $3x^2+2x+k$. **2**

(ii) For what values of k does $3x^2+2x+k=0$ have real roots?

d) If one root of the equation $mx^2-px+1=0$ is double the other, prove that $2p^2=9m$. **3**

Question 8 (12 marks)

a) The velocity of a particle moving in a straight line is given by $v = 2t - 6$ where position is measured in metres and time in seconds. If the particle is initially 4 metres to the right of the origin

(i) Find an expression for displacement. 1

(ii) Find when and where the particle comes to rest. 2

(iii) Find the total distance covered by the particle in the first 5 seconds. 1

(iv) Evaluate $\int_0^5 (2t - 6)\, dt$ 2

(v) Explain why your answers for parts (iii) and (iv) are not the same. 1

b) The rate at which gas escapes from a balloon is given by $\frac{dG}{dt} = \frac{-3}{t+1}$ where the gas is measured in cm^3 and time in seconds.

(i) Find G as a function of time if the initial amount of gas in the balloon is 10cm^3. 2

(ii) How long before all the gas has escaped? 3

Question 9 (12 marks)

a) Find:

(i) $\int \sin^2 x \cos x \, dx$ 1

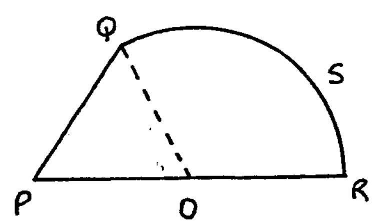
(ii) $\int_0^{\frac{\pi}{4}} (2\sin x - \cos 2x) \, dx$ 3

b) Sketch the curve $y = 2\cos \pi x$ for $0 \le x \le 2$ 1

On the same set of axes sketch the graph $y = 1 - x$ 1

Using your graph state how many solutions $2\cos \pi x = 1 - x$ has in the domain $0 \le x \le 2$ 1

c) The region *QPORS* is formed by an equilateral triangle *OPQ* with a side of 12cm and a sector *QORS*. *PR* is a straight line. *QSR* is an arc of the circle centre *O*.



Giving answers in exact form find:

(i) The perimeter of the region 2

(ii) The area of the region 3

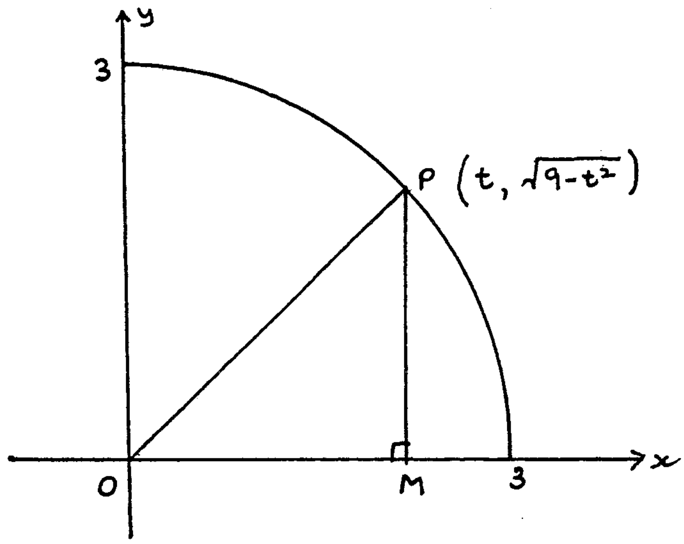
Question 10 (12 marks)

a) (i) State domain and range of the function $y = \sqrt{9-x}$ 2

(ii) Sketch a graph of this function 1

(iii) Calculate the volume of the solid generated when the area bounded by the curve and the coordinate axes in the first quadrant is rotated about the y axis. 3

b) The diagram shows the curve $y = \sqrt{9-x^2}$ for $x \geq 0$. P is the point $(t, \sqrt{9-t^2})$ on the graph and M is the foot of the perpendicular from P to the x axis.



(i) Write down an expression in terms of t for the area A of the triangle OPM. 1

(ii) Find the coordinates of the point P which gives triangle OPM a maximum area. 5

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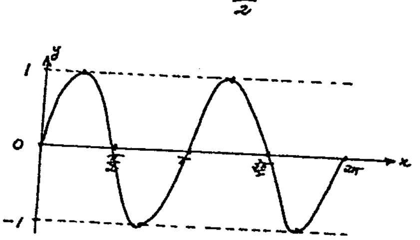
MATHEMATICS – SOLUTIONS

QUESTION 1:

(a) 5.12 (correct to 2 dec. pl)

(b)
$$\frac{x}{3} - \frac{2x+1}{4} = 5$$
$$\frac{4x - 3(2x+1)}{12} = 5$$
$$\frac{4x - 6x - 3}{12} = 5$$
$$\frac{-2x-3}{12} = 5$$
$$-2x - 3 = 60$$
$$-2x = 63$$
$$\therefore x = -\frac{63}{2}$$

(c)



(d)
$$|1-2x| < 4$$
$$\Rightarrow -4 < 1-2x < 4$$
$$-5 < -2x < 3$$
$$\frac{5}{2} > x > -\frac{3}{2}$$
$$\therefore -\frac{3}{2} < x < \frac{5}{2}$$

2.

(e) $\log_e 3.5 = 1.25$ (correct to 2 dec. pl)

(f)
$$\frac{dy}{dx} = x^2 + 8x$$
$$\Rightarrow y = \frac{x^3}{3} + 4x^2 + c$$
when $x = 3,\ y = 0$
$$\therefore 0 = 9 + 36 + c$$
$$\therefore c = -45$$
i.e. $y = \frac{x^3}{3} + 4x^2 - 45$

3.

QUESTION 2:

(a) (i)
$$y = (2x-5)^4$$
$$\frac{dy}{dx} = 4(2x-5)^3 . 2$$
$$= 8(2x-5)^3$$

(ii)
$$y = \underbrace{e^{2x}}_{u}\underbrace{\sin x}_{v}$$
$$\frac{dy}{dx} = vu' + uv'$$
$$= \sin x . 2e^{2x} + e^{2x} . \cos x$$
$$= e^{2x}(2\sin x + \cos x)$$

(b) (i) $P(-1, 0)$ $Q(5, -2)$
$$m_{PQ} = \frac{-2-0}{5--1}$$
$$= -\frac{2}{6}$$
$$= -\frac{1}{3}$$
$\therefore$ Equation of PQ is
$$y - 0 = -\tfrac{1}{3}(x+1)$$
$$3y = -x - 1$$
i.e. $x + 3y + 1 = 0$

(ii)
$$PQ = \sqrt{(5--1)^2 + (-2-0)^2}$$
$$= \sqrt{36+4}$$
$$= \sqrt{40}$$
$$= 2\sqrt{10}$$

4.

(iii) $(2,3)$ to $x + 3y + 1 = 0$
$$d = \frac{|1(2) + 3(3) + 1|}{\sqrt{1^2 + 3^2}}$$
$$= \frac{12}{\sqrt{10}}$$
$$= \frac{12\sqrt{10}}{10}$$
$$= \frac{6\sqrt{10}}{5}$$

(iv) Area of $\Delta PRQ = \frac{1}{2} \times PQ \times d$
$$= \frac{1}{2} \times 2\sqrt{10} \times \frac{6\sqrt{10}}{5} \text{ (units}^2\text{)}$$
$$= 12 \text{ (units}^2\text{)}$$

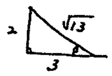
(v)
$$m_{RQ} = \frac{3--2}{2-5}$$
$$= -\frac{5}{3}$$
$$\therefore R\hat{T}P = \tan^{-1}\left(\frac{5}{3}\right)$$
$= 59^\circ$ (correct to nearest minute)

QUESTION 3:

(a) $\operatorname{cosec} x \cos x \tan x = \frac{1}{\sin x} \times \frac{\cos x}{1} \times \frac{\sin x}{\cos x}$

$= 1$

(b) $\left.\begin{array}{l}\cot\beta = \frac{3}{2}\\ \sin\beta < 0\end{array}\right\} \Rightarrow \beta$ is in 3^{rd} quadrant



$\therefore \cos\beta = -\frac{3}{\sqrt{13}}$

(c) $2\sin^2 x + \cos x = 2 \qquad 0° \le x° \le 360°$

$2(1-\cos^2 x) + \cos x = 2$

$2 - 2\cos^2 x + \cos x = 2$

$2\cos^2 x - \cos x = 0$

$\cos x(2\cos x - 1) = 0$

$\therefore \cos x = 0, \frac{1}{2}$

$\cos x = 0$

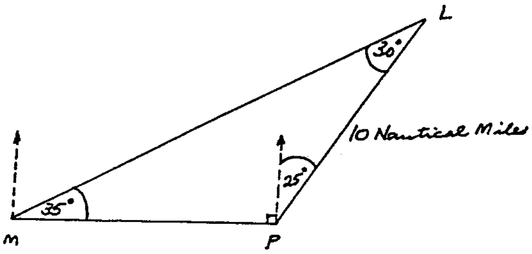
$\Rightarrow x = 90°, 270°$

$\cos x = \frac{1}{2}$ $\quad x_{acute} = 60°$

$\therefore x = 60°, 300°$

$\therefore x = 60°, 90°, 270°, 300°$

(d)



(i) $M\hat{L}P = 180° - (35° + 90° + 25°)$ (angle sum of Δ is 180°)

$= 30°$

(ii) In ΔMLP by the Sine Rule

$\frac{MP}{\sin 30°} = \frac{10}{\sin 35°}$

$\therefore MP = \frac{10 \sin 30°}{\sin 35°}$

$= 5 \operatorname{cosec} 35°$

$= 8.717...$

$= 8.7$ (correct to 1 dec. place)

(iii) Using Cosine Rule

$LM^2 = (8.717)^2 + 10^2 - 2 \times 8.717 \times 10 \cos 115°$

$= 249.66536$

$\therefore LM = 15.80$ n miles (to 2 d.p.)

QUESTION 4:

(a) (i) $\int 3x e^{x^2}\,dx = \frac{3}{2}\int 2x e^{x^2}\,dx$

$= \frac{3}{2} e^{x^2} + c$

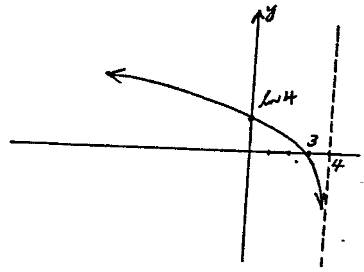
(ii) $\int \tan x\,dx = \int \frac{\sin x}{\cos x}\,dx$

$= -\int \frac{-\sin x}{\cos x}\,dx$

$= -\log(\cos x) + c$

(b) (i) $y = \ln(4-x)$ $\qquad$ Domain: $4 - x > 0$

i.e. $x < 4$



x intercept at $y = 0$

i.e. $\ln(4-x) = 0$

$4 - x = 1$

$x = 3$

y intercept at $x = 0$

i.e. $y = \ln 4$

(ii) $y = \ln(4-x)$

$\Rightarrow \frac{dy}{dx} = \frac{-1}{4-x}$

at $(3,0)$ $\frac{dy}{dx} = \frac{-1}{1}$

$= -1$

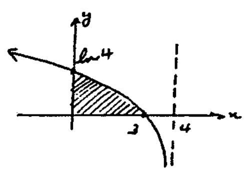
$\therefore$ Tangent at $(3,0)$ is

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

$y = -x + 3$

or $x + y - 3 = 0$

(iii) $A = \int_0^3 \ln(4-x)\,dx$ $\quad$ but as we are unable to find the primitive of $\ln(4-x)$ we must refer the area to the y-axis as shown.



$A = \int_0^{\ln 4} x\,dy$ $\qquad$ $y = \ln(4-x)$

$\Rightarrow e^y = 4 - x$

i.e. $x = 4 - e^y$

$= \int_0^{\ln 4} (4 - e^y)\,dy$

$= [4y - e^y]_0^{\ln 4}$

$= (4\ln 4 - e^{\ln 4}) - (0 - 1)$

$= 4\ln 4 - 4 + 1$

$= 4\ln 4 - 3$

Area is $(4\ln 4 - 3)$ units²

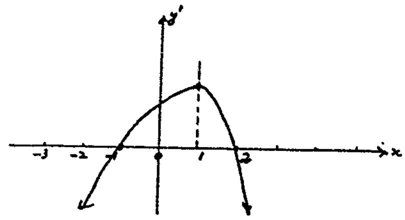
QUESTION 5:

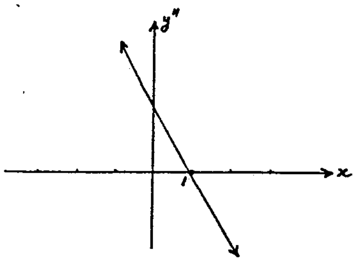
(a) $\int_1^5 f(x)\,dx \doteq \frac{h}{3}\left[(y_1+y_5)+4(y_2+y_4)+2y_3\right]$

$= \frac{1}{3}\left[(1.74+10.2)+4(3.9+7.89)+2(4.2)\right]$

$= 22.5$

(b) (i)





(ii) At a point of inflexion the curve changes concavity. Since the sign of $f''(x)$ determines the concavity of a curve, we must have $f''(x) = 0$ at a point of inflexion AND the sign of $f''(x)$ changing as we move along the curve from one side of the point to the other.

(c) (i) $y = x^3 - 6x^2 + 9x - 7$ ——— ①

$\frac{dy}{dx} = 3x^2 - 12x + 9$

Stationary point at $\frac{dy}{dx} = 0$

ie $3x^2 - 12x + 9 = 0$

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

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

$\therefore x = 1, 3$ and in ①

$y = -3, -7$

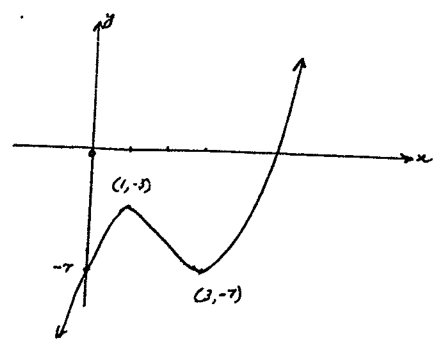
ie at $(1,-3)$ and $(3,-7)$

$\frac{d^2y}{dx^2} = 6x - 12$

at $(1,-3)$ $y'' = -6 \Rightarrow (1,-3)$ is a relative maximum turning point.

at $(3,-7)$ $y'' = 6 \Rightarrow (3,-7)$ is a relative minimum turning point.

(ii)



(iii) Increasing for $x < 1$ or $x > 3$

QUESTION 6:

(a) $R = R_0 e^{-kt}$ $\quad R_0$ = initial amount

(i) at $t = 5$, $R = \frac{1}{2}R_0$

$\therefore \frac{1}{2}R_0 = R_0 e^{-5k}$

$\Rightarrow e^{-5k} = \frac{1}{2}$

$-5k = \ln(\frac{1}{2})$

$k = -\frac{1}{5}\ln(\frac{1}{2})$

$= 0.138629\ldots$

$= 0.1386$ (correct to 4 dec. places)

(ii) when $R = \frac{3}{10}R_0$

$\frac{3}{10}R_0 = R_0 e^{-kt}$

$\frac{3}{10} = e^{-kt}$

$\Rightarrow -kt = \ln\frac{3}{10}$

$t = -\frac{1}{k}\ln(\frac{3}{10})$

$= 8.684\ldots$

$= 8.7$ (correct to 1 dec. pl.)

$\therefore$ Another 3.7 years will elapse.

(b) (i) First \$500 grows to $\$500(1.005)^{36} = \$598.34$

(ii) 1st \$500 grows to $\$500(1.005)^{36}$

2nd \$500 grows to $\$500(1.005)^{35}$

$\vdots$

last \$500 grows to $\$500(1.005)$

$\therefore$ Lump sum value

$= \$500(1.005) + \$500(1.005)^2 + \ldots + \$500(1.005)^{36}$

Geometric series $a = 500(1.005)$ $r = 1.005$ $n = 36$

$= \frac{a(r^n - 1)}{r-1}$

$= \frac{500(1.005)(1.005^{36}-1)}{1.005-1}$ dollars ——— ①

$= \$100\,500(1.005^{36} - 1)$

(iii) \$19 766.39

(iv) ① becomes

$22\,000 = \frac{R(1.005)(1.005^{36}-1)}{1.005-1}$ where \$R monthly saving.

ie $R = \frac{22\,000(1.005-1)}{1.005(1.005^{36}-1)}$

$= \$556.50$ (correct to nearest cent)

QUESTION 7:

(a) $1 + 5^{x} + 5^{2x} + \dots$

Geometric series $a = 1$, $r = 5^{x}$

$S = \frac{a}{1-r}$

$\Rightarrow \quad 5 = \frac{1}{1-5^{x}}$

ie $5 - 5^{x+1} = 1$

$4 = 5^{x+1}$

$x + 1 = \log_5 4$

$x = \frac{\log_{10} 4}{\log_{10} 5} - 1$

$= -0.1386\dots$

$= -0.139$ (correct to 3 dec. pl)

(b) $x - y = 4$ ——①

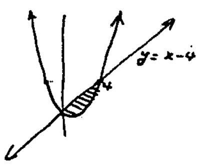
$y = x^2 - 3x - 4$ ——②

①+②: $x = 4 + x^2 - 3x - 4$

$0 = x^2 - 4x$

$0 = x(x-4)$

$x = 0, 4$



$A = \int_0^4 \{x - 4 - (x^2 - 3x - 4)\}\, dx$

$= \int_0^4 (4x - x^2)\, dx$

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

$= \left(32 - \frac{64}{3}\right) - 0$

$= \frac{32}{3}$

∴ Area is $\frac{32}{3}$ units^2

(c) (i) $3x^2 + 2x + k$

$\Delta = b^2 - 4ac$

$= 2^2 - 4(3)(k)$

$= 4 - 12k$

(ii) Real roots if $\Delta \geq 0$

ie $4 - 12k \geq 0$

$4 \geq 12k$

$\therefore \; k \leq \frac{1}{3}$

(d) Let roots be α, 2α

$mx^2 - px + 1 = 0$

$\therefore \; 3\alpha = \frac{p}{m}$ ——①

$2\alpha^2 = \frac{1}{m}$ ——②

from ① $\alpha = \frac{p}{3m}$ sub in ②

$\therefore \; 2 \times \left(\frac{p}{3m}\right)^2 = \frac{1}{m}$

$\frac{2p^2}{9m^2} = \frac{1}{m}$

$2p^2 = 9m$

QUESTION 8:

(a) (i) $v = \frac{dx}{dt} = 2t - 6$

$\therefore x = t^2 - 6t + c$

at $t = 0$, $x = 4$

$\therefore 4 = c$

$\therefore x = t^2 - 6t + 4$

(ii) comes to rest at $v = 0$

ie $2t - 6 = 0$

$\therefore t = 3$

at $t = 3$, $x = 3^2 - 6(3) + 4$

$= -5$

ie comes to rest after 3 seconds and particle is 5 m to the left of O.

(iii) at $t = 0$ $x = 4$; $t = 3$ $x = -5$; $t = 5$ $x = -1$ } ∴ Total distance $= 9 + 4 = 13$ m

(iv) $\int_0^5 (2t - 6)\, dt = \left[t^2 - 6t\right]_0^5$

$= (25 - 30) - 0$

$= -5$

$\int_0^5 (2t-6)\, dt$ is not the total distance travelled it is the change in displacement in the first 5 seconds. They would be the same if the particle did not stop and change directions in the first 5 seconds.

(b) (i) $\frac{dG}{dt} = -\frac{3}{t+1}$

$\Rightarrow \; G = \int -\frac{3}{t+1}\, dt$

$G = -3\ln(t+1) + c$

at $t = 0$, $G = 10$

$\therefore 10 = -3\ln 1 + c$

$\therefore c = 10$

ie $G = 10 - 3\ln(t+1)$

(ii) Gas escapes $\Rightarrow G = 0$

ie $0 = 10 - 3\ln(t+1)$

$3\ln(t+1) = 10$

$\ln(t+1) = \frac{10}{3}$

$t + 1 = e^{10/3}$

$t = e^{10/3} - 1$

$= 27.03\dots$

∴ Time is 27 seconds (correct to nearest second.)

QUESTION 9:

(a) (i) $\int \sin^2 x \cos x \, dx$

$= \frac{1}{3}\sin^3 x + C$

(ii) $\int_0^{\frac{\pi}{4}} (2\sin x - \cos 2x)\, dx$

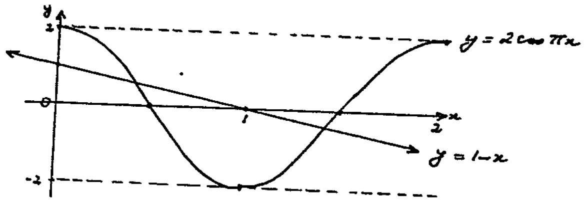
$= \left[-2\cos x - \frac{1}{2}\sin 2x\right]_0^{\frac{\pi}{4}}$

$= \left(-2\cos\frac{\pi}{4} - \frac{1}{2}\sin\frac{\pi}{2}\right) - \left(-2\cos 0 - \frac{1}{2}\sin 0\right)$

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

$= -\sqrt{2} + \frac{3}{2}$

(b)



There are 2 solutions for $0 \le x \le 2$.

(c) (i) Perimeter $= (12 + 12 + 12 + 12 \cdot \frac{2\pi}{3})$ cm

$= (36 + 8\pi)$ cm

(ii) Area = area ΔPQO + area sector $QSRO$

$= \left(\frac{1}{2}\cdot 12 \cdot 12 \sin\frac{\pi}{3} + \frac{1}{2}\cdot 12^2 \cdot \frac{2\pi}{3}\right)$ cm^2

$= \left(72\cdot\frac{\sqrt{3}}{2} + 48\pi\right)$ cm^2

$= (36\sqrt{3} + 48\pi)$ cm^2

18.

QUESTION 10:

(a) (i) $y = \sqrt{9-x}$

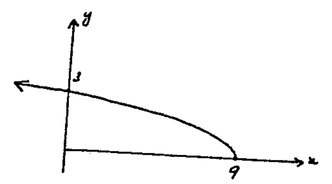
Require $9 - x \ge 0$

$9 \ge x$

$\therefore$ Domain is $\{x : x \le 9\}$

Range is $\{y : y \ge 0\}$

(ii)



(iii) $V = \pi \int_0^3 x^2 \, dy$

$y = \sqrt{9-x}$

$y^2 = 9 - x$

$x = 9 - y^2$

$x^2 = 81 - 18y^2 + y^4$

$= \pi \int_0^3 (81 - 18y^2 + y^4)\, dy$

$= \pi \left[81y - 6y^3 + \frac{y^5}{5}\right]_0^3$

$= \pi \left[243 - 162 + \frac{243}{5} - 0\right]$

$= \frac{648\pi}{5}$

$\therefore$ Volume is $\frac{648\pi}{5}$ units^3

19.

(b) (i) $A = \frac{1}{2}$ base $\times \perp$ height

$= \frac{1}{2}\cdot t \cdot \sqrt{9-t^2}$

$= \frac{t}{2}(9-t^2)^{\frac{1}{2}}$

(ii) $\frac{dA}{dt} = (9-t^2)^{\frac{1}{2}}\cdot\frac{1}{2} + \frac{t}{2}\cdot\frac{1}{2}(9-t^2)^{-\frac{1}{2}}\cdot(-2t)$

$= \frac{\sqrt{9-t^2}}{2} - \frac{t^2}{2\sqrt{9-t^2}}$

stationary point occurs when $\frac{dA}{dt} = 0$

ie $\frac{\sqrt{9-t^2}}{2} - \frac{t^2}{2\sqrt{9-t^2}} = 0$

ie $\frac{\sqrt{9-t^2}}{2} = \frac{t^2}{2\sqrt{9-t^2}}$

$\Rightarrow 2(9-t^2) = 2t^2$

$18 - 2t^2 = 2t^2$

$18 = 4t^2$

$t^2 = \frac{18}{4}$

$\therefore t = \frac{3\sqrt{2}}{2}$ (since $t \ge 0$)

TEST:

t	2.1	$\frac{3\sqrt{2}}{2}$	2.2
$\frac{dA}{dt}$	0.6	0	−0.2

NOTE: must give values for this test!!

$\therefore$ maximum area occurs at $t = \frac{3\sqrt{2}}{2}$

$\therefore$ Co-ordinates of P are $\left(\frac{3\sqrt{2}}{2}, \sqrt{9 - \frac{9}{2}}\right)$

$= \left(\frac{3\sqrt{2}}{2}, \frac{3\sqrt{2}}{2}\right)$