KAMSSA 2022 MATH APPLIED

PAPER 2(P425/2)

SECTION A:40 MARKS

1 E(x)=0.4x25=10

$\sigma x = \sqrt{0.4 \; x \; 0.6 \; x \; 25}$

$= \sqrt{15}$ OR 3.873 (3d.p)

P (≤ 20)= p (x ≤ 20.5)

$Z = \frac{20.5-10}{3.873}$

$= 2.711$

$\therefore$ p ($Z <$ 2.711) =0.5+0.4966

=0.9966

2 $\tilde{F}$ m$\tilde{a} = 500\begin{pmatrix}2\\-3\end{pmatrix}$

$= \begin{pmatrix}1000\\-1500\end{pmatrix}$ N

From $v = \tilde{u} + \tilde{a}t$

$= \begin{pmatrix}0\\0\end{pmatrix} + \begin{pmatrix}2\\-3\end{pmatrix}x4$

$= \begin{pmatrix}8\\-12\end{pmatrix}$

Power developed $= \begin{pmatrix}1000\\-1500\end{pmatrix} \cdot \begin{pmatrix}8\\-12\end{pmatrix}$

= (26,000 watts)

3(a)

X	10	15	20
Y	2.9	_	-0.1

$\frac{y-2.9}{15-10} = \frac{-0.1-2.9}{20-10}$

Y = 1.4

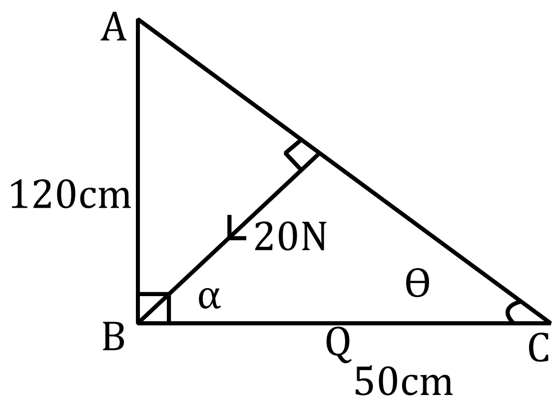
3(b)

X	20	30	_
y	- 0.1	- 2.9	- 3.2

$\frac{x-30}{-3.2-^{-2.9}} = \frac{30-20}{-2.9-^{-0.1}}$

X = 31.07 or 31.1

4)



For all forces drawn

$\tan\theta = \frac{120}{50}$

$\theta = 67.4°$

$\propto = 22.6°$

$\widetilde{\mp R} = \begin{matrix}\propto \\ 0\end{matrix} + \begin{matrix}-20\cos 22.6° \\ -20\sin 22.6°\end{matrix}$

But $\theta + \ -20\cos 22.6° = 0$

$\theta = 18.462\boldsymbol{N}$

5)

speed	20 - 30	30 - 40	40 - 60	60 - 80	80 - 100
f	2	7	20	16	5
F	2	9	29	45	50

i) 40th percentile is the $\frac{40}{100}$x 50 =20thvalue

$=40 + \left(\frac{\frac{50x40}{100} - 9}{20}\right) x\ 20$

$=40 + \left(\frac{20-9}{20}\right)$x 20

$=40 + 11$

$= 51$

b) Number of vehicles whose speed > 45

$16 + 5 + \frac{60-45}{20}$ x 20

$= 56$

6) Range (max) = 0.12 x 1000

=120m

Range (max) $= \frac{u^2}{g}$ when $\theta = 45°$

$120 = \frac{u^2}{9.8}$

U = 34.2929m/s

Or $= 14\sqrt{6m/s}$

b) from

$v^2 = u^2 \sin\ ^2\theta$ – 2gH

$O^2 = 1176\sin\ ^2 45°$ - 2 x 9.8H

$\therefore H = \frac{588m}{2\ x\ 9.8}$ or 30m

7) By simple interoal arithmetic

Min value = 6.225 – 3.15 - $\left(\frac{2.55\ x\ 4.15}{4.5}\right)$

= 0.7233 (4dip).

Max value= 6.235 – 3.05 - $\left(\frac{2.45\ x\ 4.05}{5.5}\right)$

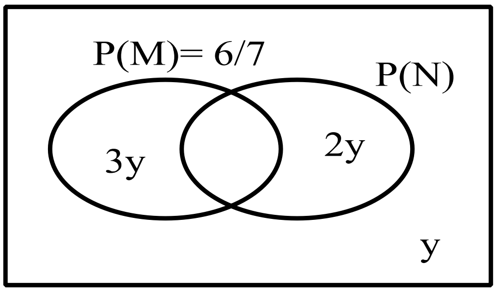
= 1.381

$\therefore Max\ p0ssible\ error = absolute\ error$

$= \frac{1.381 - 0.7238}{2}$

$= 0.329\ (3s.f\ _s)$

8)



a) $\frac{6}{7}$ +2y +y = 1

$1 - {}^{6}/_{7}$ =3y

Y=$\frac{1}{21}$ or 0.0476.

b) 3y + P(M∩N) = $\frac{6}{7}$

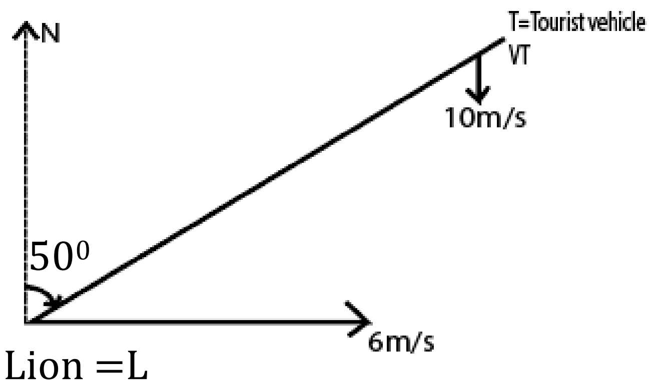
P(M∩ N} = $\frac{6}{7}$ - $\frac{3}{21}$

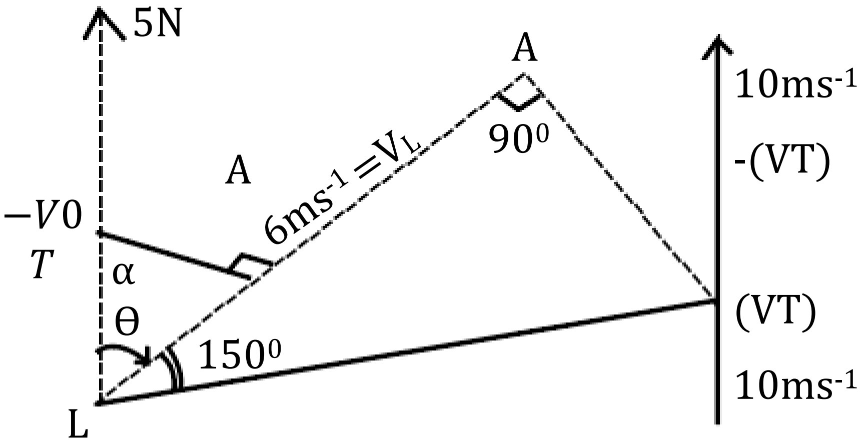
=$\frac{15}{21}$ or $\frac{5}{7}$

OR 0.7143

SECTION B : 60 MARKS

9a)





$\sin\theta = \frac{6}{10}$

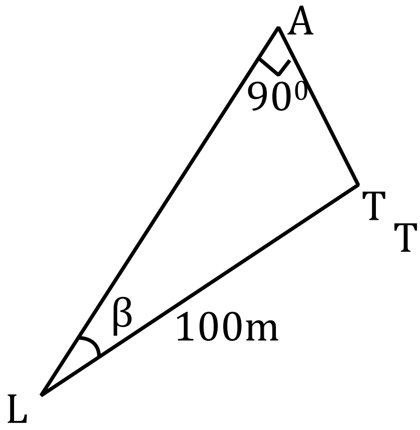
$\theta = 36.9°$

$\rightarrow \propto = 180°$ - $90° - 36.9° = 53.1°$

$\therefore$ *Direction or bearings is*

$180°$ - $53.1° = 126.9°$

b) Closest or best distance occurs at A.



$\beta = 50° - 36.9° = 13.1°$

$\therefore$ *least distance*

$\text{AT} = 100\sin 13.1° = 22.6651\text{m} \quad (4d.p)$

Time to reach the closest distance A.

$\text{t} = \frac{AL}{|_L V_T|}$

$\left|{}_L \underset{\sim}{V_T}\right| = \sqrt{10^2 - 6^2}$

$= 8MS^{-1}$

$\text{AL} = 100\cos 13.1° = 97.3976\text{m} \quad (4dp)$

$\text{Time t} = \frac{97.3976}{8}$

$= 12.1747$ seconds

10a) $h = \frac{4-0}{5} = 0.8$

X	0	0.8	1.6	2.4	3.2	4.0
$f_{(x)}$	1	5.7995	33.6347	195.0662	1131.2954	6561

$\therefore \int_0^4 3^{2x} \text{dx} \quad = \frac{1}{2}\ x\ 0.8\ (6562 + 2x1365.7958)$

$= 3717.44$

b) let $\text{U} = 3^{2X}$

$\text{In U} = 2\text{x in } 3$

$\frac{1}{U}\frac{du}{dx} = 2 \text{ in } 3$

$\text{dx} = \frac{du}{2\ in\ 3x4}$

$\int U \cdot \frac{du}{2u\ in\ 3} \quad = \frac{u}{2\ in\ 3} \qquad\qquad \frac{3^{2x}}{2\ in\ 3}\Big|_0^4$

$= \frac{3^8}{2\ in\ 3} - \frac{1}{2\ in\ 3}$

$= 2985.58$

c) $|error\ | = \ |2985.58 - 3717.44|$

$= 731.86$

$\therefore Relative\ error$

$= \frac{731.86}{2985.58}$

$= 0.245$

$= 0.25(2d.p)$

Comment: By increasing sub interrals or ordinates or reducing the width of strips.

11 (a) $\text{x} = \frac{500m}{100} = 5\text{m}$ OR 8 x 10^3ug

OR 2 X 10^3ug

U=0

From $V^2 = U^2 + 2\text{ax}$

$V^2 = O^2 + 2 \text{ X } 10 \text{ X } 5 = 100$

$\therefore V = \frac{10m}{s}$

OR P.E = K.E $= 8\ X\ 10^3 X\ 10\ X\ 5$

$= \frac{1}{2}\ X\ 8\ X\ 10^3 X\ U^2$

$= V^2 = 100$

$=$V = 10m/s

d) Initial total mom = 8 x 10^3 x 10 = 8 x 10^4 ng m/s

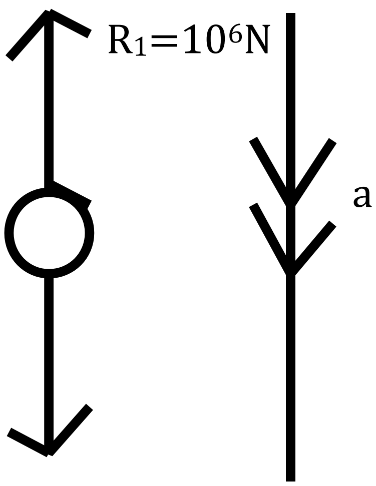
let V_1 be the common speed

final total mom = (8 + 2) x 10^3 x V_1

But $10^4\ V_1 = 8\ X\ 10^4$

$\therefore\ V_{1=}8$m/s

c)



W = (8 + 2) x $10^3 x\ 10 =\ 10^5 N$

By Newton's 2nd law downwards

$10^5 - 10^6\ = (8 + 2)$ x $10^3 a$

a $= -90\ m/s^2$

Let h be distance penetrated.

From $V^2 = 4^2 + 2ax$

$O^0\ =\ 8^2 + 2\ x\ (-90)\ x\ h$

h $= \frac{64}{180}$ m

or $\frac{32}{90}$ m

or $\frac{16}{45}$ m

or 0.3556m.

12a) $P(x > 200) = P(Z > Z_1) = 0.63$

$Z_1 = -_{0.332}$

$\Rightarrow -_{0.332} = \frac{200-N}{\sigma} \ldots \ldots \ldots \ldots \ldots (i)$

$P(X < 250) = p(Z < Z_2) = 054$

$Z_2 = 0.101$,0R = 0.10, OR = 0.11

$\Rightarrow 0.101 = \frac{250-N}{\sigma} \ldots \ldots \ldots \ldots . . (ii)$

i – ii

$\frac{-0.433\sigma}{\sigma}$ = -50

= 115.4734 OR 113.1738

Put σ *in* (i) φ = 200 + 0.332 x 115.4734

= 238.3372

OR = 237.5504

b) $P(x > 195)$

$Z = \frac{195-238.3372}{115.4734}$

= - 0.375

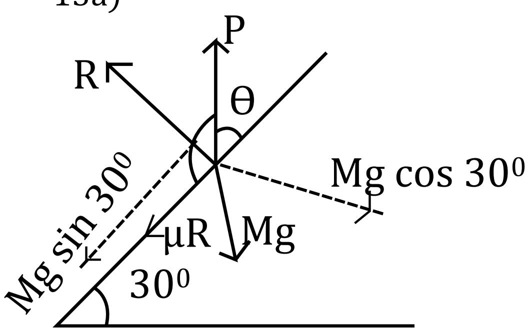
$P(Z > -_{0.375})$ = 0.5 + 0. 1462 (or = 0.465)

= 0.6462 or 0.6465

$\therefore$ % *age* = 0.6462 *x* 100

= 64.62

13a)



Resolve parallel to the plane

$P\cos\theta\ \mu\mathcal{R} + mg\sin 30° = \mu\mathcal{R} + \frac{mg}{2}$……………….(i)

Resolve $\therefore$ $R + P\sin\theta =$ $mg\cos 30° = \frac{\sqrt{3}}{2}mg$…….(2)

$R = \frac{\sqrt{3}}{2}mg - P\sin\theta$.

From (1) and (2) $\mathrm{P}\cos\theta = \mu\left(\frac{\sqrt{3}}{2}mg - P\sin\theta\right) + \frac{mg}{2}$

For equilibrium , $t\ and\ \lambda = \frac{\sin\lambda}{\cos\lambda}$

$\mathrm{P}\cos\theta = \frac{\sin\lambda}{\cos\lambda}\left(\frac{\sqrt{3}}{2}mg - \sin\theta\right) + \frac{mg}{2}$

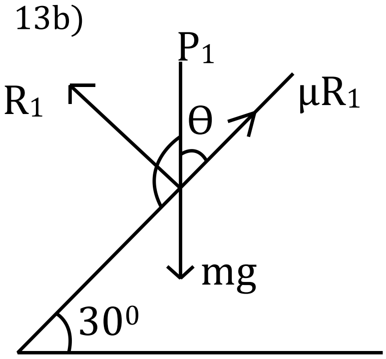
$\mathrm{P}\cos\theta\cos\lambda = \frac{\sqrt{3}}{2}\mathrm{mg}\sin\lambda$ - $\mathrm{P}\sin\theta\sin\lambda + \frac{mg}{2}\cos\lambda$

$\mathrm{P}(\cos\theta\sin\lambda + \sin\theta\sin\lambda) = \frac{mg}{2}\left(\sqrt{3}\sin\lambda + \cos\lambda\right)$

For $P_{min}, \cos(\theta - \lambda) = +1$

$\therefore P_{min} = \frac{mg}{2}\left(\sqrt{3}\sin\lambda + \cos\lambda\right)$

13b)



For all forces

$\mu\mathcal{R}_1 = \mathrm{mg}\sin 30° + P_1\cos\theta$

$= \frac{mg}{2} + P_{1\cos\theta}$ ………………(1)

$\mathcal{R}_1 = P_{1\sin\theta} + \mathrm{mg}\cos 30°$

$= P_{1\sin\theta} + \frac{\sqrt{3}}{2}\mathrm{mg}$ …………………(2)

From (1) and (2)

$\mu\left(P_1\sin\theta + \frac{\sqrt{3}}{2}mg\right) = \frac{mg}{2}\ x\ P_1\cos\theta$

For equilibrium,$\mu = \tan\lambda = \frac{\sin\lambda}{\cos\lambda}$.

$\frac{\sin\lambda}{\cos\lambda}\left(P_1\sin\theta + \frac{\sqrt{3}}{2}mg\right) = \frac{mg}{2} + P_1\cos\theta$

$P_1\left(\sin\theta\sin\lambda + \frac{\sqrt{3}}{2}mg\sin\lambda\right) = \frac{mg}{2}\cos\lambda + P_1\cos\theta\cos\lambda$

$\frac{mg}{2}\left(\sqrt{3}\sin 7 - \cos\lambda\right) = P_1(\cos\theta\ \cos\lambda - \sin\theta\sin\lambda)$

$= P_1\cos(\theta + \lambda)$

For $P_{min}\cos(\theta + \lambda) = +1$

NO 14a

14b)

x	82	78	86	72	91	80	95	72	89	74
y	75	80	93	65	87	71	98	68	84	77
$\mathcal{R}_x$	5	7	4	9.5	2	6	1	9.5	3	8
$\mathcal{R}_y$	7	5	2	10	3	8	1	9	4	6
D^2	4	4	4	0.25	1	4	0	0.25	1	4

$\sum d^2 =$

22.5

$$P = 1 - \frac{6\ x\ 22.5}{10(10^2-1)}$$

$= 0.86$

Comment : At 1% level of significance there is reasonable for much significant of math's on Economics

15 a) $f(0) = 0+0\text{-}1 = \text{-}1$

$f(1) = 1 + 2 - 1 = 2$ OR

X	0	1
$f(X)$	-1	2

Since $f\ (0)$ x $f\ (1) < 0$

or a change in sign of f(x), there in a real root between x=0 and x= 1

b)

x	0	x_0	1
$f(x)$	-1	0	2

$$\frac{x_0-0}{0-{}^-1} = \frac{1-0}{2-{}^-1}$$

$$x_0 = \frac{1}{3} \approx 0.3$$

c) $f^1(x) = 3x^2 + 2$, $\left(Not\ f^1(x_n) = 3x_n^2 + 2\right)$

$X_1 = 0.3 - \frac{(0.3)^3 + (2\ x\ o.3)-1}{3x\ (0.3)^2+1} = 0.464$

$X_2 = 0.464 - \frac{(0.464)^3+2\ (0.464)^2-2}{3\ x\ (0.464)^2+2}$

$= 0.453$

$X_3 = 0.453 - \frac{(0.453)^3+2\ X\ \ 0.453-1}{3X(0.453)^2+2}$

$= 0.453$

$=|0.453 - 0.453|$

$\therefore Root = 0.45$

16a) for $f(X) < 0$, $f(X) = 0$

For $0 \leq x \leq 1$

$$f(X) = 0 + \int_0^X Kx\,(1 - X^2)\,dX$$

$$= \frac{-k}{4}(1 - X^2)^{\,2} \Big|_0^X$$

$$f(X) = \frac{-K}{4}(1 - X^2)^2 \;\frac{K}{4}$$

$$f(1) = 0 + \frac{K}{4} = \frac{K}{4}$$

$$\therefore f(X) = \begin{cases} 0\,, \;\; x < 0\; 0r\; x \leq 0 \\ \frac{K}{4} - \frac{K}{4}(1 - X^2)^2; 0 \leq X \leq 1 \\ \frac{K}{4}\;; x \geq 1\; or\; x \geq 1 \end{cases}$$

b (i)

$$\frac{K}{4} = 1$$

$$K = 4$$

(ii) $\frac{K}{4} - \frac{K}{4}(1 - X^2)^2 \Big|_o^m = \frac{1}{2}$

(ii) $\frac{4}{4} - \frac{4}{4}(1 - m^2)^2 + \frac{4}{4} - \frac{4}{4} = \frac{1}{2}$

$1 - \frac{1}{2}$ -$(1 - m^2)^2$ =0

$-m^4 + 2m^2 - 1 = 0$

$+m^2 - 2m^2 + \frac{1}{2} = 0$

$m^2 = 4 \pm \frac{\sqrt{16-8}}{4} = \frac{4 \pm 2\sqrt{2}}{4}$

M $= \sqrt{1 - \frac{\sqrt{2}}{2}} = \sqrt{0.2929}$

$$= 0.5412$$

c) *mean of x*

E(X) $= \int_0^1 x\,.\,k\,x\,(1 - X^2)\,dx$

$$= \int_0^1 k\,(x^2 - x^4)dx$$

$$= K\left(\frac{X^3}{3} - \frac{X^5}{5}\right)\Big|_0^1$$

$=4\left(\frac{1}{3}-\frac{1}{5}\right)=0$

$=\frac{8}{15}$ OR 0.5333

END

Area of 1st triangle $=\frac{1}{2}$ x 30 x 45

$$= 675\ sq\ .units$$

Area of 2nd triangle $= \frac{1}{2}$ x 60 x 25

$$= 750\ sq.units$$

Area of a trapezium $= \frac{1}{2}\ h\ (a + b)$

$$= \frac{1}{2} \text{ x } 60\ (45 + 65)$$

$$= 3150\ sq\ .units$$

Total are $= 675 + 750 + 3150$

$$= 4575sq\ .units$$

END