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.

$$P(T) + P(T') = 1 \quad B_1 \; M_1$$

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

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

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

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

$\overline{05}$

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

$\therefore$ 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

$\overline{05}$

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 = 64800 watts
Driving force = ?

Power = Force x velocity.

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

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

$= 4320\text{N}$. B1

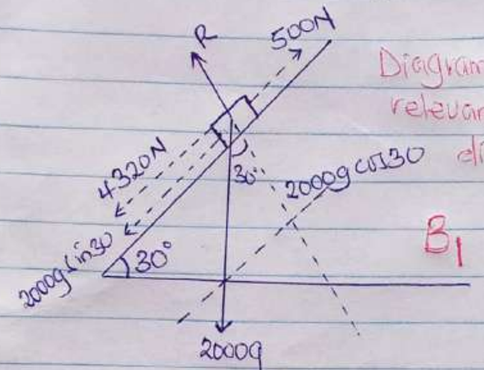

Diagram should show all the relevant forces in the right directions.

B1

05

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

Resultant force = 13620 N B1

From Force = ma m1

$13620 = 2000a$

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

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

∴ The acceleration of the car is $6.81\,ms^{-2}$ A1

Deny without unit.

QN·4

Mock	UNEB	R_{mock}	R_{UNEB}	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 B1	8 B1	1	1 B1
					$\Sigma d^2 = 23$

05

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

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

$\rho = 0.72619$ A1

Comment; Not significant at 1% level.

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) $u = d_1 - \frac{5}{2}a$

05

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

$a = d_2 - d_1$

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

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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.

	A	B	C
x	4	7	10
y	400000	z	800000

Using linear Interpolation.

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

05

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

$$z = 600000$$

Deny without units

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

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) $= 3/5$
P(Paying by credit card) $= 2/5$.

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

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

$P(X=3)$

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 0.21499 A1

~~QN 7~~(b).

$p = 3/5$, $q = 2/5$, $n = 10$.

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

$P(5 < Y \leq 9)$

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

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

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

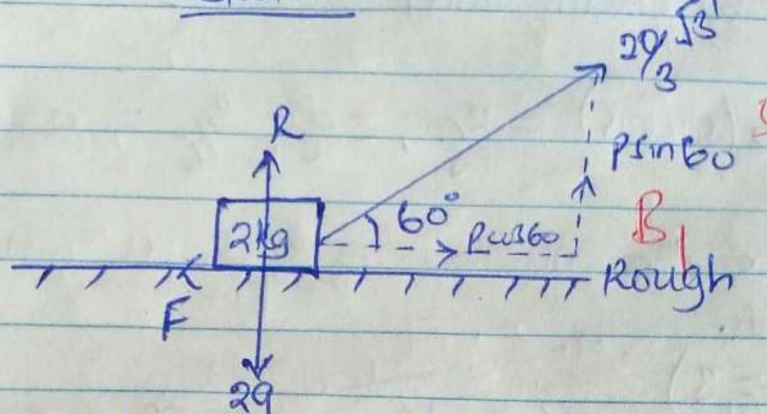
$= 0.25082 + 0.21499 + 0.12093 + 0.04031$

$= 0.62705$

∴ Probability of between 5 to 9 customers paying by cash is 0.62705 A1 (5dp).

QN: 8

Sketch



strictly using ruller to show direction of forces.

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

R = Normal reaction

let μ = Coefficient of friction.

Resolving forces horizontally.

$P\cos 60 = F$ B

Resolving forces vertically.

US

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

But $F = \mu R$. B

$P\cos 60 = \mu R$.

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

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

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

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

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

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

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

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) $\text{Mean} = \dfrac{\Sigma fx}{\Sigma f}$

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

$\text{Mean} = 27.52$ seconds. A_1

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

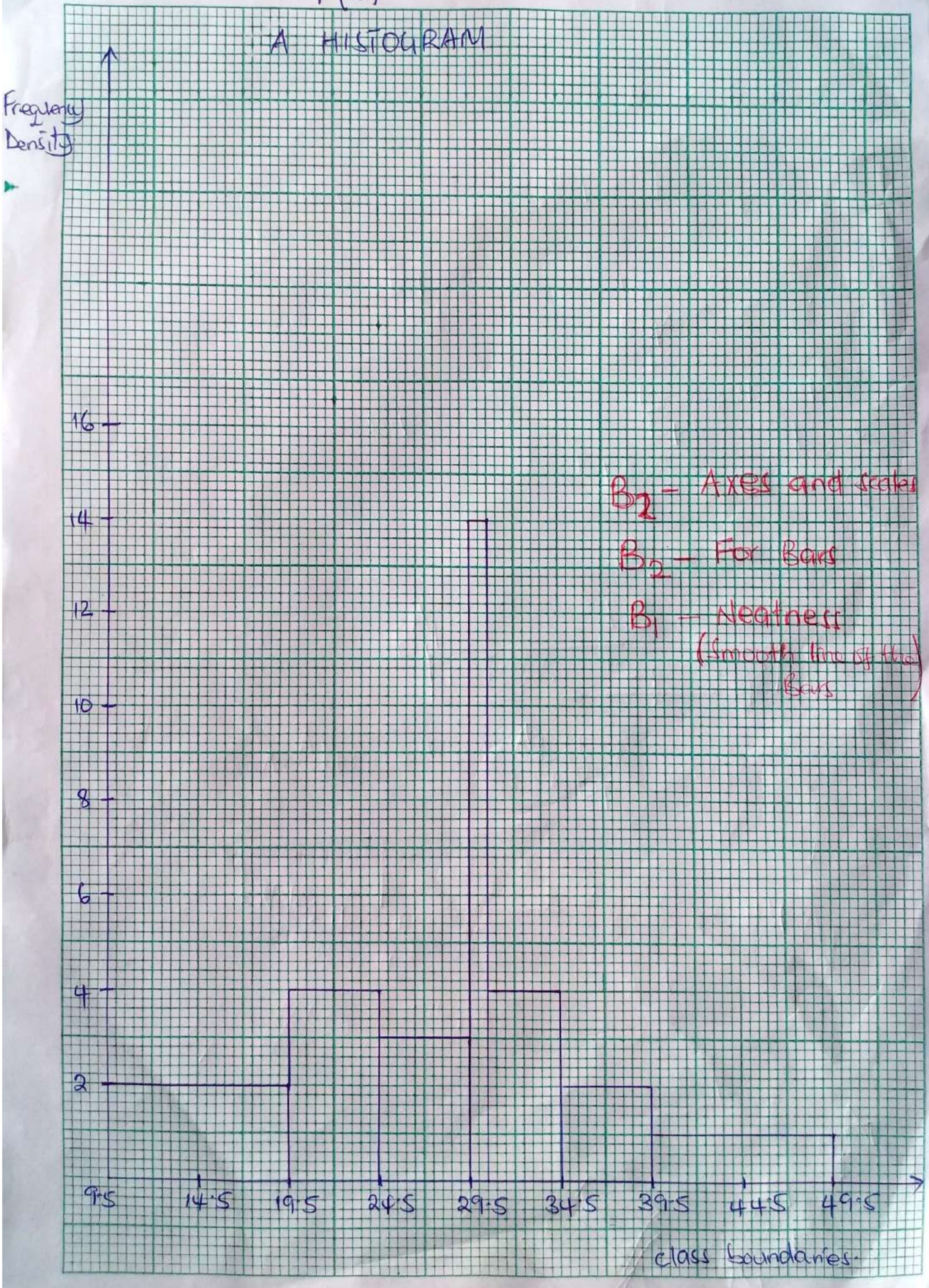
$\left(\dfrac{80}{100} \text{ of } 105\right)^{th}$ value $= 84^{th}$ value.

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

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

$\therefore$ 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 $\quad V(t) = (2-3t^2)\underset{\sim}{i} - 2\sin 2t\,\underset{\sim}{j}$

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.

$$F = \begin{bmatrix} -12(1) \\ -8\cos(2 \times 2.7778\times10^{-4}) \end{bmatrix} \quad B_1$$

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

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

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

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

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

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

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

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

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

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

Work Done = <u>111 Joules</u>. A_1

TOTAL MARKS: 12

11 (a)

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

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

X_n	y_0, y_4	$y_1, \ldots y_3$
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.

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

$$\simeq \frac{1}{2}(0.2)\left[1.57735 + 2 \times 2.265509\right]$$ 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 $\int_0^1 \frac{dx}{\sqrt{3-2x}} = \int_0^1 \frac{1}{u} \cdot -u\,du$

$= -\int_0^1 du$ 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 $\int_0^1 \frac{dx}{\sqrt{3-2x}} = 0.732$ 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.

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

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

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

$$\alpha^2 = 9$$

$$\alpha = 3$$

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

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

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

90^{th} percentile, P_{90}

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

TOTAL	12 marks

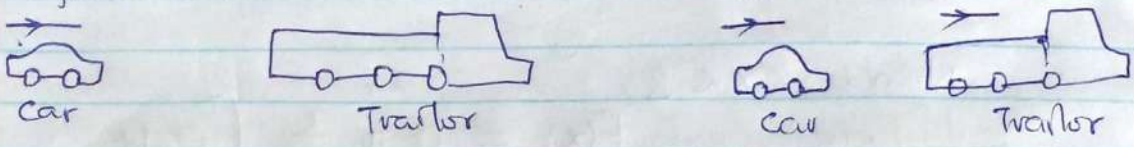
$$P_{90} = 2+2.7$$

$$= 4.7$$

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

QN 13 (a)

Before collision After collision



Car $mass = 300kg$, $u_1 = \frac{144 \times 1000}{3600}$

$= 40ms^{-1}$

Initial momentum of a car $= m_1u_1$ m_1

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

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

$m_1V_1 = \frac{100-15}{100} \times 12000$ B_1

$300V_1 = 85 \times 120$

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

$V_1 = 34ms^{-1}$ B_1

From law of conservation of linear momentum.

$m_1u_1 + m_2u_2 = m_1V_1 + m_2V_2$ m_1

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

$12000 - 10200 = 900V_2$

$V_2 = \frac{12000-10200}{900}$ B_1

$V_2 = 2ms^{-1}$

∴ The trailor's velocity after collision $= 2ms^{-1}$ A_1

(b)

Car coming to rest.

$u = 34ms^{-1}$, $a = -6ms^{-2}$, $V = 0ms^{-1}$. B_1

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

$0^2 = 34^2 + 2(-6)s$. m_1 B_1

$12s = 1156$

$s = 96.3333m$. A_1 Deny without units

(c)

Decelleration $= \underline{6ms^{-2}}$. A_2

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, $z = x\sqrt{y}$

$$z + \Delta z = Z$$

$$\Delta z + x\sqrt{y} = X\sqrt{Y}$$ M1

$$(\Delta z + x\sqrt{y})^2 = \left[(x+\Delta x)\sqrt{(y+\Delta y)}\right]^2$$ B1

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

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

Assumption: $\Delta z << z$, $\Delta x << x$, $(\Delta z)^2 \simeq 0$, $(\Delta x)^2 \simeq 0$.
$\Delta y << y$ $\quad \Delta y \Delta x \simeq 0$ B1 - 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.

$$\left|\frac{\Delta z}{z}\right| = \left|\frac{x\Delta y}{2\sqrt{y}(x\sqrt{y})} + \frac{y\Delta x}{\sqrt{y}(x\sqrt{y})}\right|$$ B1

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

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

Percentage error = R.E × 100 . B1

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

B1 - 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 $= \pi R^2 H$.

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

$$V_{max} = \pi(2.6+0.05)^2(5.18+0.005) \quad M_1$$
$$= \pi(7.0225 \times 5.185)$$
$$V_{max} = 36.4117\pi \ cm^3 \quad B_1$$

$$V_{min} = \pi R^2 H.$$
$$= \pi(2.6-0.05)^2(5.18-0.005)$$
$$V_{min} = \pi(6.734025 \times 5.175) \quad M_1$$
$$V_{min} = 34.8486\pi cm^3 \quad B_1$$

Interval in which the volume of cylinder is expected to lie $(34.8486\pi cm^3, 36.4117\pi cm^3)$
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, $R = (4\underset{\sim}{i} + 6\underset{\sim}{j})N$.

$R = (4\underset{\sim}{i} + 6\underset{\sim}{j})N$. B1

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

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

M1

$6x = 12 - 10 + 4$.

$6x = 6$

$x = 1$ B1

$\therefore$ The position vector of the point where the line of action of the resultant force cuts OA is $\underline{\underline{\underset{\sim}{i} + 0\underset{\sim}{j}}}$ A1

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

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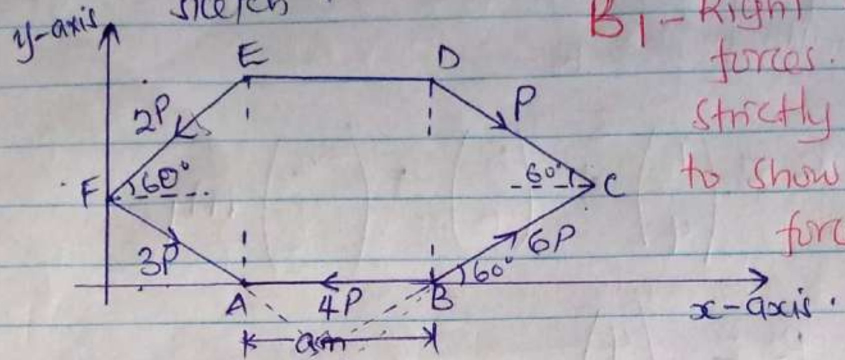
15(b)

sketch.



B1 - Right direction of forces.
Strictly using ruler to show direction of forces.

Resultant force $= \begin{bmatrix} -4P + (6P + P + 3P - 2P)\cos 60 \\ (6P - P - 2P - 3P)\sin 60 \end{bmatrix}$ M1

Resultant force, $R = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$ N B1

Sum of moment; G =

$A\circlearrowleft;\ G_1 = 6P \times a\sin 60 + (P \times {}^{-}a\sqrt{3}) + (2Pa\sin 60)$ M1

$G_1 = 6Pa\frac{\sqrt{3}}{2} - Pa\sqrt{3} + 2Pa\frac{\sqrt{3}}{2}$

$G_1 = 3Pa\sqrt{3} - Pa\sqrt{3} + Pa\sqrt{3}$

$G_1 = 3Pa\sqrt{3}$ Nm. B1

Since Resultant force of the system = 0 N and $G \neq 0$; these system of forces reduce to a couple. A1

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

TOTAL:	12 marks

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Stthpleef MPIG1

16 (a)

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

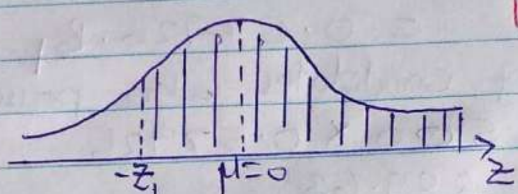
$\mu = -8$, $\sigma^2 = 12$, $\sigma = \sqrt{12}$

Let $P(Y > -8.2) = P(Z > Z_1)$.

$= P\left(Z > \frac{-8.2 - -8}{\sqrt{12}}\right)$ m1

$P(Z > -0.057735)$

Sketch.



Ignore; Normal distribution curve

$P(Y > -8.2) = 0.5 + P(0 < Z < 0.057735)$ B1

$= 0.5 + 0.02302$ B1

$\therefore P(Y > -8.2) = \underline{\underline{0.52302}}$ A1 (Calculator)

Accept; use of tables (tab).

16 (b) (i)

Mean, $\mu = 45$, Standard deviation, $\sigma = 20$.

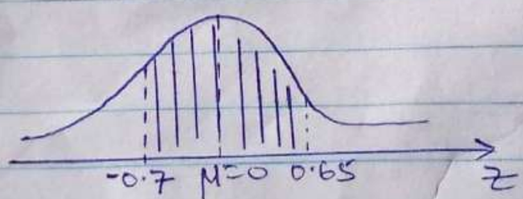
Let X be the radom variable for the marks scored.

$P(31 < X < 58) = P(Z_1 < Z < Z_2)$.

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

$= P(-0.7 < Z < 0.65)$ m1

Sketch.



$P(31 < X < 58) = P(0 < Z < 0.7) + P(0 < Z < 0.65)$ B1

$= 0.25804 + 0.24215$ B1

$= 0.50019$ (Calculator) A1

16 b (ii).

But

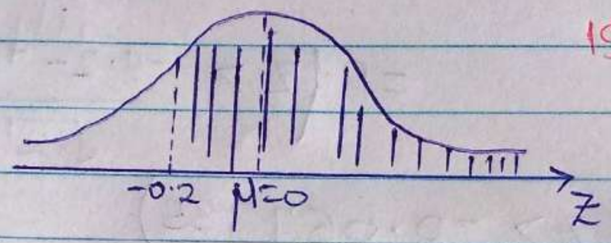
$P(X \geq 41) = P(Z \geq Z_1)$

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

$P(Z \geq -0.2)$ B_1

Answer; To atleast 4 dps.

Sketch



Ignore: Distribution curve.

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

$= 0.5 + 0.07926$ B_1

$= 0.57926$. B_1

Number of candidates who passed the examination

$= 500 \times 0.57926$

$= 289.63$

$\simeq 290$ A_1 students passed the examination.

TOTAL:	12 marks

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