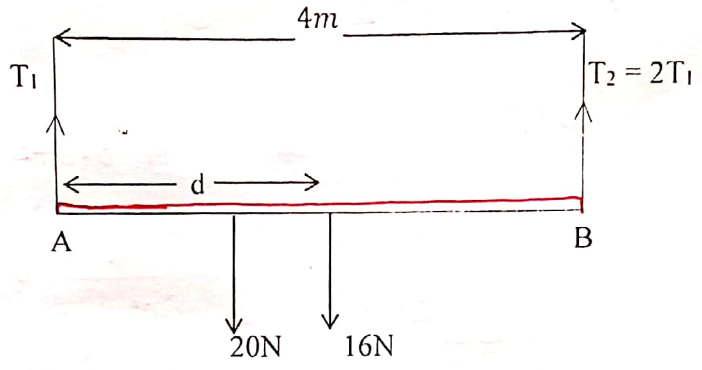
JINJA JOINT EXAMINATIONS BOARD

MOCK EXAMINATIONS 2022

P425/2 MATHEMATICS

MARKING GUIDE

1.



B1 [Correct force diag, no stock for not straight forces]

(T) :	$T_1 + 2T_1$	$=$	36	**M1** [Equating forces
	T_1	$=$	12	**B1** [For the 1st mentioned T
$\therefore$	T_2	$=$	24	
Taking moments (A) M(A) :	$20 \times 2 + 16 \times d$	$=$	24×4	**M1** [Both clockwise and anticlockwise
	d	$=$	3.5m	**A1** [Accuracy mark]

05

2. $P(P \cap Q) = P(P) \times P(Q/P)$

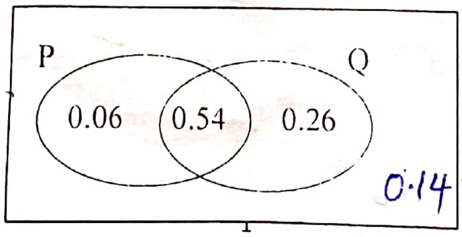
$= 0.6 \times 0.9$

$= 0.54$ **B1** [For any step written]

$P(Q/P) = \frac{P(Q)}{P(P \cap Q)}$

$P(Q/P) = \frac{P(P)}{P(P \cap Q)}$

$P(P)_{only} =$



B1 [no mark for any missing in the venn diag.

0.14

(i) P (P or Q but not both P and Q) $= 0.06 + 0.26$ **A1**

$= 0.32$

(ii) P(P/Q) $= \frac{P(P\cap Q)}{P(Q)}$

$= \frac{0.54}{0.8}$ **M1**

$= \frac{54}{80}$ or 0.675 **A1** [accept 1dp]

05

$\frac{5}{1.6} = \frac{20-D}{1.8}$ | $\frac{4}{1.6} = 20 - D$ D =

[correct equating of Gradients]

3. (a) $\frac{20-15}{13.6-12} = \frac{20-D}{13.6-12.8}$

15	D	20
12	12.8	13.6

B1 M1

10	15	D
11	12	12.8

$\frac{D-15}{13.8-12.8} = \frac{15-10}{12-11}$

$D = 17.5$ or 18 **A1** [B1 comes fast for M1] [Accuracy]

$\frac{20-D}{0.8} = \frac{5}{3.1}$

$62 - 3.1D = 4$

$D =$

(b) $\frac{34.7-31}{F-\cancel{12}\,5} = \frac{31-25}{5.0-10.5}$

25	31	34.7
10.5	5.0	F

M1

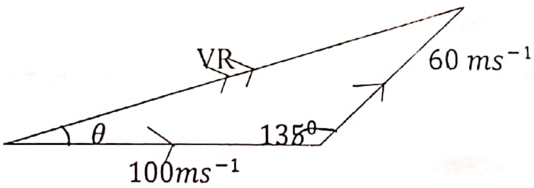
$\frac{D-15}{0.8} = 5$

$D = 19$

$F = 16.08\overline{3}$ **A1** [accept to 1dp] 16.1

05

4. (a)



$\frac{3.7}{F-5} = \frac{6}{-5.5}$

B1 [For correct velocity diag - accept parallelogram & vector diag.]

$6F - 30 = -20.35$

$V_R^2 = 100^2 + 60^2 - 2 \times 60 \times 100 \times cos135^0$ M1 [correct use of cosine rule]. $= 22085.28$

$6F = -20.35 + 30$

$V_R = 148.6112\ ms^{-1}$ A1 [accept to 1dp] with correct units.

$F = 1.608$

(b) $\frac{148.6112}{\sin 135^0} = \frac{60}{\sin\theta}$ M1 [Correct use of sine rule].

$F = 1.61$ (accept 1.6)

DATE

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$\theta = 16.6^0$ B1 [Accept E 16.6° N with the degrees]

$\therefore$ Direction is $N\,73.4^0 E$ 073.4° A1

05

5. $P = 0.46,\ q = 0.54,\ n = 100$ $\sigma = \sqrt{\mu q}$

$\mu = np = 100 \times 0.46$ | $\sigma = \sqrt{100 \times 0.46 \times 0.54}$

$\mu = 46$ | $= 4.98397$ or 4.984 B1 [For both μ & σ correct two]

$P(X < 50) = P(Y < 49.5)$ B1 [Correct use continuity correction]

$P\left(z < \frac{x-\mu}{\sigma}\right) = P\left(Z < \frac{49.5-46}{4.98397}\right)$ M1 [Standardizing]

$P(Z < 0.702)$

$0.5 + 0.2586$ M1 [For finding the prob. ie 0.5+0.2586]

$= 0.7586$ A1 [atleast 4 dp]

05

6. $h = \frac{\frac{\pi}{3}-0}{4} = \frac{\pi}{12}$ or 0.2618 B1

~~$\frac{1}{2}h(a+b)$~~ $h = \frac{x_n - x_0}{n}$

$\int_{x_0}^{x_n} f(x)dx = \frac{1}{2}h\left(y_0+y_n\right)+2\left(y_1+y_2 - - - +y_{n-1}\right)$ [All values of x are seen] B1

x	y_0, y_4	$y_1, \ldots \ldots y_3$
0	1.000	
0.2618 $\frac{\pi}{12}$		1.255
0.7854 $\frac{\pi}{4}$		1.462
1.0472 $\frac{\pi}{3}$	1.425	1.551
Sum	2.425	
		4.268

B1 [All y values seen atleast to 4 s.f]

[An implied mark]

$\int_0^{\frac{\pi}{3}} e^x \cos x\, dx = \frac{1}{2} \times \frac{\pi}{12} \times [2.425 \times 2\,(4.268)]$ M1

$= 1.434$

$1.43\ (3s.f)$ A1 [For 3 s.f] 1.434 must be seen first

05

x	y	R_x	R_y	d	d^2
55	60	3	2	1	1
42	48	6	5	1	1
37	41	8	6	2	4
59	63	1	1	0	0
38	35	7	8	-1	1
48	39	4.5	7	-2.5	6.25
56	51	2	4	-2	4
48	55	4.5	3	1.5	2.25

$\Sigma d^2 = 19.5$ $\quad \frac{4+5}{2} = \frac{9}{2}$

7.

Rx	3	6	7	1	8	4.5	2	4.5
Ry	2	5	6	1	8	7	4	3
d	1	1	1	0	0	-2.5	-2	1.5
d^2	1	1	1	0	0	6.25	4	2.25

B1 [Correct ranks of x

B1 [Correct ranks of y

accept descending order approach

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

~~$\Sigma d^2 = 15.5$~~ $\quad 19.5$

B1 [For Σd^2]

$$r_s = 1 - \frac{6\times15.5}{8\times63} \qquad 1 - \frac{6\times19.5}{8\times63}$$

M1 [Find the correlation]

$= \cancel{0.8155}$ $\qquad = 0.7679$

A1 [accept atleast to 2dp

05 [~~don't~~ accept truncating]

8. $\quad v = e^t i + 2e^{-2t} i - \sin tk$

$P = \frac{F\times d}{t}$

$\frac{dv}{dt} = \quad a = e^t i - 4e^{-2t} j - cosk$

M1 [For $\frac{dv}{dt}$ vectors ~~or~~ symbols must be seen.

$P = F\times V$

$P = FV$

$\therefore force, F = 2\,(e^t i - 4e^{-2t} j - costk)$

But $F = ma$ ' $F = m\cdot a$ $\quad = 2e^t i - 8e^{-2t} j - costk$

B1

$a = \frac{dv}{dt} = e^t + 2(-2)e^{-2t} - \cos tk$

$a = e^t i - 4e^{-2t} j - \cos t k$

Power $= F\,.\,V$ $\qquad P = FV$

$$= \begin{pmatrix} 2e^t \\ -8e^{-2t} \\ -2cost \end{pmatrix} \cdot \begin{pmatrix} e^t \\ 2e^{-2t} \\ -sint \end{pmatrix}$$

$P = maV$

$= 2e^{2t} + -16e^{-4t} + sin2t$

M1 [Should be dotting not crossing or multiply i.e $P = F\times V$

When $t = 4$; power $= 2e^{2(4)} - 16e^{-4(4)} + sin2\,(4)$

M1

$= 5961.92$ ~~units~~ W

A1 [accept 5962]

5962.78 units.

05

9. (a) $\mu = 52, \ \sigma = 16$

(i) $P(X < 40) = P\left(Z < \frac{40-52}{16}\right)$ M1 [For standardizing]

$= P(Z < -0.75)$

$= 0.5 - 0.2734$

$= 0.2266$ B1 [atleast to 4 dp]

$\therefore$ Number of candidates in the school $= \frac{20}{0.2266}$ M1 [For finding the required prob]

$= 88.2613$ A1 [accept 88]

(ii) $P(X \geq 68) = P\left(Z \geq \frac{68-52}{16}\right)$ M1 [Standardizing]

$= P(Z \geq 1.000)$

$= 0.5 - 0.3413$

$= 0.1587$ B1 [atleast 4 dp]

$\therefore$ Number who got distinctions.

$= 0.1587 \times 88.2613$ M1

$= 14.0071$ A1 [accept 14]

or 0.1587×88

$= 13.9656$

(b) $S.E = \frac{16}{\sqrt{16}} = 4$ B1 [standard error give for $\frac{16}{\sqrt{16}}$]

$\therefore (46 < \bar{X} < 58) = P\left(\frac{46-52}{4} < Z < \frac{58-52}{4}\right)$ M1 M1 [Standardizing]

$= P(-1.5 < Z < 1.5)$

$= 2 \times 0.4332$

$= 0.8664$ A1 [accept for 4 dp]

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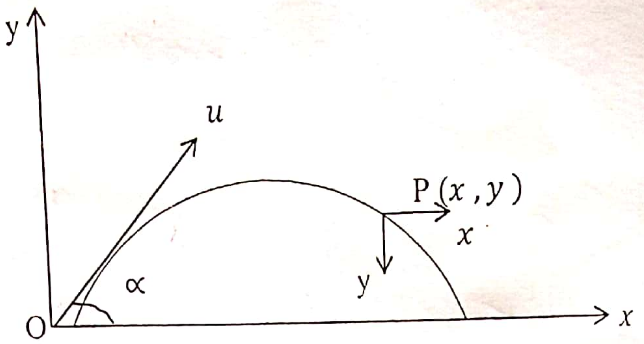
10. (a)



If the particle is projected with speed u, at an angle $\propto$ to the horizontal, then,

$\dot{x} = u\cos\propto$ ------- (1) B1 [$\Rightarrow$ Co

$\dot{y} = u\sin\propto - gt$ ---- (2) B1 [$\uparrow\uparrow$ v. Co

$\Longrightarrow x = u\cos\propto t$ ----(3) B1 [$\Rightarrow$ dist.

$y = u\sin\propto t - \frac{1}{2}gt^2$ ---(4) B1 [$\uparrow\uparrow$ dist.

Substituting (3) into (4) for t,

$$y = u\sin\propto\left(\frac{x}{u\cos\propto}\right) - \frac{gx^2}{2u^2\cos^2\propto}$$ M1 [Substituting (3) in (4)]

$$y = x\tan\propto - \frac{gx^2}{2u^2}(1 + \tan^2\propto)$$ B1 [For Derivation]

(b) $y = 9$, $x = 72$

(i) using $y = x\tan\propto - \frac{gx^2}{2u^2}(1 + \tan^2\propto)$

$9 = 72\tan\alpha - 28.8(1+\tan^2\alpha)$

$9 = 72\tan\alpha - 28.8 + 28.8\tan^2\alpha$

$28.8\tan^2\alpha \pm 72\tan\alpha + 28.8 + 9 = 0$

$$9 = 72\tan\propto - \frac{10(72)^2}{2(30)^2}(1 + \tan^2\propto)$$ M1 [Substituting for ∝ & y

$$16\tan^2\propto - 40\tan\propto + 21 = 0$$ B1 [For quadratic eqn.

using the formula.

$x = \frac{b \pm \sqrt{b^2 - 4ac}}{2a}$

$$\tan\propto = \frac{40 \pm 16}{32}$$ M1 [Finding tan∝ or solving the eqn.

$$\frac{56}{32} \text{ or } \frac{24}{32}$$

or factorizing,

$$\therefore \tan\propto = \frac{3}{4} \text{ or } \frac{7}{4}$$

tan

$28.8\tan^2\alpha + 72\tan\alpha - 37.8 = 0$

$28.8\tan^2\alpha - 72\tan\alpha + 37.8 = 0$ 0.75 1.75

accept 37°

[finding the angles

36.9°

60.2°

$\Longrightarrow \propto = 36.9^0$ *and* 60.2^0 M1 A1 A1

[not accept without degrees

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11. (a) (i)

x	0	0.39	0.79	1.18	1.57
$y = x^2$	0	0.2	0.6	1.4	~~4.9~~ 2.5

B1

2

Table of results ~~first~~ is first seen b4 graphing.

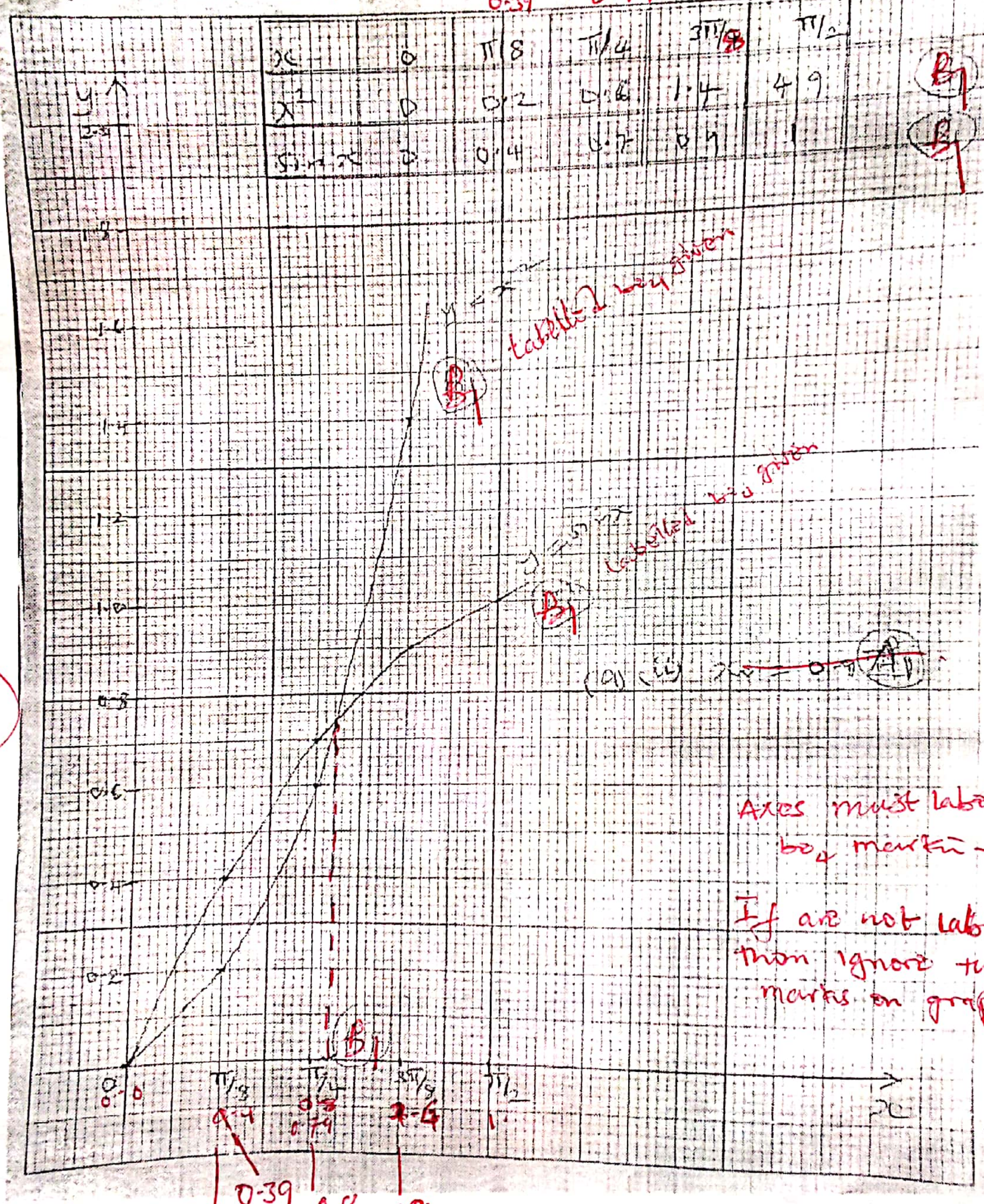
x	0	$\pi/8$	$\pi/4$	$3\pi/8$	$\pi/2$
$y = \sin x$	0	0.4	0.7	0.9	1

B1

Signature ....

Subject Name ......Q11(a)(i)...... Paper code ...... Personal Number

0.39 0.79 2.36 1.57 Accept to 1dp.



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Axes must labelled b4 marking.

If are not labelled then ignore the marks on graph

(a) (ii) $x_0 = 0.9$ A1

(Imply for 'B1')

1

0.4 = 10

0.04 ← 1

If x_0 is not got in (a)(ii) then (b) is wrong.

(b) $f(x) = x^2 - \sin x$

$f'(x) = 2x - \cos x$ → M1 [Correct derivative]

$x_1 = 0.9 - \frac{(0.9^2 - \sin 0.9)}{2(0.9) - \cos 0.9}$ → M1 [Substituting in the formula.]

$= 0.8774$ $\quad e_1 = 0.0226$ → B1 [for e_1 atleast 4 dp]

$x_2 = 0.8774 - \frac{(0.8774^2 - \sin 0.8774)}{2(0.8774) - \cos(0.8774)}$ → M1 [Substituting]

[M_0 & B_0 for just putting e_2 without calculating]

$= 0.8767$ $\quad e_2 = 0.0007$ → B1 [for e_2 atleast 4dp.]

$\therefore root = 0.877$ A1 [correct root 3 dp]

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12. From $a = \frac{dv}{dt}$. $\int dv = \int a\, dt$
$v = \int a\, dt$.

(a) $V_t = \int (e^{-2t}\, \boldsymbol{i} - 2\cos t\, \boldsymbol{j} + 4\sin 2t\, \boldsymbol{k})\, dt$

$= \frac{-1}{2} e^{-2t}\boldsymbol{i} - 2\sin t\, \boldsymbol{j} - 2\cos 2t\, \boldsymbol{k} + C$ → M1 [for correct integration.]

$V_t = 0 = \boldsymbol{i} - 2j + 4\boldsymbol{k}$

$\Rightarrow \boldsymbol{i} - 2j + 4\boldsymbol{k} = \frac{-1}{2} e^{-2(0)}\boldsymbol{i} - 2\sin 0 j - 2\cos 2(0)\boldsymbol{k} + C$ M1 [For substituting and equating to initial velo.]

$C = \frac{3}{2}\, \boldsymbol{i} - 2j + 6k$ B1 [for value of C]

$\therefore\ V_t = \begin{pmatrix} \frac{-1}{2} e^{-2t} & + & \frac{3}{2} \\ -2\sin t & - & 2 \\ -2\cos 2t & + & 6 \end{pmatrix}$ A1 [velocity at time t without units]

[A_0 if puts the units]

(b) $V_t = \frac{\pi}{2} = \begin{pmatrix} \frac{-1}{2} e^{-\pi} & + & \frac{3}{2} \\ -2\sin \frac{\pi}{2} & - & 2 \\ -2\cos\pi & + & 6 \end{pmatrix}$. M_1 [Substitution] ~~B~~

$\begin{pmatrix} 1.4784 \\ -4 \\ 8 \end{pmatrix}$ → [accept 1.5]

Give m_0 for $\sqrt{1.5^2 + -4^2 + 8^2}$

Speed $= \sqrt{(1.4784)^2 + (-4)^2 + 8^2}$ | $\sqrt{1.5^2 + (-4)^2 + 8^2}$ M1 [Substitution]

$= 9.06563$ | $= 9.0656$ A1 [accept 4dp]

(c) $r_t = \int \left(\frac{-1}{2} e^{-2t} + 3\right) i - (2 + 2sint)\, j + (6 - 2cos2t)\, k\, dt$

$= \left(\frac{1}{4} e^{-2t} + \frac{3}{2} t\right) i - (2t + 2cost)\, j + (6t - 4sin2t)k + C_1$ → M1 [correct integration]

when $t = 0$;

$2i - j + 4k = \frac{1}{4} i - 2j + 0k + C_1$ → M1 [Equating two initial conditions]

$C_1 = \frac{7}{4} i + j + 4k$ → B1 [all vector symbols seen.]

$\therefore r_t = \left(\frac{1}{4} e^{-2t} + \frac{3}{2} t + \frac{7}{4}\right) i + (2t + 2cost + 1) j + (6t - 2sin2t + 4)k$ M1 A1 [disp't]

12

[Finding the disp't at time t (no units)]

13. (b)

Height	f	X	Xf	$X^2 f$	$f.d$
147 – 156	12	151. 5	1818	275427	1.2
157 – 161	8	154	1272	202248	1.6
162 – 166	8	164	1312	215168	1.6
167 – 171	9	169	1521	257049	1.8
172 – 176	7	174	1218	211932	1.4
177 – 186	6	181.5	1089	197653.5	0.6
Sum	50		8230	1,359,477.5	

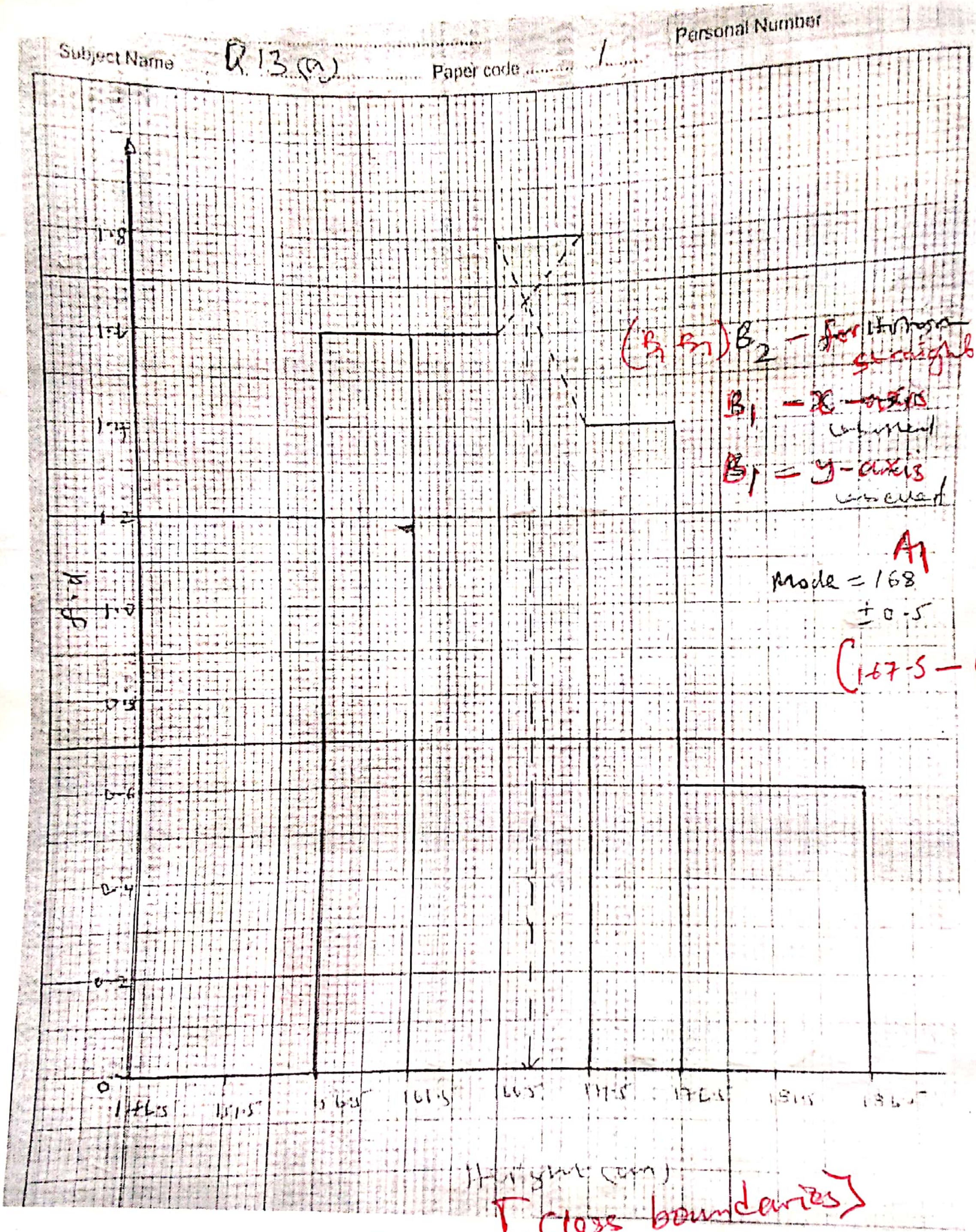
Σfx B1 Σfx^2 B1 B1 [for all correct values]

(All the values and the sum correct)

$2i - j + 4k = \frac{1}{4} i - 2j + 0k + c$

$c = \frac{7}{4} i + j + 4k$.

$r_t = \frac{1}{4} e^{-2t} + \frac{3}{2} t + \frac{7}{4}) i + (2t - 2cost + 1) j + (6t - 2sin2t + 4$



(b) (i) Mean height $= \frac{8230}{50}$ → M1

$= 164.6$ → A1

Give $\sigma = \sqrt{Var}$

(ii) Standard deviation $= \left[\frac{1,359,477.5}{50} - (164.6)^2\right]^{\frac{1}{2}}$ → M1 [Correct substitution]

$= 9.8178$ A1 [atleast 4dp]

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14. (a) $\frac{\Delta l}{L} \times 100 = 5$ $\qquad \frac{\Delta w}{w} \times 100 = 4.2$

$\Delta L = \frac{5 \times 1.25}{100}$ $\qquad \Delta w = \frac{4.2 \times 0.44}{100}$

$= 0.0625$ B1 $\qquad = 0.01848$ B1 [accept 0.0185]

A max $= (1.25 + 0.0625) \times (0.44 + 0.01848)$ → M1 [Finding max Area]

$= 0.602$

$= 0.60$ (2.s.f) → A1 st 0.602 to be round off.

A min $= (1.25 - 0.0625) \times (0.44 - 0.01848)$ → M1 [min. Area]

$= 0.500$ → M1

$= 0.50$ → A1 [2 s.f]

(b) $e_1 = A - a$, $e_2 = B - b$

$e = \frac{A^2}{B} - \frac{a^2}{b}$ → M1 [mathematical definition.]

$= \frac{(a+e_1)^2}{(b+e_2)} - \frac{a^2}{b}$

$= \frac{b\,(a^2+2ae_1+e_1^2) - a^2\,(b+e_2)}{b\,(b+e_2)}$

$= \frac{2abe_1 + e_1^2 b - a^2 e_2}{b\,(b+e_2)}$

$= \frac{2abe_1 + e_1^2 b - a^2 e_2}{b^2\,(1+\frac{e_2}{b})}$

assumption → If $|e_1| <<< |A|$ and $|e_2| <<< |B|$ → B1 [assumption]

If e_1 & e_2 are very small: $\frac{e_2}{b} \approx 0$ and $e_1^2 \approx 0$ $\quad$ Also $\frac{a^2}{b} \simeq \frac{A^2}{B}$ $\quad$ (Dont accept $e_1 \to 0$)

$\therefore e = \frac{2\,a\,b\,e_1 - a^2 e_2}{b^2}$

$= \frac{a^2}{b}\left[\frac{2e_1}{a} - \frac{e_2}{b}\right]$ $\quad$ re-organizing

$|e| \leq \frac{a^2}{b}\left[\left|\frac{2e_1}{a}\right| + \left|\frac{e_2}{b}\right|\right]$ M1 B1 [triangular inequality]

erel $= \frac{|e|}{\left|\frac{a^2}{b}\right|} \leq \frac{a^2}{b} \times \frac{b}{a^2}\left[\left|\frac{2e_1}{a}\right| + \left|\frac{e_2}{b}\right|\right]$ → M1 [Relative error

(erel) max $= 2\left|\frac{e_1}{a}\right| + \left|\frac{e_2}{b}\right|$ B1 [For proof]

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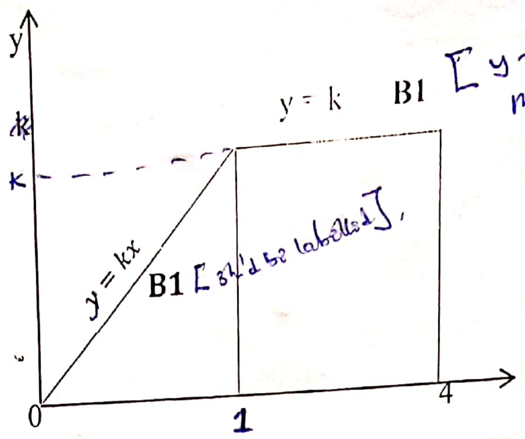
15. (a)



B1 [y = k or f(x) = k] must be labelled

B1 [sh'd be labelled].

B1 (for axes)

(b) (i) $\frac{1}{2} \times 1 \times k + 3k = 1$ — M1 [Finding the value of k]

$K = \frac{2}{7}$ or 0.2857 — A1 [accept 4dp].

(ii) $E(x) = \int_0^1 x.\frac{2}{7} x dx + \int_1^4 x.\frac{2}{7} dx$

$= \frac{2}{21} [x^3]_0^1 + \frac{1}{7} [x^2]_1^4$ — M1 [correct integration and limits]

$= \frac{2}{21} + \frac{1}{7}(16 - 1)$ — M1 [correct substitution]

$\frac{47}{21} = \frac{47}{21}$ or 2.2381 — A1 [at least to 4 dp].

(iii) $\int_0^1 \frac{2}{7} x dx = \frac{1}{7} [x^2]_0^1$ — B1 [Testing for median.]

$= \frac{1}{7} < \frac{1}{2}$

$\frac{1}{2} - \frac{1}{7}$

$\frac{7-2}{14} = \frac{5}{14}$

$\therefore$ median $= \frac{1}{7} + \int_1^m \frac{2}{7} dx = \frac{1}{2}$

$\Rightarrow \frac{2}{7} [x]_1^m = \frac{5}{14}$ — M1 [correct integration and equating to $\frac{1}{2}$]

$\Rightarrow \frac{2}{7} [m - 1] = \frac{5}{4}$ — M1 [Substitution]

$m = \frac{9}{4}$ or 2.25 — A1 [accept 2.3].

$\frac{1}{7} + \int_1^m \frac{2}{7} dx = \frac{1}{2}$

$\frac{2}{7} \int_1^m dx = \frac{5}{14}$

$\frac{2}{7} [x]_1^m = \frac{5}{14}$

$\frac{2}{7}(m-1) = \frac{5}{14}$

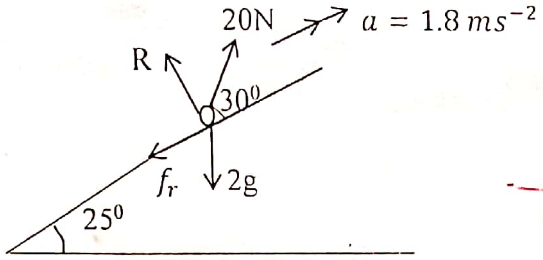
$m - 1 = \frac{5}{4}$

$m = \frac{9}{4}$ or 2.25

12

16.

(a)



$\longrightarrow$ B1 [Forces shown correctly with arrows.

to the plane $\quad R + 20\sin 30 - 2g\sin 65 = 0$

($\perp$) : $R + 20\cos 60^0 - 2g\cos 25 = 0$ $\longrightarrow$ M1 [Resolution [perpendicular] to the plane

$R = 7.7636$ $\qquad R = 7.76336N$ $\longrightarrow$ B1 — for normal

($\parallel$) : $20\cos 30^0 - f_r - 2g\cos 65^0 = 2 \times 1.8$ M1 — [$\Rightarrow$ to the plane]

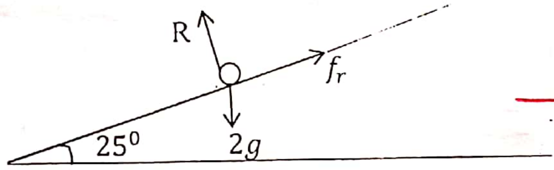
to the plane $\qquad f_r = 5.4372\ N$ $\longrightarrow$ B1 — [Bonus for friction force

~~$f_r + 2g\cos 25 - 20\cos$~~ $\quad \therefore coeff.of\ friction, \mu = \frac{f_r}{R} = \frac{5.4372}{7.7636}$ $\longrightarrow$ M1

$20\sin 60^\circ - f_r - 2g\sin 65^\circ = ma$

$= 0.7$ $\longrightarrow$ A1

(b)



$\longrightarrow$ B1 [force diag.]

($\perp$) : $R = 2g\cos 25^0$ M1 [Resolving [perpendicular] to the plane]

$= 2 \times 9.8\cos 25^0$

$= 17.7636\ N$

$F_{max} = \mu R$ M1 [getting max force.

$= 0.7 \times 17.7636 \quad = 12.435N$ $\longrightarrow$ B1 [Value for friction force

Particle will remain at rest if the friction force is large enough to balance the component of its weight down the plane.

Component weight $\quad = 2 \times 9.8 \times \cos 65^0$ $\quad 2 \times 9.8 \times \sin 25^0$

$= 8.2833\ N$ $\longrightarrow$ ~~M1~~ B1

Since $F_{max} > 8.28\ N$, particle will remain at rest. $\longrightarrow$ B1

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END

P425/2
PURE MATHEMATICS
AUGUST - 2022
3 HOURS

JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS – AUGUST, 2022

PURE MATHEMATICS

Paper 1

3 HOURS

INSTRUCTIONS TO CANDIDATES

*Answer **all** questions in section A and any five from section **B**.*

*Any additional question(s) will **not** be marked.*

*All working **must** be shown clearly.*

Begin each question on a fresh sheet of paper.

Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

SECTION A: (40 MARKS)
ANSWER ALL THE QUESTION IN THIS SECTION

1. A uniform rod AB of length 4m and weight 20N hangs in equilibrium in a horizontal position supported by two vertical inextensible strings at A and B. If a bead of weight 16N is now moved along the rod so that the tension in the string at B is twice the tension in the string at A. (05 marks)
   Calculate the distance of the bead from A.

2. A car is examined for the MOT test by two garages P and Q. The probability that P passes the car is 0.6 and that of Q is 0.8. Given that P passes the car, the probability that Q passes it is 0.9. using a venn diagram, find the
   (i) P(P or Q but not both P and Q) (03 marks)
   (ii) P (P / Q) (02 marks)

3. A body freely moving from rest is acted on by a variable force, F as shown in the table below;

Distance (m)	0	4	10	15	20	25	31
Force (N)	5.0	8.0	11	12	13.6	10.5	5.0

   Using linear interpolation / extrapolation determine the;
   (a) Distance when a force of 12.8N is acted on the body (03 marks)
   (b) Force when the body has travelled a distance of 34.7m (02 marks)

4. The driver of a train moving Eastwards at a velocity of $100ms^{-1}$ sights a car moving North – Eastwards at a velocity of $60ms^{-1}$. Calculate the;
   (i) relative velocity of the car to the train. (03 marks)
   (ii) direction of the car relative to the train (02 marks)

5. In a certain town, 46% of the population are under 30 years of age. If a random sample of 100 people is taken, find the probability that less than half of the people in the sample are under 30 years. (05 marks)

6. Use the trapezium rule with four sub – intervals to estimate the

$$\int_0^{\frac{\pi}{3}} e^x \cos x \, dx$$

   Correct to 3 significant figures (05 marks)

7. The marks scored by 8 students in chemistry (x) and mathematics (y) are given below;

Chemistry (x)	55	42	37	59	38	48	56	48
Mathematics (y)	60	48	41	63	35	39	51	55

Calculate the rank correlation coefficient of the performance of the students in the two subjects. (05 marks)

8. A particle of mass 2kg moves with velocity $(e^t\boldsymbol{i} + 2e^{-2t}\boldsymbol{j} - sin\boldsymbol{k})\,ms^{-1}$. Find the power developed after 4 seconds. (05 marks)

SECTION B: (60 MARKS)

Answer any five questions from this section. All questions carry equal marks.

9. The marks of all the candidates from a certain school in a national examination were normally distributed with a mean of 52% and standard deviation of 16%. The lowest mark for a distinction in the examination was 68%.
   (a) (i) determine the number of candidates in the school given that 20 candidates scored below 40%. (04 marks)
   (ii) calculate the number of candidates who got distinctions (03 marks)
   (b) If sixteen candidates in the examination were picked at random, find the probability that their mean score was between 46% and 58%. (05 marks)

10. (a) Derive the equation of the path of a particle projected from 0 at angle $\propto$ to the horizontal with initial speed ums^{-1} (06 marks)
   (b) A particle projected from point A with speed 30ms^{-1} at an angle of elevation θ, hits the ground again at B at the same level as A. If before landing the particle just clears the top of a tree which is at a horizontal distance of 72m from A, the top of the tree being 9m above the level AB. Calculate the possible angles of projection. (Use $g = 10ms^{-2}$) (06 marks)

11.(a) (i) On the same axes, draw graphs of $y = x^2$ and $y = sinx$ for $0 \leq x \leq \frac{\pi}{2}$ at intervals of $\frac{\pi}{8}$.
   (ii) From your graphs, obtain to one decimal place an approximate root of the equation $x^2 - sinx = 0$ (06 marks)
   (b) Using Newton – Raphson method, find the root of the equation $x^2 - sinx = 0$, taking the approximate root in (a) (i) as an initial approximation. Given your answer correct to 3 decimal places. (06 marks)

12. A body moving with acceleration $\boldsymbol{a} = e^{-2t}\boldsymbol{i} - 2\,cos t\boldsymbol{j} + 4\,sin2t\boldsymbol{k}$ is initially located at point $(2, -1, 4)$ and has a velocity $\boldsymbol{i} - 2\boldsymbol{j} + 4\boldsymbol{k}$. Find the

(a) velocity of the body at any time t, (04 marks)

(b) speed of the body at time $t = \frac{\pi}{2}$ (03 marks)

(c) displacement of the body at any time t. (05 marks)

13. The table below shows the heights (in cm) of a senior six science class of a certain school.

Height (cm)	Frequency
147 – 156	12
157 – 161	8
162 – 166	8
167 – 171	9
172 – 176	7
177 – 186	6

(a) Draw a histogram and use it to estimate the modal height (06 marks)

(b) Calculate the

(i) mean height (03 marks)

(ii) standard deviation of the data (03 marks)

14. (a) The dimensions of a rectangular plot are 1.25km and 0.44km. If the length and width have 5% and 4.2% errors respectively, in the estimates. Calculate the limits within which the area of the plot lies correct to two significant figures. (06 marks)

(b) The number a and b are approximated with possible errors of e_1 and e_2 respectively. Show that the maximum absolute relative error in the quotient $\frac{a^2}{b}$ is given by $2\left|\frac{e_1}{a}\right| + \left|\frac{e_2}{b}\right|$ (06 marks)

15. A continuous random variable X has a probability density function given by

$$f(x) = \begin{cases} Kx & , \quad 0 \le x \le 1 \\ K & , \quad 1 \le x \le 4 \\ 0 & , \quad \text{other wise} \end{cases}$$

(a) Sketch $f(x)$ (03 marks)

(b) Find the

(i) value of K (02 marks)

(ii) mean, (03 marks)

(iii) median of X (04 marks)

16. A particle of mass 2kg moves up a line of greatest slope on a rough plane inclined at 25^0 to the horizontal. It is attached to a taut inextensible string which makes an angle of 30^0 with the plane. If the particle moves up the plane with an acceleration of 1.8 ms^{-2} and the tension in the string is 20N,

(a) calculate the coefficient of friction between the particle and the plane. (07 marks)

(b) while the particle is moving up the plane, the string is cut and the particle comes to rest. Show that the particle will remain at rest on the plane. (05 marks)