MASAKA DIOCESAN EXAMINATION BOARD MOCK 2023

P425/2 MATH 2 PROPOSED GUIDE

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MTC/CHEM

SECTION A

QN.1

Let John speaking the truth be represented by J; that for Peter, P.

Also, John not speaking the truth be J'; and that of Peter, P'

T = Both speaking the the truth

T' = Both Not speaking the truth.

$P(T) + P(T') = 1$ $B_1 M_1$

$P(T) = P(J \cap P)$ B_1

$P(T) = \frac{3}{5} \times \frac{5}{8}$

$P(T) = \frac{3}{8}$.

From $P(T') = 1 - \frac{3}{8}$ B_1 $\overline{OS}$

$P(T') = \frac{5}{8}$.

$\therefore$ The probability that they are likely to contradict each other on an identical point is $\frac{5}{8}$ A_1

QN. 2.

$x^3 + 2x^2 = 4x + 4$.

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

let $y = x^3 + 2x^2 - 4x - 4$ B_1 $\overline{OS}$

x	-3	-2	-1	0	1	2	3
y	-1	0	1	-4	-5	4	29

B_1

The root exist where there is a sign change

$\therefore$ The root exist between -3 and -2 A_1

Between -1 and 0 A_1

Between 1 and 2 A_1

QN. 3.

Mass of car = 2000kg.
Power = 64 800 watts
Driving force = ?

Power = Force x velocity.

$64800 = \text{Driving force} \times \left(\frac{54 \times 1000}{3600}\right)$

$\text{Driving force} = \frac{64800}{15}$

$= 4320\,N.$ B_1

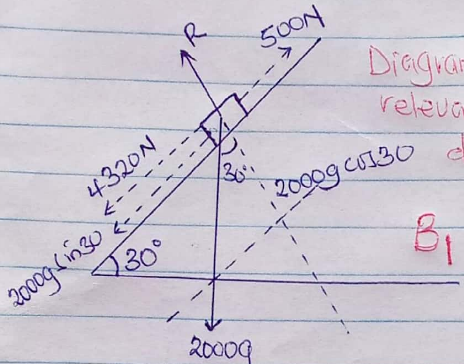

Diagram should show all the relevant forces in the right directions.

B_1

05

Resultant Force $= \left(4320 + 2000 \times 9.8 \times \frac{1}{2}\right) - 500$

Resultant force $= 13620\,N$ B_1

From Force = ma M_1

$13620 = 2000a$

$a = \frac{13620}{2000}$

$a = 6.81\,ms^{-2}$

∴ The acceleration of the car is $6.81\,ms^{-2}$ A_1

Deny without units.

QN. 4

Mock	UNEB	Rmock	RUNEB	d	d^2
E	O	6	6.5	-0.5	0.25
C	B	4	1.5	2.5	6.25
G	C	2.5	4	-1.5	2.25
F	O	8	6.5	1.5	2.25
D	C	5	4	1	1
A	C	1	4	-3	9
B	B	2.5	1.5	1	1
O	F	7 B_1	8 B_1	1	1 B_1
					$\sum d^2 = 23$

05

From $\rho = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$

$\rho = 1 - \frac{6 \times 23}{8(63)}$ B1

$\rho = 0.72619$

Comment; Not significant at 1% level. A1

Not to be awarded without comment.

QN. 5: let u = Initial speed

Motion in the 3rd seconds.

$d_1 = \left(3u + \frac{9}{2}a\right) - \left(2u + \frac{4}{2}a\right)$

$d_1 = 3u - 2u + \frac{9}{2}a - \frac{4}{2}a$

$d_1 = u + \frac{5}{2}a$ ——— (i) B1

Motion in the 4th seconds.

$d_2 = \left(4u + \frac{16}{2}a\right) - \left(3u + \frac{9}{2}a\right)$

$d_2 = u + \frac{7}{2}a$ ——— (ii) B1

From equation (i) $u = d_1 - \frac{5}{2}a$

$d_2 = d_1 - \frac{5}{2}a + \frac{7}{2}a$

$a = d_2 - d_1$

$d_2 = u + \frac{7}{2}(d_2 - d_1)$ M1 B1

$u = d_2 - \frac{7}{2}d_2 + \frac{7}{2}d_1$

$u = \frac{7}{2}d_1 - \frac{5}{2}d_2$

$u = \frac{1}{2}(7d_1 - 5d_2)$ A1

$\therefore$ initial speed of travelling particle is $\frac{1}{2}(7d_1 - 5d_2)$ As required.

05

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QN. 6

let the number of years worked be x
Amount earned be y shs.
let estimated Kakeeto's salary be z.

x	4	7	10
y	400000	Z	800000
	A	B	C

Using linear Intepolation.

$$\frac{Z-400000}{7-4} = \frac{800000-400000}{10-4}$$

05

$$Z-400000 = \frac{200000 \times 3}{3}$$

$$Z = 600000$$

∴ Kakeeto estimated salary is shs600000 in 7 years of work.

Deny without units

b) let Kalekezi number of years be P.

x	7	10	P
y	600000	800000	1000000

$$\frac{10-7}{200000} = \frac{P-7}{400000}$$

$$\frac{3 \times 400000}{200000} = P-7$$

$$6 = P-7$$

$$P = 13 \text{ years.}$$

∴ The estimated years of work for Kalekezi is 13years inorder to earn 1 million.

Deny without units

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QN. 7.

P(customers who pay by cash) $= \frac{3}{5}$

P(Paying by credit card) $= \frac{2}{5}$.

a) $p(\text{success}) = \frac{2}{5}$, $q = \frac{3}{5}$; $n = 10$

Let X be the number of customers who paid by credit cards.

$P(X=3)$

05

From $P(X=r) = {}^nC_r\, p^r q^{n-r}$.

$P(X=3) = {}^{10}C_3 \left(\frac{2}{5}\right)^3 \left(\frac{3}{5}\right)^7$ M1

$P(X=3) = 120 \times \frac{8}{125} \times \frac{2187}{78125}$

$P(X=3) = 0.21499$ (5dp).

∴ Probability of exactly 3 customers paying by credit cards is $\underline{\underline{0.21499}}$ A1

~~QN. 7~~(b).

$p = \frac{3}{5}$, $q = \frac{2}{5}$, $n = 10$.

let Y be the number of customers who pays by cash.

$P(5 < Y \leq 9)$

$P(5 < Y \leq 9) = P(Y=6) + P(Y=7) + P(Y=8) + P(Y=9)$

$= {}^{10}C_6 \left(\frac{3}{5}\right)^6 \left(\frac{2}{5}\right)^4 + {}^{10}C_7 \left(\frac{3}{5}\right)^7 \left(\frac{2}{5}\right)^3 +$ M1 ${}^{10}C_8 \left(\frac{3}{5}\right)^8 \left(\frac{2}{5}\right)^2 +$ ~~${}^{10}C_9 \left(\frac{3}{5}\right)^9 \left(\frac{2}{5}\right)^1$~~

1 1

${}^{10}C_9 \left(\frac{3}{5}\right)^9 \left(\frac{2}{5}\right)^1$

$= 0.25082 + 0.21499 + 0.12093 + 0.04031$

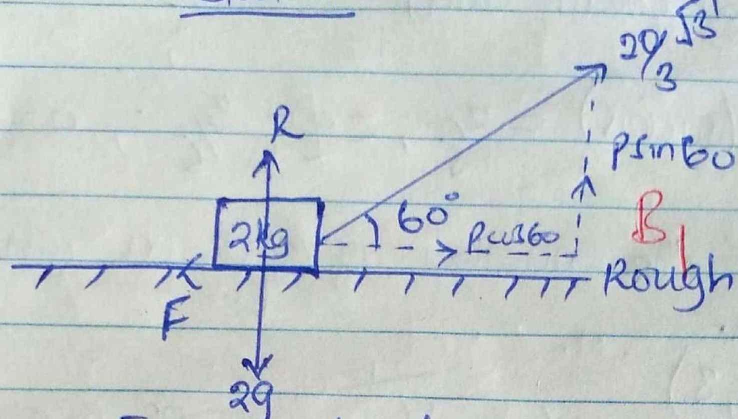
$= 0.62705$

∴ Probability of between 5 to 9 customers paying by cash is 0.62705 (5dp).

1

QN: 8

Sketch



Strictly using ruler to show direction of forces. B1

Where, F = Frictional force. let $P = \frac{20\sqrt{3}}{3}$.

R = Normal reaction

let μ = Coefficient of friction.

Resolving forces horizontally.

$P\cos 60 = F$ B1

Resolving forces vertically.

$R + P\sin 60 = 2g$ B1

But $F = \mu R$. B1

$P\cos 60 = \mu R$.

Also, $R = 2g - P\sin 60$.

$P\cos 60 = \mu(2g - P\sin 60)$.

$$\mu = \frac{P\cos 60}{2g - P\sin 60}$$

$$\mu = \frac{20\sqrt{3}}{3} \cdot \frac{1}{2} \div \left(2 \cdot 9.8 - \frac{20\sqrt{3}}{3} \cdot \frac{\sqrt{3}}{2}\right)$$

$$\mu = \frac{10\sqrt{3}}{3} \div (19.6 - 10)$$

$$\mu = \frac{10\sqrt{3}}{3 \times 9.6}$$

$\mu = \underline{\underline{0.6}}$ A1 (Coefficient of friction)

05

SECTION B

QN 9

Time (seconds)	Frequency (f)	mid point (x)	fx	Cf	c.b
10–19	20	14.5	290	20	9.5–19.5
20–24	20	22	440	40	19.5–24.5
25–29	15	27	405	55	24.5–29.5
30	14	30	420	69	29.5–30.5
31–34	16	32.5	520	85	30.5–34.5
35–39	10	37	370	95	34.5–39.5
40–49	10	44.5	445	105	39.5–49.5
	$\Sigma f = 105$		$\Sigma fx = 2890$		

class width	frequency density (f/c)
10	2
5	4
5	3
1	14
4	4.0
5	2
10	1

B_1 – Mid point (x).

B_1 – For Σfx

Total marks
12 marks

a(i) $\text{Mean} = \frac{\Sigma fx}{\Sigma f}$

$\text{Mean} = \frac{2890}{105}$ m_1

Mean $= 27.52$ seconds. A_1

(ii) 80^{th} percentile, P_{80}.

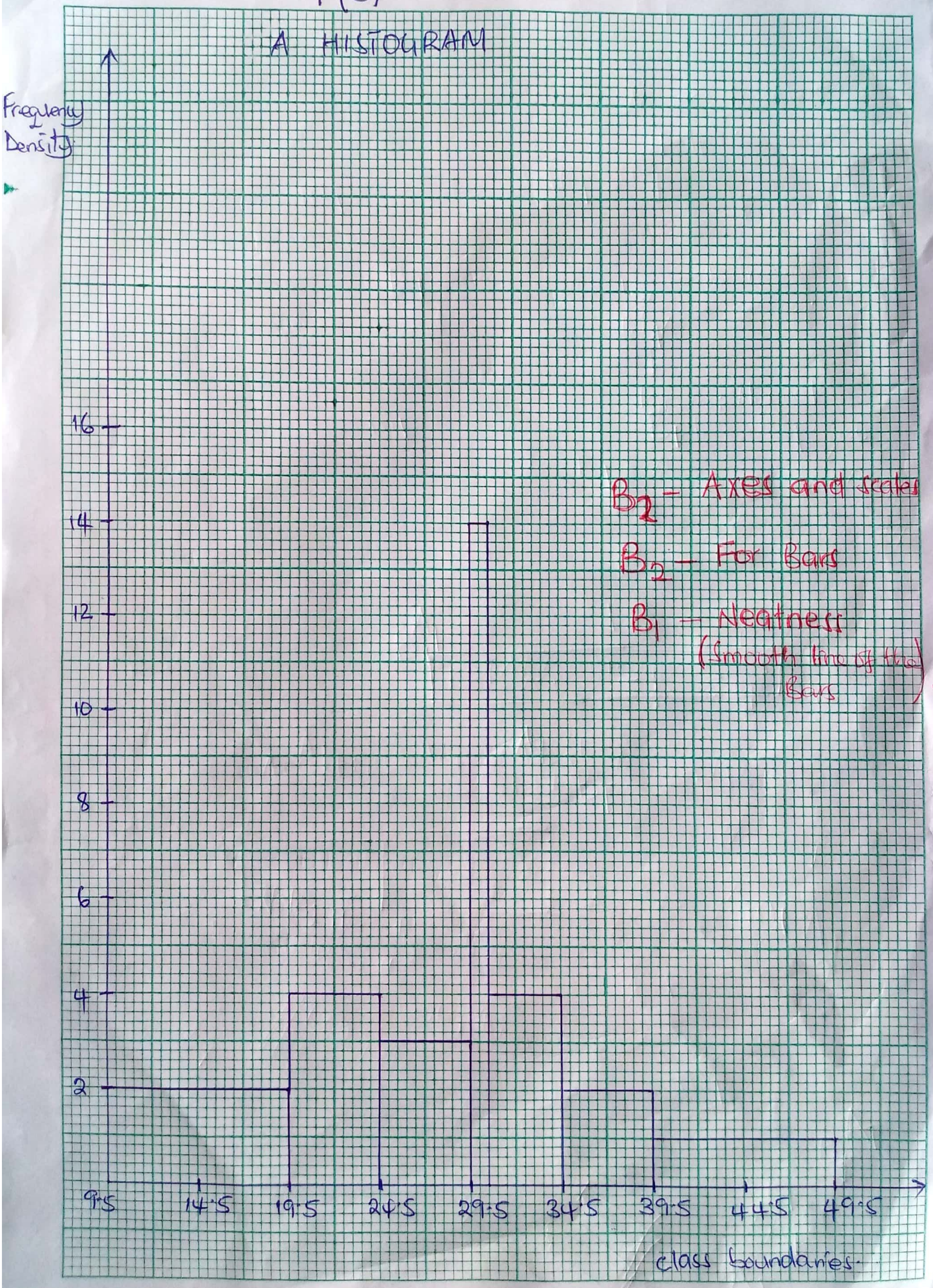
$\left(\frac{80}{100} \text{ of } 105\right)^{th}$ value $= 84^{th}$ value.

From $P_{80} = L_{80} + \left(\frac{\frac{80N}{100} - cfb}{f_{80}}\right)c$. $m_1 B_1$

$P_{80} = 30.5 + \left(\frac{84 - 69}{16}\right) \times 4$.

$\therefore$ 80^{th} percentile $= \underline{\underline{34.25}}$ seconds A_1

9 (b)


A HISTOGRAM
Frequency Density
16
14
12
10
8
6
4
2
9·5
14·5
19·5
24·5
29·5
34·5
39·5
44·5
49·5
class boundaries
B2 - Axes and scales
B2 - For Bars
B1 - Neatness
(Smooth line of the Bars)

9 (b) Shown on the graph

QN. 10 (a)

Mass = 2kg $V(t) = (2-3t^2)\underset{\sim}{i} - 2\sin 2t\underset{\sim}{j}$

From acceleration, $a = \frac{dv}{dt}$.

$$\frac{dv}{dt} = \begin{pmatrix} -6t \\ -4\cos 2t \end{pmatrix} \quad M_1$$

$$a = -6t\underset{\sim}{i} - 4\cos 2t\underset{\sim}{j}. \quad B_1$$

Force at any time, t (Impulse)

$$F = ma \quad M_1$$

$$F = 2(-6t\underset{\sim}{i} - 4\cos 2t\underset{\sim}{j})$$

$$F = 2\begin{pmatrix} -6t \\ -4\cos 2t \end{pmatrix}$$

$$F = \begin{pmatrix} -12t \\ -8\cos 2t \end{pmatrix} \quad B_1$$

Note; Here time is given in seconds; So it must be converted to degrees

When t = 1 seconds.

$$F = \begin{bmatrix} -12(1) \\ -8\cos(2 \times 2.7778 \times 10^{-4}) \end{bmatrix} \quad B_1$$

$$F_{(t=1)} = \begin{pmatrix} -12 \\ -8 \end{pmatrix}$$

$$F(t=1) = (-12\underset{\sim}{i} - 8\underset{\sim}{j}).N$$

Impulse after one second $\sqrt{(-12)^2 + (-8)^2}$

$\therefore$ Impulse after one second = $\underline{\underline{14.4222\,N}}$ A_1

10(b).

From work done = Force x Distance.

At time, t = 2.

$$\text{Force} = \begin{bmatrix} -12(2) \\ -8\cos\left(2 \times \frac{2}{3600}\right) \end{bmatrix} \quad B_1$$

$$F = \begin{pmatrix} -24 \\ -7.9998 \end{pmatrix}$$

Between t = 1 and t = 2, $F = \begin{pmatrix} -24 \\ -7.9998 \end{pmatrix} - \begin{pmatrix} -12 \\ -8 \end{pmatrix}$

$$F = \begin{pmatrix} -12 \\ 0 \end{pmatrix} \quad B_1$$

Distance between t = 1 and t = 2.

$$S = \int_1^2 V(t)$$

Accept other correct alternative methods

$$S = \int_1^2 (2 - 3t^2)\underset{\sim}{i} - 2\sin 2t\,\underset{\sim}{j}\ dt \quad m_1$$

$$S = \left[2t - \frac{3}{4}t^4\right]_1^2 \underset{\sim}{i} + 2\left[\frac{1}{2}\cos 2t\right]_1^2 \underset{\sim}{j}$$

$$S = \left(-8 - \frac{5}{4}\right)\underset{\sim}{i} + (0.9999 - 1)\underset{\sim}{j}$$

$$S = \begin{pmatrix} -9.25 \\ 0 \end{pmatrix} \quad B_1$$

$$W \cdot D = \begin{pmatrix} -12 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} -9.25 \\ 0 \end{pmatrix} \quad m_1$$

$$WD = (111\underset{\sim}{i} + 0\underset{\sim}{j}) \text{ Joules.}$$

$$W \cdot D = \sqrt{111^2 + 0^2}$$

Work Done = 111 Joules. A_1

$\boxed{\text{TOTAL MARKS: 12}}$

11 (a)

let $y = \dfrac{1}{\sqrt{3-2x}}$

$h = \dfrac{1}{5}$ B1

X_n	y_0, y_4	$y_1, \dots y_3$
0	0.57735	
2/5		0.674999
3/5		0.745356
4/5		0.845154
1.0	1.00000	
Sum	1.57735	2.265509

B1 – X_n Values.

B2 – All y-values correct

Reject; if the y-values are recorded to less than 4 decimal places.

$$\int_0^1 \frac{dx}{\sqrt{3-2x}} \simeq \frac{1}{2} h \left[(y_0 + y_4) + 2(y_1 + y_2 + y_3) \right]$$

$$\simeq \frac{1}{2}(0.2) \left[1.57735 + 2 \times 2.265509 \right] \text{ M1}$$

Reject; Equal sign used here.

Accept; strictly approximation sign.

$$\simeq 0.1(6.88753)$$

$$\simeq 0.688753$$

$$\int_0^1 \frac{dx}{\sqrt{3-2x}} \simeq 0.689 \text{ (3dp) A1}$$

Deny; if not to 3 dps

(b)

Exact value.

$$\int_0^1 \frac{dx}{\sqrt{3-2x}}$$

let $u = \sqrt{3-2x}$ B1

$u^2 = 3-2x$.

$2u\,du = -2dx$.

$dx = -u\,du$.

From $\displaystyle\int_0^1 \frac{dx}{\sqrt{3-2x}} = \int_0^1 \frac{1}{u} \cdot -u\,du$

$$= -\int_0^1 du \text{ B1}$$

$$= -\left[u\right]^1$$

$$- \left[\sqrt{3-2x}\right]_0^1$$

$$- \left[\sqrt{1} - \sqrt{3}\right]$$

$$\int_0^1 \frac{dx}{\sqrt{3-2x}} = 0.73205$$

$\therefore$ The exact value of $\displaystyle\int_0^1 \frac{dx}{\sqrt{3-2x}} = 0.732$ A (3dp)

Error = |(Exact Value) - (Approximate value)|

Error = $|0.732 - 0.689|$

$= 0.043$ B_1

$$\text{Relative error} = \frac{\text{Absolute error}}{\text{Exact Value}}$$

$$= \frac{0.043}{0.732} \quad m_1$$

$\therefore$ Relative error $= \underline{\underline{0.0587}}$ A_1

TOTAL	12 Marks

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QN. 12(a)

From the graph.

$$f(x) = \begin{cases} \frac{x^2}{27} & ; \quad 0 < x < \alpha \\ \frac{1}{3} & ; \quad \alpha < x < \beta \\ 0 & ; \quad \text{Elsewhere} \end{cases}$$

$f_1(\alpha) = f_2(\alpha)$.

$$\frac{\alpha^2}{27} = \frac{1}{3} \quad B_1$$

$$\alpha^2 = 9$$

$$\alpha = 3$$

From $\frac{1}{27}\int_0^3 x^2\,dx + \frac{1}{3}\int_3^\beta dx = 1.$ M_1

$$\frac{1}{27}\left[\frac{x^3}{3}\right]_0^3 + \frac{1}{3}\left[x\right]_3^\beta = 1.$$

$$\frac{27}{81} + \frac{1}{3}\left[\beta - 3\right] = 1$$

$$\frac{1}{3} + \frac{1}{3}(\beta - 3) = 1.$$

$$1 + \beta - 3 = 3$$

$$\beta = 5$$

$\therefore$ $\alpha = 3$ A_1 and $\beta = 5$ A_1

$$\text{P.d.f of } x = \begin{cases} \frac{x^2}{27} & ; \quad 0 < x < 3 \\ \frac{1}{3} & ; \quad 3 < x < 5 \\ 0 & ; \quad \text{elsewhere.} \end{cases} \quad A_1$$

12 (b)

When $x < 0$, $F(x) = 0$.

When $0 < x < 3$

$$F(x) = 0 + \frac{1}{27}\int_0^x t^2\,dt \quad m_1$$

$$F(x) = \frac{1}{27}\left[\frac{t^3}{3}\right]_0^x$$

$$F(x) = \frac{1}{81}\left[x^3\right]$$

$$F(3) = \frac{27}{81}$$

$$= \frac{1}{3} \quad B_1$$

For the interval $3 < x < 5$

$$F(x) = \frac{1}{3} + \frac{1}{3}\int_3^x dt \quad m_1$$

$$F(x) = \frac{1}{3} + \frac{1}{3}\left[t\right]_3^x$$

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

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

$$F(5) = 1 \quad B_1$$

Cumulative distribution function, $F(x) = \begin{cases} 0 & ; \quad x < 0 \\ \dfrac{x^3}{81} & ; \quad 0 < x < 3 \\ \dfrac{1}{3}(x-2) & ; \quad 3 < x < 5 \\ 1 & ; \quad x \geq 5 \end{cases}$ A_1

90th percentile, P_{90}

$$\frac{P_{90} - 2}{3} = 0.9 \quad m_1$$

TOTAL	12 marks

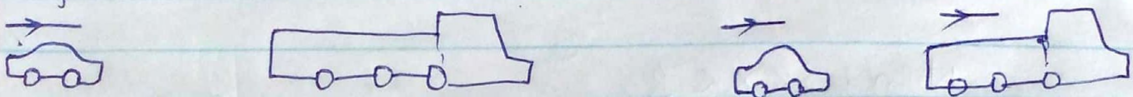
$$P_{90} = 2 + 2.7$$

$$= 4.7$$

$\therefore$ The 90th percentile $= \underline{4.7}$ A_1

QN 13 (a)

Before collision　　　　　　　　After collision



Car　　Trailor　　Car　　Trailor

Car $mass = 300kg$, $u_i = \frac{144 \times 1000}{3600}$

$= 40ms^{-1}$

Initial momentum of a car $= m_1u_1$ m1

$300 \times 40 = 12000\ kgms^{-1}$

Final momentum of the car, let V_1 be final velocity.

$m_1V_1 = \frac{100-15}{100} \times 12000$ B1

$300V_1 = 85 \times 120$

$V_1 = \frac{85 \times 120}{300}$

$V_1 = 34ms^{-1}$ B1

From law of conservation of linear momentum.

$m_1u_1 + m_2u_2 = m_1V_1 + m_2V_2$ m1

$300 \times 40 + 0 \times 900 = 10200 + 900V_2$.

$12000 - 10200 = 900V_2$

$V_2 = \frac{12000-10200}{900}$ B1

$V_2 = 2ms^{-1}$

∴ The trailor's velocity after collision $= 2ms^{-1}$ A1

(b)

Car coming to rest.

$u = 34ms^{-1}$, $a = -6ms^{-2}$, $V = 0ms^{-1}$. B1

From $V^2 = u^2 + 2as$

$0^2 = 34^2 + 2(-6)s$. m1 B1

$12s = 1156$

$s = 96.3333m$. A1　　Deny without units

(c)

Decelleration $= \underline{\underline{6ms^{-2}}}$. A2

TOTAL:	12 marks

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QN. 14 (a)

Let exact value, $Z = X\sqrt{Y}$

let error in Z be Δz.

Approximate value, $z = x\sqrt{y}$

$$z + \Delta z = Z$$

$$\Delta z + x\sqrt{y} = X\sqrt{Y} \quad m_1$$

$$(\Delta z + x\sqrt{y})^2 = \left[(x+\Delta x)\sqrt{(y+\Delta y)}\right]^2 \quad B_1$$

$$(\Delta z)^2 + 2\Delta z\, x\sqrt{y} + (x\sqrt{y})^2 = (x+\Delta x)^2(y+\Delta y).$$

$$(\Delta z)^2 + 2\Delta z\, x\sqrt{y} + x^2 y = \left[x^2 + 2x\Delta x + (\Delta x)^2\right](y+\Delta y)$$

Assumption: $\Delta z << z$, $\Delta x << x$, $(\Delta z)^2 \simeq 0$, $(\Delta x)^2 \simeq 0$.
$\Delta y << y$ $\quad \Delta y \Delta x \simeq 0$ $\quad B_1$ – Assumptions

$$2\Delta z\, x\sqrt{y} + x^2 y = x^2 y + x^2\Delta y + 2xy\Delta x$$

$$2\Delta z\, x\sqrt{y} = x^2\Delta y + 2xy\Delta x$$

$$\Delta z = \frac{x^2\Delta y}{2x\sqrt{y}} + \frac{2xy\Delta x}{2x\sqrt{y}}$$

$$\Delta z = \frac{x\Delta y}{2\sqrt{y}} + \frac{y\Delta x}{\sqrt{y}}$$

Stop marking when assumptions arenot stated clearly and correctly.

$$\left|\frac{\Delta z}{z}\right| = \left|\frac{x\Delta y}{2\sqrt{y}(x\sqrt{y})} + \frac{y\Delta x}{\sqrt{y}(x\sqrt{y})}\right| \quad B_1$$

$$\frac{\Delta z}{z} = \frac{1}{2}\left|\frac{\Delta y}{y}\right| + \left|\frac{\Delta x}{x}\right|$$

$$\frac{\Delta z}{z} \leq \left|\frac{\Delta x}{x}\right| + \frac{1}{2}\left|\frac{\Delta y}{y}\right|$$

Percentage error $= R\cdot E \times 100$ $\quad B_1$

$$\text{Percentage error} = \left(\left|\frac{\Delta x}{x}\right| + \frac{1}{2}\left|\frac{\Delta y}{y}\right|\right) \times 100$$

B_1 – For conclusion "as required"

As required.

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14 (b).

let ΔH be error in Height $R = 2.6$

Δr be error in radius. $H = 5.18$

From Volume $= \pi R^2 H$.

$\Delta h = 0.005$, $\Delta r = 0.05$.

$$V_{max} = \pi(2.6 + 0.05)^2(5.18 + 0.005) \quad M_1$$

$$= \pi(7.0225 \times 5.185)$$

$$V_{max} = 36.4117\pi \text{ cm}^3 \quad B_1$$

$$V_{min} = \pi R^2 H.$$

$$= \pi(2.6 - 0.05)^2(5.18 - 0.005)$$

$$V_{min} = \pi(6.734025 \times 5.175) \quad M_1$$

$$V_{min} = 34.8486\pi \text{cm}^3 \quad B_1$$

Interval in which the Volume of cylinder is expected to lie $(34.8486\pi \text{cm}^3, 36.4117\pi \text{cm}^3)$

A_2 – conclusion.

Accept; When π value is replaced/substituted

Deny: units in m^3

Deny: Without units (Volume)

TOTAL:	12 marks

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QN. 15 (a).

let $F_1 = (\underset{\sim}{i} + 4\underset{\sim}{j})N$, $F_2 = 5\underset{\sim}{i}$, $F_3 = -2\underset{\sim}{i} + 2\underset{\sim}{j}$

Resultant force, R

$$R = \begin{pmatrix} 1 \\ 4 \end{pmatrix} + \begin{pmatrix} 5 \\ 0 \end{pmatrix} + \begin{pmatrix} -2 \\ 2 \end{pmatrix} \quad m_1$$

$$R = \begin{pmatrix} 4 \\ 6 \end{pmatrix}$$

Resultant force, $R = (4\underset{\sim}{i} + 6\underset{\sim}{j})N$.

$$R = (4\underset{\sim}{i} + 6\underset{\sim}{j})N. \quad B_1$$

let the position vector at which resultant cuts OA be $(x\underset{\sim}{i} + 0\underset{\sim}{j})$.

At the origin. Deny; Other format of bracketing

$$\begin{vmatrix} x & 0 \\ 4 & 6 \end{vmatrix} = \begin{vmatrix} 3 & 0 \\ 1 & 4 \end{vmatrix} + \begin{vmatrix} 3 & 2 \\ 5 & 0 \end{vmatrix} + \begin{vmatrix} 0 & 2 \\ -2 & 2 \end{vmatrix}$$

m_1

$$6x = 12 - 10 + 4.$$
$$6x = 6$$
$$x = 1 \quad B_1$$

$\therefore$ The position vector of the point where the line of action of the resultant force cuts OA is $\underline{\underline{\underset{\sim}{i} + 0\underset{\sim}{j}}}$ A_2

Accept; $\underset{\sim}{i}$ only

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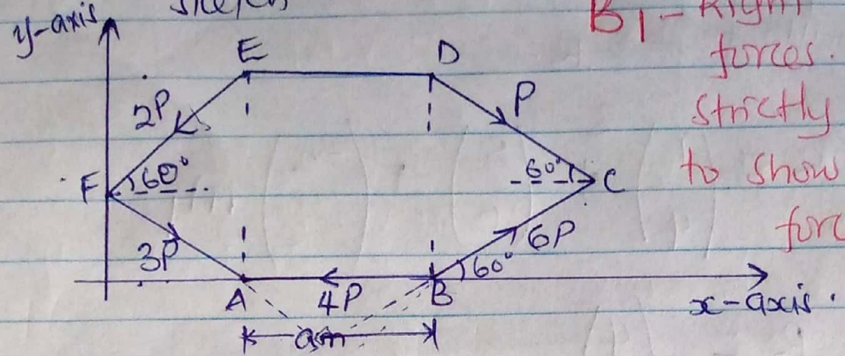
15(b)

sketch.



B_1 - Right direction of forces.
strictly using ruler to show direction of forces.

Resultant force = $\begin{bmatrix} 4P + (6P + P + 3P - 2P)\cos 60 \\ (6P - P - 2P - 3P)\sin 60 \end{bmatrix}$ M_1

Resultant force, $R = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$ N B_1

Sum of moment; $G =$

A↺; $G = 6P \times a\sin 60 + (P \times {}^-a\sqrt{3}) + (2Pa\sin 60)$ M_1

$G = 6Pa\frac{\sqrt{3}}{2} - Pa\sqrt{3} + 2Pa\frac{\sqrt{3}}{2}$

$G = 3Pa\sqrt{3} - Pa\sqrt{3} + Pa\sqrt{3}$

$G = 3Pa\sqrt{3}$ Nm. B_1

Since Resultant force of the system = 0 N and $G \neq 0$; these system of forces reduce to a couple. A_1

Emphasize $R = 0$, $G \neq 0$

TOTAL:	12 marks

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[signature] MPIG1

16 (a)

$Y \sim N(-8, 12)$,

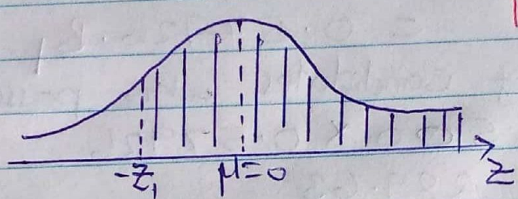
$\mu = -8$, $\sigma^2 = 12$, $\sigma = \sqrt{12}$

let $P(Y > -8.2) = P(Z > z_1)$.

$$= P\left(Z > \frac{-8.2 - -8}{\sqrt{12}}\right) \quad m_1$$

$P(Z > -0.057735)$

Sketch.



Ignore; Normal distribution curve

$P(Y > -8.2) = 0.5 + P(0 < Z < 0.057735)$ B_1
$= 0.5 + 0.02302$ B_1
$\therefore P(Y > -8.2) = \underline{\underline{0.52302}}$ A_1 (calculator)

Accept; use of tables (tab).

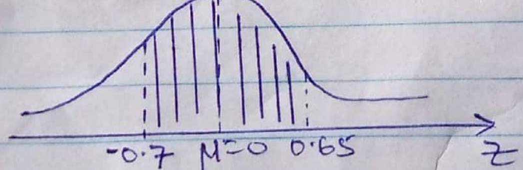
16 (b) (i)

Mean, $\mu = 45$, Standard deviation, $\sigma = 20$.
Let X be the radom variable for the marks scored.
$P(31 < X < 58) = P(z_1 < Z < z_2)$.

$$= P\left(\frac{31-45}{20} < Z < \frac{58-45}{20}\right)$$

$= P(-0.7 < Z < 0.65)$ m_1

Sketch.



$P(31 < X < 58) = P(0 < Z < 0.7) + P(0 < Z < 0.65)$ B_1
$= 0.25804 + 0.24215$ B_1
$= 0.50019$ (calculator) A_1

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16 b (ii).

But

Answer; To atleast 4 dps.

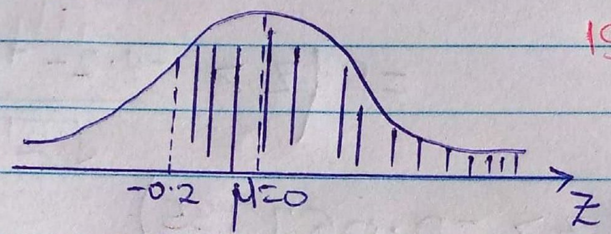
$P(X \geq 41) = P(Z \geq Z_1)$

$= P\left(Z \geq \frac{41-45}{20}\right)$.

$P(Z \geq -0.2)$ B1

Sketch

Ignore: Distribution curve.



$P(X \geq 41) = 0.5 + P(0 < Z < 0.2)$

$= 0.5 + 0.07926$ B1

$= 0.57926$. B1

Number of candidates who passed the examination

$= 500 \times 0.57926$

$= 289.63$

$\simeq 290$ A1 students passed the examination.

TOTAL:	12 marks

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St Hopeload. MPIGI MTC/CHEM