30.3 Mathematics (121)

30.3.1 Mathematics Paper 1 (121/1)

1.

$$\frac{-8+(-5)\times(-8)-(-6)}{-3+(-8)\div 2\times 4}=\frac{-8+40+6}{-3+-4\times 4}$$

$$=\frac{38}{-19}$$

$$=-2$$

(2 marks)

2.

$$\frac{(3^3)^{2/3}\div 2^4}{(2^5)^{-3/5}}=\frac{3^2\div 2^4}{2^{-3}}$$

$$=\frac{3^2}{2^4\times 2^{-3}}=\frac{9}{2}$$

$$=4\frac{1}{2}\ or\ 4.5$$

(3 marks)

3.

$$\frac{a^4-b^4}{a^3-ab^2}=\frac{(a^2+b^2)(a^2-b^2)}{a(a^2-b^2)}$$

$$=\frac{a^2+b^2}{a}\ or\ a+\frac{b^2}{a}$$

(3 marks)

4.

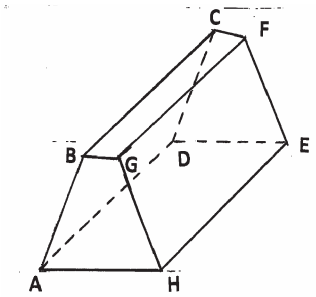
$$23.50+(7\text{h}15\text{min}+45\text{min}+5\text{h}40\text{min})$$

$$=1330\text{h}$$

$$=1.30\text{ pm on Monday}$$

(2 marks)

5.



(3 marks)

6.

Sales : Petrol $-\frac{1}{3}\times 900000$

Diesel $-\frac{2}{3}\times 900000$

Profit $\frac{1}{3}\times\frac{900000}{1000}\times 520+\frac{2}{3}\times\frac{900000}{1000}\times 480$

$=156000+288000$

$=444000$

(3 marks)

7.

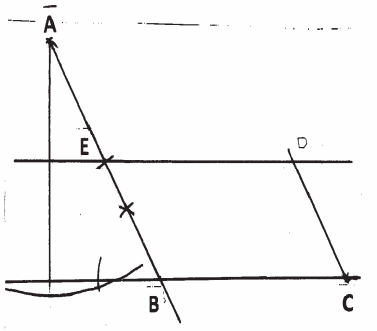
$\text{Volume of Liquid}=\frac{384}{0.6}$

$\text{Height of Liquid}=\frac{38}{\pi\times 3.2^2}$

$=19.89$

(3 marks)

8.



$\angle 120^\circ$ constructed at B and completion of Δ ABC

Droping $\perp$ from A to CB produced

Bisection of height and determination of point E

Determination of point D and completion of parallelogram BCDE

(4 marks)

9.

$\text{Volume of Sphere}=\frac{\frac{4}{3}\pi\times 4.2^3}{}$

$\therefore \text{Side of cube}=\sqrt[3]{\frac{4}{3}\pi\times 4.2^3}$

$=6.77$

(3 marks)

10.

$$\text{Radius of circle} = \frac{23.4}{1.8}$$

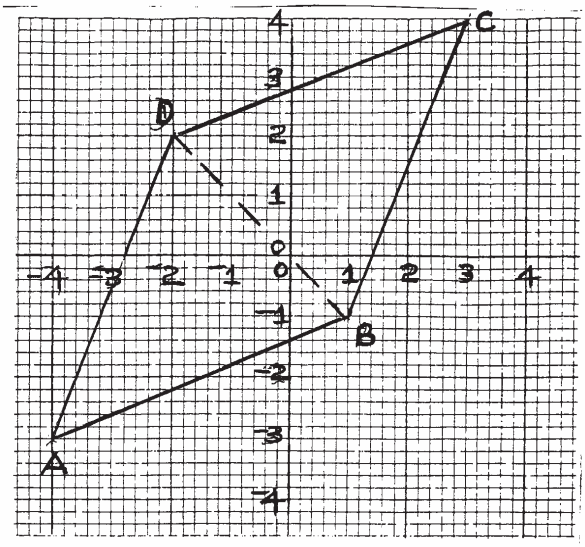
$$= 13 \text{ cm}$$

$$\text{Area of Sector} = \frac{1.8}{2\pi} \times \pi \times 13^2$$

$$= 152.1 \text{cm}^2$$

(4 marks)

11.



Equation of line AD

$$= \frac{y - {}^{-}3}{x - {}^{-}4} = \frac{5}{2}$$

$$y = \frac{5}{2}x + 7$$

(4 marks)

12.

$$AB = \begin{pmatrix} k & 4 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = \begin{pmatrix} k+12 & 2k+16 \\ 3+6 & 6+8 \end{pmatrix}$$

$$= \begin{pmatrix} k+12 & 2k+16 \\ 9 & 14 \end{pmatrix}$$

$$\text{Det} \quad AB = (k+12) \times 14 - (2k+16) \times 9 = 4$$

$$14k + 168 - 18k - 144 = 4$$

$$-4k = -20$$

$$k = 5$$

(3 marks)

13.

Area of Rectangular part $= 2 \times 5.2 \times \pi \times 18$

$= 187.2\pi$

Area of circular parts $= 2 \times 5.2 \times \pi$

$= 54.08\pi$

$= 241.28\pi$

(3 marks)

14.

$\text{Log } 0.096 = \text{Log}\left(4^2 \times 6 \times 10^{-3}\right)$

$= 2(0.6021) + \bar{3}.7782$

$= \bar{2}.9824 \text{ or}$

(-1.0176)

(3 marks)

15.

$2y = 5x + 8$

$y = \frac{5}{2}x + 4$

Gradient of $L_1 = \frac{5}{2}$

Gradient $L_2 = \frac{0 - {}^{-}4}{{}^{-}5 - 5} = \frac{4}{{}^{-}10} = \frac{{}^{-}2}{5}$

$= \frac{5}{2} \times \frac{{}^{-}2}{5} = {}^{-}1$

$\therefore L_1$ and L_2 are perpendicular.

(3 marks)

16.

$2 \cos 2\theta = 1$

$\cos 2\theta = ½$

$\therefore 2\theta = 60^\circ, 300^\circ$

$420^\circ, 660^\circ$

$\theta = 30^\circ, 150^\circ$

$210^\circ, 330^\circ$

(4 marks)

17.

(a) Juma's earnings before increase:

$112\% \rightarrow 8400$

$100\% \rightarrow 8400 \times \frac{100}{112}$

$= 7500$

Akinyi's earnings before increase:

$\frac{3}{5} \times 7500 = 4500$

Increase in Akinyi's earnings

$14100 - 8400 - 4500$

$= 1200$

% increase in Akinyi's earnings

$\frac{1200}{4500} \times 100$

$= 26\frac{2}{3}$

(b) No. of bags bought

$\frac{14100}{1175}$

$= 12 \text{ bags}$

$\text{Profit} = (1762.50 - 1175) \times 12 = 7050$

Ratio 5700:8400 = 19:28

$\text{Profit for Akinyi} := 7050 \times \frac{19}{47} = 2850$

Total earning for Akinyi:

$5700 + 2850$

$= 8550$

(10 marks)

18.

(a) Trapezium Rule:

x	-2	-1	0	1
y	7	5	5	7

$A_c = \frac{1}{2} \times 1\{(11 + 11) + 2(7 + 5 + 5 + 7)\}$

$= \frac{1}{2}\{22 + 48\}$

$= 35$

$A_r = 11 \times 5 = 55$

$A = 55 - 35$

$= 20 \text{ square units}$

(b) Mid-ordinates

x	-2.5	-1.5	-0.5	0.5	1.5
y	8.75	5.75	4.75	5.75	8.75

$A_c = (8.75 + 5.75 + 4.75 + 5.75 + 8.75) \times 1$

$= 33.75$

$A = 55 - 33.75$

$= 21.25$

$\text{Difference} = 21.25 - 20$

$= 1.25 \text{ sq units}$

(10 marks)

19.

(a) (i) $BD = q - p$

(ii) $\mathrm{BC} = \frac{2}{3}(\mathrm{q} - \mathrm{p})$

(iii) $\mathrm{CD} = \frac{1}{3}(\mathrm{q} - \mathrm{p})$

(iv)

$$\mathrm{AC} = \mathrm{p} + \frac{2}{3}\mathrm{q} - \frac{2}{3}$$

$$= \frac{1}{3}\mathrm{p} + \frac{2}{3}\mathrm{q}$$

(b) (i)

$$\mathrm{CE} = \mathrm{CD} + \mathrm{DE}$$

$$= \frac{1}{3}\mathrm{q} - \frac{1}{3}\mathrm{p} + \frac{1}{2}\mathrm{p}$$

$$= \frac{1}{3}\mathrm{q} - \frac{1}{6}\mathrm{p}$$

$$\mathrm{AC} = \mathrm{k}\left(\frac{1}{3}\mathrm{q} + \frac{1}{6}\mathrm{p}\right)$$

$$= \frac{1}{3}\mathrm{p} + \frac{2}{3}\mathrm{p} = \frac{1}{3}\mathrm{kq} + \frac{1}{6}\mathrm{kp}$$

$$= \frac{1}{6}\mathrm{k} = \frac{1}{3} \Rightarrow \mathrm{k} = 2$$

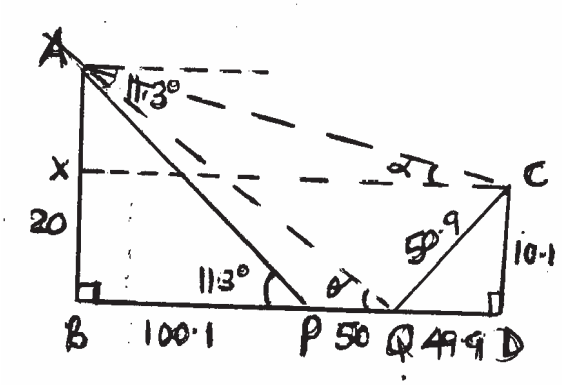
(ii)

$$\mathrm{AC} = 2\mathrm{CE}$$

$$\mathrm{AC} : \mathrm{CE} = 2 : 1$$

(10 marks)

20.



(a)

$$\tan 11.3^\circ = \frac{20}{x} \Rightarrow x = \frac{20}{\tan 11.3^\circ}$$

$$= \frac{20}{0.1998197} = 100.09022$$

$$\approx 100.1m$$

(b)

$$\text{PQ} = \frac{36 \times 1000}{60 \times 60} \times 5 = 50\text{m}$$

$$\text{BQ} = 100.1 + 50 = 150.1\text{m}$$

$$\tan\theta = \frac{20}{150.1} = 0.1332445$$

$$\theta = 7.5896426$$

$$\theta = 7.59$$

(c) (i)

$$\text{QD} = 200 - 150.1 = 49.9$$

$$\text{CD} = \sqrt{50.9^2 - 49.9^2}$$

$$= 10.03992$$

$$\approx 10.04\text{m}$$

(ii)

$$\text{AX} = 20 - 10.04 = 9.96$$

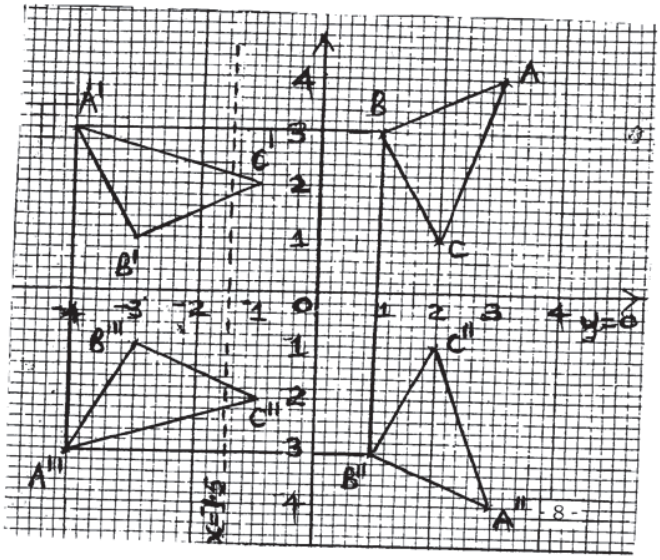
$$\tan\alpha = \frac{9.96}{200} = 0.0498$$

$$\alpha = 2.8509745$$

$$\alpha \cong 3^\circ$$

(10 marks)

21.



(a) $\Delta A^1B^1C^1$ correctly drawn

(b) $\Delta A^{11}B^{11}C^{11}$ correctly drawn

(c) $\Delta A^{111}B^{111}C^{111}$ correctly drawn

(d) Reflection in the line $y = x$

(e)

$x = -1.5$

$y = 0$

(10 marks)

22.

(a) $\frac{1}{3} \times \frac{22}{7} \times 21 \times 21 \times 30 = 13860$

(b) (i)

$\frac{r}{21} = \frac{36}{30}$

$r = \frac{36 \times 21}{30} = 25.2 \text{ cm}$

(ii)

$\frac{1}{3} \times \frac{22}{7} \times 25.2 \times 25.2 \times 36$

$= 23950.08 - 13860$

$= 10090.08 \text{ cm}^3$

(iii)

$$\frac{4}{3}\times\frac{22}{7}\times r^3 = 10090.08$$

$$r^3 = \frac{10090.08\times 21}{4\times 22}$$

$$r = \sqrt[3]{2407.86}$$

$$= 13.40\text{cm}$$

(10 marks)

23.

(a) Let the original number be n

Amount per member originally $= \frac{2000000}{n}$

Amount per member after withdrawal of 40 $= \frac{2000000}{n-40}$

$$\frac{2000000}{n-40} - \frac{2000000}{n} = 2500$$

$$2000000n = (n-40)(2500n + 2000000)$$

$$2000000n = 2500n^2 + 2000000n - 100000n - 80000000$$

$$n^2 - 40n - 32000 = 0$$

$$(n-200)(n+160) = 0$$

$$n = 200$$

(b) New total contribution by members

$$= \frac{55}{100}\times\frac{2000000}{160} = 6875$$

(c) Actual cash contribution by members

$$= \frac{55}{100}\times 2000000\times\frac{19}{25} = 836000$$

(10 marks)

24.

(a)

$$\frac{ds}{dt} = 3t^2 - 12t + 9$$

$$\frac{ds}{dt}(0.5) = 3(0.5)^2 - 12(0.5) + 9$$

$$= 3.75$$

(b)

$$\frac{ds}{dt} = 0 \Rightarrow 3t^2 - 12t + 9 = 0$$

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

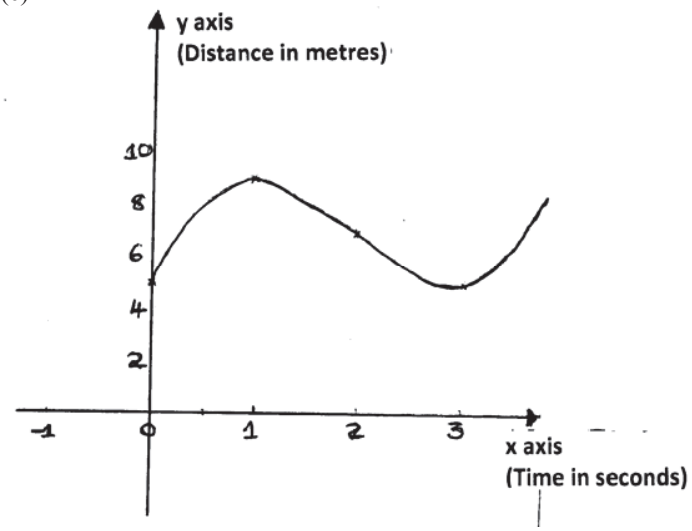
$$(t-3)(t-1) = 0$$

$$t = 3 \text{ or } t = 1$$

When t=3, $s=3^3-6x3^2+9x3+5=5$

When t=1, $s=1^3-6x1+9x1+5=9$

(c)



(10 marks)

30.3.2 Mathematics Paper 2 (121/2)

1.

No	Log
6.3730 0.6944	0.8043 $\bar{1}.8416$ +
$\sqrt{0.004636}$	0.6459 $\bar{3}.6661 \div 2$ $\bar{1}.83331$ −
	1.8128 ↓ 64.98

(3 marks)

2.

$q - htq = 1 + rh$

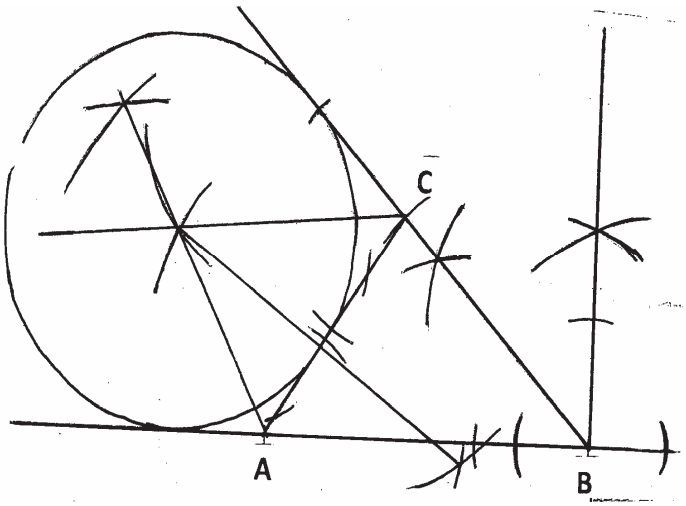
$q - 1 = rh + htq$

$q - 1 = h(r + tq)$

$$h = \frac{q-1}{r+tq}$$

(2 marks)

3.



(3 marks)

4.

$$AB = \begin{pmatrix} 8 \\ -6 \\ 6 \end{pmatrix} - \begin{pmatrix} 3 \\ -1 \\ -4 \end{pmatrix} = \begin{pmatrix} 5 \\ -5 \\ 10 \end{pmatrix}$$

$$OP = OA + AP$$

$$= \begin{pmatrix} 3 \\ -1 \\ -4 \end{pmatrix} + \frac{2}{5}\begin{pmatrix} 5 \\ -5 \\ 10 \end{pmatrix} = \begin{pmatrix} 5 \\ -3 \\ 0 \end{pmatrix}$$

(3 marks)

5.

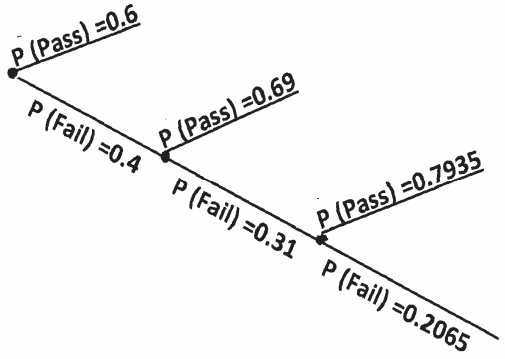
$$0.05 \times 6 = 0.3$$

$$\% \text{ error} = \frac{0.3}{50 \times 6} \times 100\%$$

$$= 0.1\%$$

(3 marks)

6.



$$p(\text{passing in 2nd attempt})$$
$$= 0.4 \times 0.69$$
$$p(\text{passing in 3rd attempt})$$
$$= 0.4 \times 0.31 \times 0.7935$$
$$p(\text{passing in 2nd or 3rd attempt})$$
$$= 0.4 \times 0.69 + 0.4 \times 0.31 \times 0.7935$$
$$= 0.276 + 0.098394$$
$$= 0.374394$$

(3 marks)

7.

(i) Distance $= 500 \times \frac{9}{4} = 1125nm$

(ii)

$$\theta \times 60 \times \cos 53.4^\circ = 1125$$
$$\theta = \frac{1125}{60 \cos 53.4^\circ}$$
$$= 31.45^\circ$$
$$\therefore \text{Longitude of Q} = 71.45^\circ \text{E}$$

(3 marks)

8.

(a)

$$\left(10 + \frac{2}{x}\right)^5 = 10^5 + 5.10^4\left(\frac{2}{x}\right) + 10.10^3\left(\frac{2}{x}\right)^2 + 10.10^2\left(\frac{2}{x}\right)^3 + 5.10\left(\frac{2}{x}\right)^4 + \left(\frac{2}{x}\right)^5$$
$$= 100000 + \frac{100000}{x} + \frac{40000}{x^2} + \frac{8000}{x^3} + \frac{800}{x^4} + \frac{32}{x^5}$$

(b)

$$14^5 = \left(10 + \frac{2}{\frac{1}{2}}\right)^5$$

$$= 100000 + \frac{100000}{\frac{1}{2}} + \frac{40000}{\left(\frac{1}{2}\right)^2} + \frac{8000}{\left(\frac{1}{2}\right)^3} + \frac{800}{\left(\frac{1}{2}\right)^4} + \frac{32}{\left(\frac{1}{2}\right)^5}$$

$$= 100000 + 200000 + 160000 + 64000 + 128000 + 1024 = 537824$$

(4 marks)

9.

Δ ADC and Δ BAC are similar

$$\frac{AC}{BC} = \frac{4}{3}$$

$$\text{Area scale factor} = \left(\frac{4}{3}\right)^2 = \frac{16}{9}$$

$$\text{Area of } \Delta \text{ ADC} = \frac{16}{9} \times 24 = 42\tfrac{2}{3}\,\text{cm}^2$$

(3 marks)

10.

$$\text{Let } T = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} 2 & 4 \\ 2 & 3 \end{pmatrix} = \begin{pmatrix} 2 & 4 \\ 8 & 15 \end{pmatrix}$$

$2a + 2b = 2 \quad 2c + 2d = 8$

$4a + 3b = 4 \quad 4c + 3d = 15$

$4a + 4b = 4 \quad 4c + 4d = 16$

or

$4a + 3b = 4 \quad 4c + 3d = 15$

$b = 0, a = 1 \quad d = 1, c = 3$

$$\therefore T = \begin{pmatrix} 1 & 0 \\ 3 & 1 \end{pmatrix}$$

(4 marks)

11.

$$x^2 + y^2 - 2x + 5y = \frac{7}{4}$$

$$x^2 - 2x + 1 + y^2 + 5y + \frac{25}{4} = \frac{7}{4} + 1 + \frac{25}{4}$$

$$(x-1)^2 + \left(y + \frac{5}{2}\right)^2 = 9$$

$$\text{centre } \left(1, -2\tfrac{1}{2}\right)$$

(3 marks)

12.

$$\text{Log}\left(\frac{3y+2}{10}\right) = \text{Log}(y-4)$$

$$\frac{3y+2}{10} = y-4$$

$$3y+2 = 10y-40$$

$$y = 6$$

(3 marks)

13.

$$\frac{\sqrt{3}}{1-\cos 30^\circ} = \frac{\sqrt{3}}{1-\frac{\sqrt{3}}{2}}$$

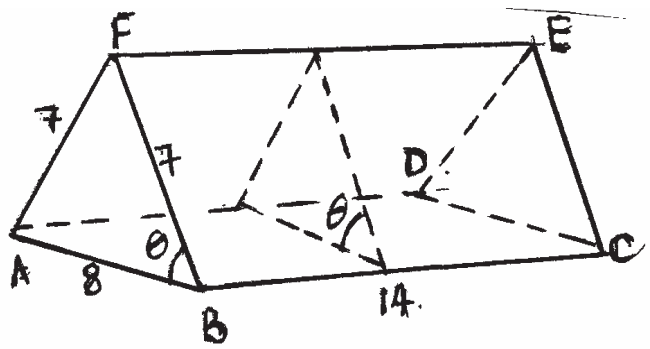
$$= \frac{2\sqrt{3}\left(2+\sqrt{3}\right)}{\left(2-\sqrt{3}\right)\left(2+\sqrt{3}\right)}$$

$$= \frac{2\sqrt{3}\left(2+\sqrt{3}\right)}{4-3}$$

$$= 4\sqrt{3}+6$$

(3 marks)

14.



$$\cos\theta = \frac{4}{7}$$

$$\theta = 55.1500954^\circ$$

$$\approx 55.15^\circ$$

(3 marks)

15.

$$\text{Distance travelled} = \left(\frac{9}{3}t^3 - \frac{4}{2}t^2 + t\right)_2^3$$

$$= \left(3\times 3^3 - 2\times 3^3 + 3\right) - \left(3\times 2^3 - 2\times 2^2 + 2\right)$$

$$= 66 - 18$$

$$= 48\text{m}$$

(3 marks)

16.

$2(1-\sin^2 x)-\sin x=1$

$2\sin^2 x+\sin x-1=0$

$2\sin^2 x+2\sin x-\sin x-1=0$

$(2\sin x-1)(\sin x+1)=0$

$\sin x=\frac{1}{2}$ or $\sin x=-1$

$x=\frac{1}{6}\pi^c,\frac{5}{6}\pi^c,\frac{3}{2}\pi^c$

(4 marks)

17.

(a)

$CP=400\times 30+350\times 50=29500$

$SP=\frac{120}{100}\times 29500=35400$

$1\,bag=35400\div 80=sh.442.50$

(b)

$CP=\frac{400x+350y}{x+y}$

$\frac{400x+350y}{x+y}=383.50$

$400x+350y=383.5x+383.5y$

$\Leftrightarrow 16.5x=33.5y$

$x:y=33.5:16.5$

$=67:33$

(c)

$\left(\frac{3}{8}+\frac{67}{100}\right):\left(\frac{5}{8}+\frac{33}{100}\right)$

$=209:191$

(10 marks)

18.

(a)

$$p = \frac{kq}{r^2}$$

$$9 = \frac{k(12)}{2^2} \qquad k = 3$$

$$p = \frac{3(15)}{5^2} = 1.8$$

(b)

$$q = \frac{pr^2}{3}$$

(c)
(i)

$$q_1 = \frac{1.2p(0.9r)^2}{3} = 0.972\frac{pr^2}{3}$$

$$\Delta q = 0.972\frac{pr^2}{3} - \frac{pr^2}{3} = -0.028\frac{pr^2}{3}$$

(ii)

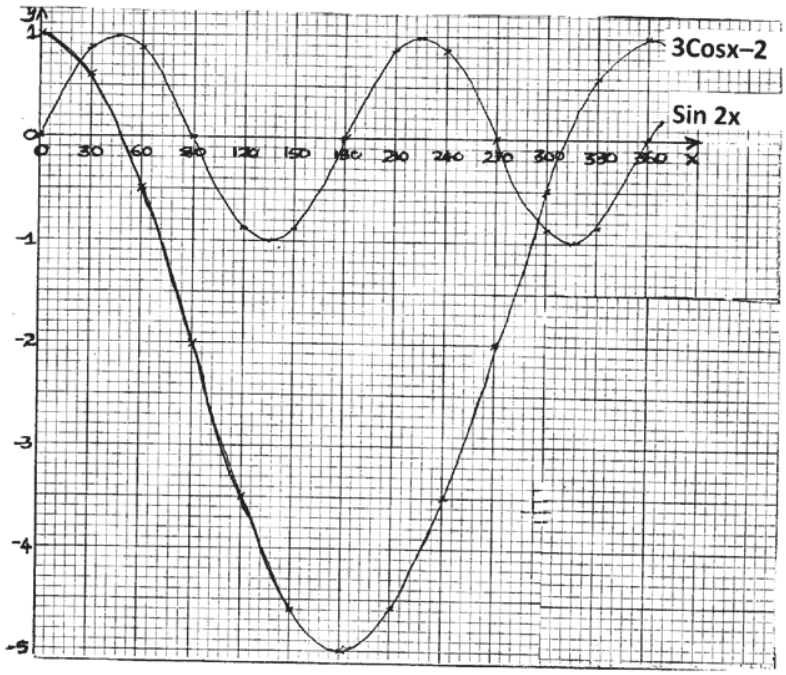
$$\% \text{ change} = \frac{0.028\frac{pr^2}{3}}{\frac{pr^2}{3}} \times 100\%$$

$$= -2.8\%$$

(10 marks)

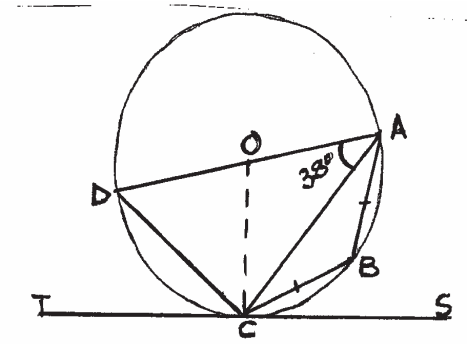
19.

x°	30°	60°	90°	150°	180°	240°	270°	300°	330°
sin 2x	0.87		0	⁻0.87			0	⁻0.87	⁻0.87
3 cos x-2		⁻0.5		⁻4.60	⁻5	⁻3.5	⁻2		0.60



(10 marks)

20.



(a)

(i)

$\angle ADC = 52^\circ$ or $\angle OCA = 38^\circ$ or $\angle DCT = 38^\circ$

$= 52^\circ$

(ii)

$\angle CBA = 128^\circ$

$\angle BCA = 26^\circ$

(b)

(i)

$AC = 20 \cos 38$

$= 15.76$ cm

(ii)

$$\frac{AB}{\sin 26^\circ} = \frac{15.76}{\sin 128^\circ}$$

$$AB = \frac{15.76 \sin 26^\circ}{\sin 128^\circ}$$

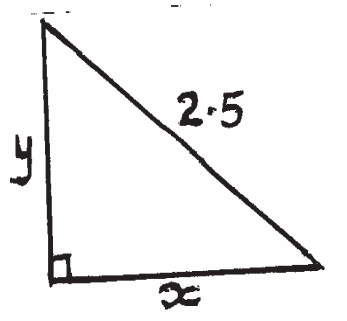
$$= \frac{15.76 \times 0.4384}{0.7880}$$

$$= 8.768\text{cm}$$

(10 marks)

21.

(a)



(b)

(i)

$$x^2 + y^2 = 2.5^2$$

$$\frac{y}{2.4} = \frac{x}{3.2}$$

(ii)

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

$$x^2 + \left(\frac{3}{4}x\right)^2 = 2.5^2$$

$$16x^2 + 9x^2 = 6.25 \times 16$$

$$x^2 = \frac{6.25 \times 16}{25}$$

$$x = 2\text{km}$$

$$y = \frac{3}{4} \times 2 = 1.5\text{km}$$

(iii)

$$\text{Time taken} = \frac{2}{3.2} \quad \text{or} \quad \frac{1.5}{2.4}$$

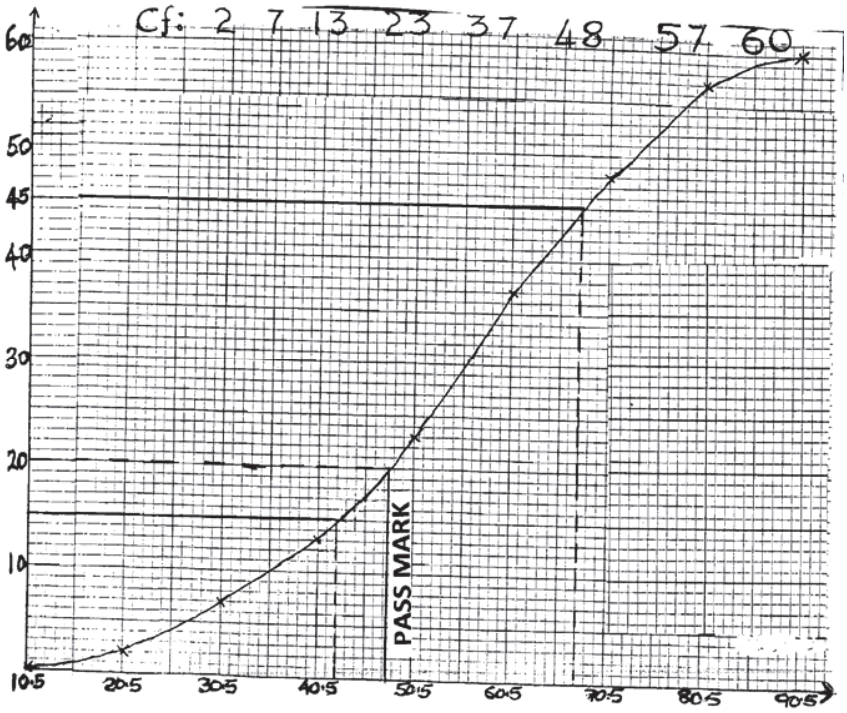
$$= 0.625 \text{hrs}$$

$$\text{or} \quad 37\frac{1}{2} \text{minutes}$$

$$\text{or} \quad \frac{5}{8} \text{hrs}$$

(10 marks)

22.



(10 marks)

23.

(a)

$$Interest = 109375 \times \frac{8}{10} \times 2 = 17500$$

$$Amount = 109375 + 17500 = sh\,126875$$

(b)

(i)

$$1^{st}\ year\ value = \frac{96}{100} \times 126875 = sh\,121800$$

(ii)

$$4^{th}\ year\ value = 121800\left(1+\frac{6}{100}\right)^{9} = sh\ 205779$$

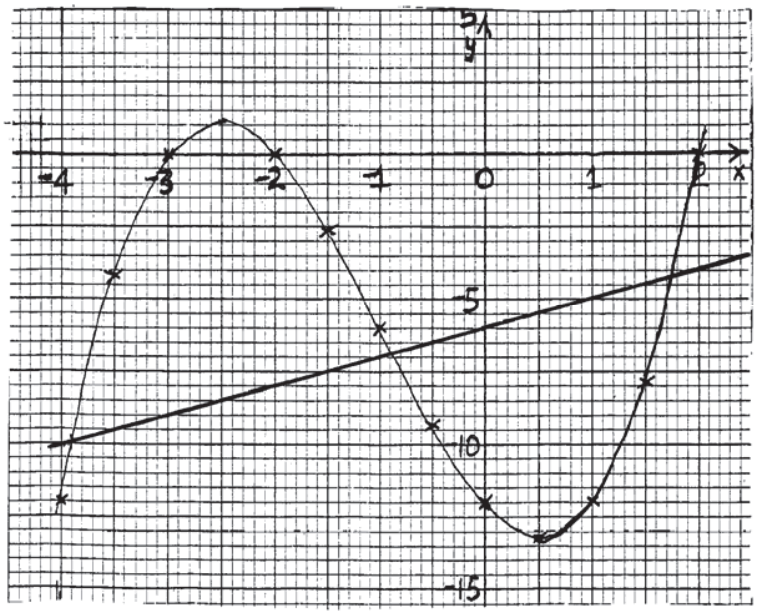
(c)

$$\%\ gain = \frac{205779-126875}{126875}\times 100\% = 62.19\%$$

(10 marks)

24.

x	-4	-3	-2	-1	0	1	2
y	-12	0	0	-6	-12	-12	0



$$y = x^3 + 3x^2 - 4x - 12$$

$$0 = x^3 + 3x^2 - 5x - 6$$

$$y = x - 6$$

$$x = (-3.9, -0.9, 1.76) \pm 0.05$$

(10 marks)