UACE MATHEMATICS PAPER 2 2019 guide

SECTION A

1. The table shows the masses of bolts bought by a carpenter.

Mass (grams)	98	99	100	101	102	103	104
Number of bolts	8	11	14	20	17	6	4

Calculate the:
(a)median mass
(b) mean mass of the bolt (05mark

2. A uniform rod AB of length 3m and mass 8kg is freely hinged to a vertical wall at A. A string BC of length 4m attached at b and to point C on the wall, keeps the rod in equilibrium. If C is 5m vertically above A, find the
(a) Tension in the string (03marks)
(b) Magnitude of the normal reaction at A. (02marks)

3. Use the trapezium rule with seven coordinates to estimate
$\int_0^3 [(1.2)^x - 1]^{\frac{1}{2}}$dx correct to 2 decimal places (05marks)

4. A discrete random variable X has the following probability distribution

X	0	1	2	3	4	5
P(X = x)	0.11	0.17	0.2	0.13	p	0.09

Find the
(a) Value of p (02marks)
(b) Expected value of X (03marks)

5. A stone is thrown vertically upwards with velocity 16ms^{-1} from a point H meters above the ground level. The stone hits the ground 4 seconds later.
Calculate the
(a) Value of H (03marks)
(b) Velocity of the stone as it hits the ground (02marks)

6. The table below shows the commuter bus fare from stages A to B, C, D and E

Stage	A	B	C	D	E
Distance (km)	0	12	16	19	23
Fare (shs)	0	1300	1700	2200	2500

(a) Jane boarded from A and stopped at a place 2km after E. How much did she pay? (03marks)
(b) Okello paid shs 2000. How far from A did the bus leave him? (02marks)

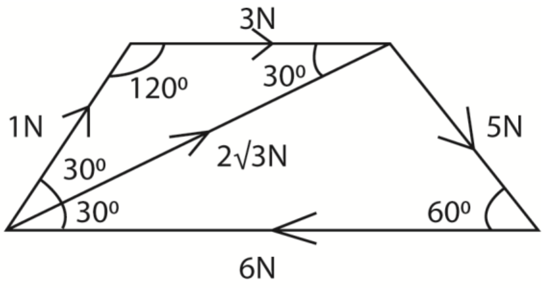
7. The amount of meat sold by a butcher is normally distributed with a mean of 43kg and standard deviation 4kg. Determine the probability that the amount of meat sold is between 40kg and 50kg. (05marks)
8. A particle is moving with simple harmonic motion (SHM). When the particle is 15m from the equilibrium, its speed is $6ms^{-1}$. When the particle is 13 m from equilibrium, its speed is $9ms^{-1}$. Find the amplitude of the motion (05marks)

SECTION B

9. Car A is 80m North West of point O. Car B is 50m N 30^0E of O. Car A s moving at $20ms^{-1}$ while car B is moving at $10ms^{-1}$ each on a straight road towards O. Determine the
   (a) Initial distance between the two cars (03mark)
   (b) Velocity of A relative to B (05marks)
   (c) The shortest distance between the two cars as they approach O (04marks)
10. The table below shows the marks obtained in a mathematic test by a group of student

marks	5 -<15	15-<25	25-<35	35-<45	45-<55	55-<65	65-<75	75-<100
Number of students	5	7	19	17	7	4	2	3

   (a) Construct a cumulative frequency (O give) for the data (05 marks)
   (b) Use your Ogive to find the
      (i) Range between the 10^{th} and 70^{th} percentiles
      (ii) Probability that a student selected at random scored below 50 marks. (07 marks)
11. (a) Show that the equation x -3sinx = 0 has a root between 2 and 3. (03marks)
   (b) Show that Newton- Raphson iterative formula for estimating the root of the equation in (a) is given by
$$X_{n+1} = \frac{3(\sin x_n - x_n \cos x_n\ )}{1 - 3\cos x_n}, n = 0, 1, 2 ....$$
   Hence find the root of the equation corrected to 2 decimal places (09 marks)
12. A force F = (2t i + j – 3t k)N acts on a particle of mass 2kg. The particle is initially at a point (0,0,0) and moving with a velocity (i + 2j-k)ms^{-1}. Determine the:
   (a) Magnitude of the acceleration of the particle after 2 seconds (04marks)
   (b) Velocity of the particle after 2seconds (04marks)
   (c) Displacement of the particle after 2 seconds (04marks)
13. Two events A and B are such that P(B) = $\frac{1}{8}$, P(A∩B) = $\frac{1}{10}$ and P(B/A) = $\frac{1}{3}$
   Determine the
   (a) P(A) (03marks)
   (b) P(A∪ B) (03marks)
   (c) P(A/$\bar{B}$) (06marks)
14. (a) Given that y = e^x and x = 0.62correct to two decimal places, find the interval within which the exact value of y lies. (05marks)
   (b) Show that the maximum possible relative error in ysin^2x is
   $\left|\frac{\Delta y}{y}\right| + 2\cot x\ |\Delta x|$, where$\Delta x$ and Δy are errors in x and y respectively
   Hence find the percentage error in calculating ysin^2x if y = 5.2 $\pm$ 0.05 and x = $\frac{\pi}{6} \pm \frac{\pi}{360}$
   (07 marks)
15. The diagram below shows a trapezium rule ABCD, AD = DC = CB = 1and AB = 2meters. Forces of magnitude 1N, 3N, 5N, 6N and $2\sqrt{3}$ N respectively.



(a) Calculate the magnitude of the resultant force and the angle it makes with side AB (09marks)

(b) Given that the line of action of the resultant force meets AB at X, find AX. (03marks)

16. A biased die with faces labelled 1, 2, 3, 4, 5 and 6 is tossed 45 times
Calculate the probability that 2 will appear;
(a) More than 18 times (07marks)
(b) Exactly 11 times (05marks)

Solutions

SECTION A

17. The table shows the masses of bolts bought by a carpenter.

Mass (grams)	98	99	100	101	102	103	104
Number of bolts	8	11	14	20	17	6	4
fx	784	1084	1400	2020	1734	618	416
c.f	8	19	33	53	70	76	80

$$\sum f = 80, \sum fx = 8061$$

Calculate the:

(a)median mass

Medan position = $\left(\frac{N}{2}\right)^{th}$ $value$ = $\left(\frac{80}{2}\right)^{th}$ value = 40^{th} value

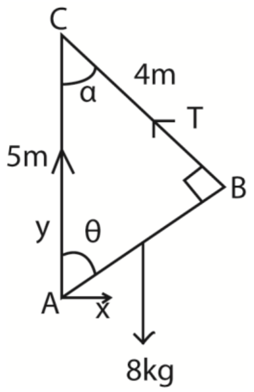
∴ median = 101

(b) mean mass of the bolt (05mark

Mean = $\frac{\sum fx}{\sum f} = \frac{8061}{80} = 100.76g$

18. A uniform rod AB of length 3m and mass 8kg is freely hinged to a vertical wall at A. A string BC of length 4m attached at b and to point C on the wall, keeps the rod in equilibrium. If C is 5m vertically above A, find the

(c) Tension in the string (03marks)



$AB^2 + 4^2 = 5^2$

AB = $\sqrt{(25-16)}$ = 3

Let T be tension in the string, from the diagram

cos θ = $\frac{3}{5}$, cos α = $\frac{4}{5}$

Equation of moment about A

T x 3 = 8g x 1.5cosα

3T = 8 x 9.8 x $\frac{4}{5}$; T = 31.36N

∴ tension in the string is 31.36N

(d) Magnitude of the normal reaction at A. (02marks)

x = Tcosθ = 31.36 x $\frac{3}{5}$ = 18.816N

∴ the magnitude of normal reaction at A is 18.816N

19. Use the trapezium rule with seven coordinates to estimate

$\int_0^3 [(1.2)^x - 1]^{\frac{1}{2}}dx$ correct to 2 decimal places (05marks)

Solution

For 7 ordinates, there are 6 subintervals

Width, h = $\frac{b-a}{subinterval} = \frac{3-0}{6} = 0.5$

Let y = $\sqrt{(1.2)^x - 1}$

x	y	
0	0	
0.5		0.309
1		0.447
1.5		0.561
2		0.663
2.5		0.760
3	0.853	
Sum	0.853	2.74

Using the trapezium rule

$\int_0^3 [(1.2)^x - 1]^{\frac{1}{2}}dx = \frac{0.5}{2}[0.853 + 2(2.74)]$ = 1.58

20. A discrete random variable X has the following probability distribution

X	0	1	2	3	4	5
P(X = x)	0.11	0.17	0.2	0.13	p	0.09

Find the

(c) Value of p (02marks)

Using $\sum P(X = x)$ = 1

0.11 + 0.17 + 0.2 + 0.13 + p + 0.09 = 1

p = 0.3

(d) Expected value of X (03marks)

E(X) = $\sum x.P(X = x)$

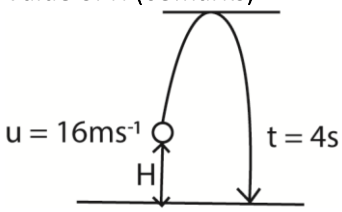
= 0 x 0.11 + 1 x 0.17 + 2 x 0.2 + 3 x 0.13 + 4 x 0.3 + 5 x 0.09

= 2.61

21. A stone is thrown vertically upwards with velocity $16ms^{-1}$ from a point H meters above the ground level. The stone hits the ground 4 seconds later.

Calculate the

(c) Value of H (03marks)



Using s = ut + ½ at^2; s = -H(below point of projection), u = 16ms^{-1}, a = -g, t = 4s

-H = 16 x 4 - $\frac{1}{2}$ x 9.8 x 4^2

H = 14.4m

(d) Velocity of the stone as it hits the ground (02marks)

Using v = u + at; v = -v(below point of projection), a = -g, t = 4s

-v = 16 -9.8 x 4

v = 23.2ms^{-1}

∴ the velocity of the stone as it hits the ground is 23.2ms^{-1}

22. The table below shows the commuter bus fare from stages A to B, C, D and E

Stage	A	B	C	D	E
Distance (km)	0	12	16	19	23
Fare (shs)	0	1300	1700	2200	2500

(c) Jane boarded from A and stopped at a place 2km after E. How much did she pay? (03marks)

2kn after E = 25km from A, let x be the fare

Extract

D	E	
19	23	25
2200	2500	x

Using linear extrapolation

$$\frac{x-2500}{25-23} = \frac{2500-2200}{23-19}$$

x = sh 2650

(d) Okello paid shs 2000. How far from A did the bus leave him? (02marks)

Let y be the distance

Extract

C		D
16	y	19
1700	200	2200

Using linear extrapolation

$$\frac{y-16}{2000-1700} = \frac{19-16}{2200-1700}$$

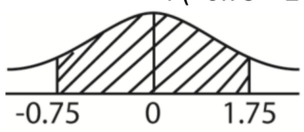
y = 17.8km

23. The amount of meat sold by a butcher is normally distributed with a mean of 43kg and standard deviation 4kg. Determine the probability that the amount of meat sold is between 40kg and 50kg. (05marks)

X ~N(43,4)

P(40<x<50) = $P\left(\frac{40-43}{4} < Z < \frac{50-43}{4}\right)$

= $P(-0.75 < Z < 1.75)$



$P(40<x<50) = P(-0.75 < Z < 0) + P(0 < Z < 1.75)$

By property of symmetry

$P(40<x<50) = P(-0.75 < Z < 0) + P(0 < Z < 1.75)$

= 0.2735 + 0.4599

= 0.733

24. A particle is moving with simple harmonic motion (SHM). When the particle is 15m from the equilibrium, its speed is $6ms^{-1}$. When the particle is 13 m from equilibrium, its speed is $9ms^{-1}$. Find the amplitude of the motion (05marks)

$v^2=\omega^2(A^2 - x^2)$

$6^2= \omega^2(A^2 - 15^2)$ ……. (i)

$9^2=\omega^2(A^2 - 13^2)$ …….. (ii)

Dividing (i) by (ii)

$\frac{36}{81} = \frac{A^2-225}{A^2-169}$

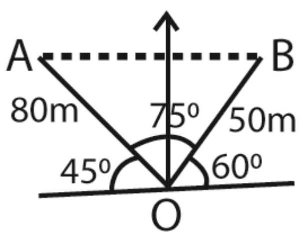
Amplitude A = 16.4256m

SECTION B

25. Car A is 80m North West of point O. Car B is 50m N 30^0E of O. Car A s moving at $20ms^{-1}$ while car B is moving at $10ms^{-1}$ each on a straight road towards O. Determine the

(d) Initial distance between the two cars (03mark)

Method I: using geometrical approach



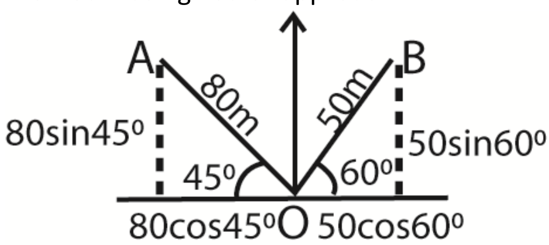
Initial distance = $\overline{AB}$

Using cosine rule

$\overline{AB}^2 = 80^2 + 50^2 - 2\ x\ 80\ x 50 \cos 75^0$

$\overline{AB} = 82.64m$

Method II using vector approach



AB = OB – OA

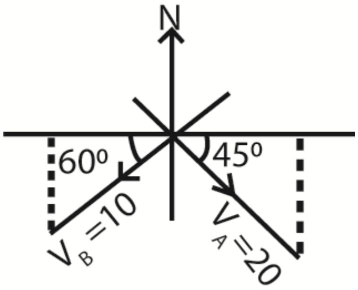
$= \begin{pmatrix} 50\cos 60^0 \\ 50\sin 60^0 \end{pmatrix} - \begin{pmatrix} -80\cos 45^0 \\ 80\sin 45^0 \end{pmatrix} = \begin{pmatrix} 81.569 \\ -13.267 \end{pmatrix}$

$\overline{AB} = \sqrt{81.569^2 + (-13.267)^2} = 82.64m$

(e) Velocity of A relative to B (05marks)

Method I: using vector approach

Vector	Direction	Magnitude
V_A	South east	$20ms^{-1}$
V_B	$S30^0W$	$10ms^{-1}$
${}_AV_B$	?	?



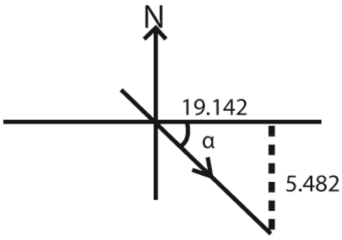
${}_AV_B = V_A - V_B$

$$= \begin{pmatrix} 20\cos 45^0 \\ -50\sin 45^0 \end{pmatrix} - \begin{pmatrix} -10\cos 60^0 \\ -10\sin 60^0 \end{pmatrix} = \begin{pmatrix} 19.142 \\ -5.482 \end{pmatrix}$$

$\therefore {}_AV_B = 19.142i - 5.482j$

Or : expressing it in terms of magnitude and direction

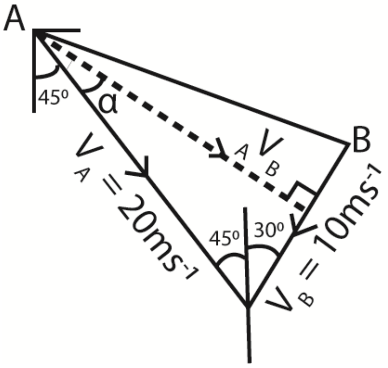
$|{}_AV_B| = \sqrt{(19.142)^2 + (-5.482)^2} = 19.912m$



$\alpha = \tan^{-1}\left(\frac{5.482}{19.142}\right) = 15.98^0$

Hence the relative velocity of A relative B is $19.912ms^{-1}$ in the direction $E15.98^0S$

Method II: Using geometric approach



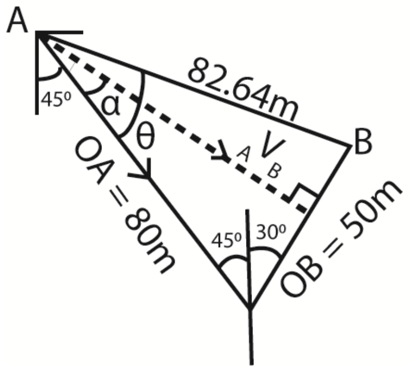
Using cosine rule

$|{}_AV_B|^2 = 20^2 + 10^2 - 2 \, x \, 20 \, x 10 \cos 75^0$

$\left|{}_{A}V_{B}\right| = 19.912ms^{-1}$

$\frac{\left|{}_{A}V_{B}\right|}{\sin 75^0} = \frac{10}{\sin\alpha}$
$\alpha = 29.02^0$
$45^0 + 29.02^0 = 74.02^0$
∴ The velocity of A relative to B is 19.912ms^{-1} due S74.02^{0}E

(f) The shortest distance between the two cars as they approach O (04marks)
Using geometrical approach



$\frac{50}{\sin\theta} = \frac{82.64}{\sin 75^0}$; θ = 35.76^0
$< BAD$ = 35.76 – 29.02 = 6.74^0
$\sin 6.74^0 = \frac{\left|{}_{A}r_{B}\right|}{AB}$
$_Ar_B$ = 82.64sin 6.74^0 = 9.699m
∴ The shortest distance between the two cars they approach O is 9.699m

26. The table below shows the marks obtained in a mathematic test by a group of student

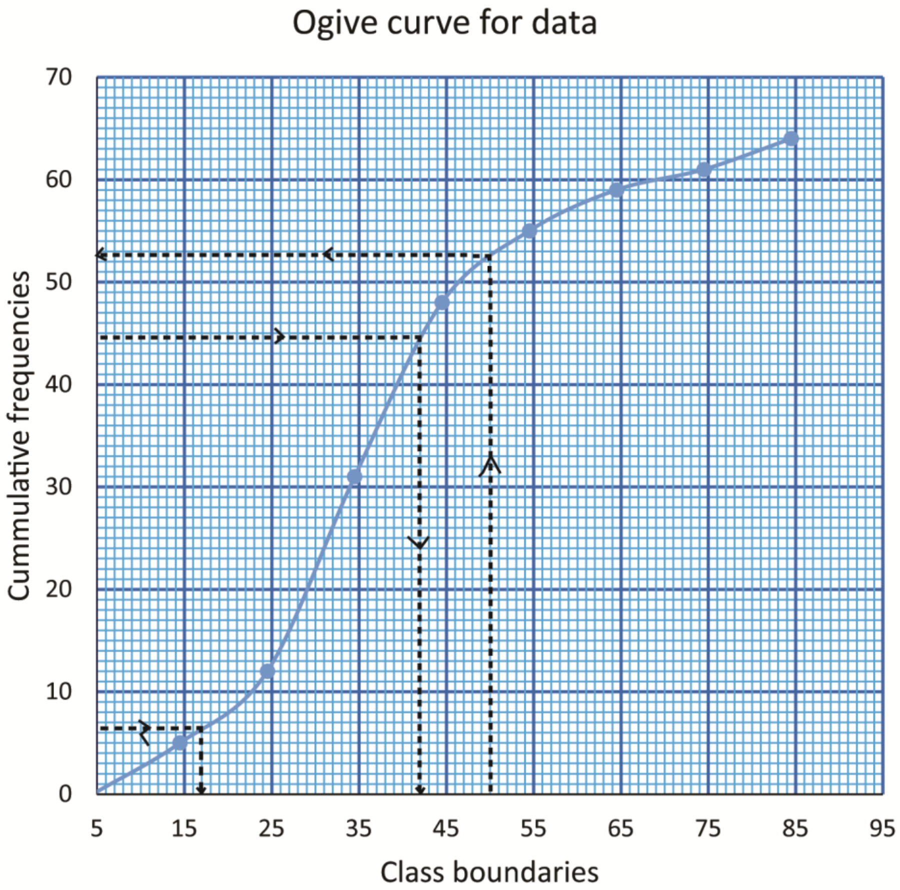
marks	5 -<15	15-<25	25-<35	35-<45	45-<55	55-<65	65-<75	75-<100
Number of students	5	7	19	17	7	4	2	3

(c) Construct a cumulative frequency (O give) for the data (05 marks)

Class boundaries	F	Cf
5 – 15	5	5
15 - 25	7	12
25 – 35	19	31
35 – 45	17	48
45 – 55	7	55
55 – 65	4	59
65 – 75	2	61
75 – 85	3	64

(d) Use your Ogive to find the
(iii) Range between the 10th and 70th percentiles
10th percentile = $\left(\frac{10}{100}\ x\ 64\right)^{th}$ value = 6.4th value
From the graph below P_{10} = 17
10th percentile = $\left(\frac{70}{100}\ x\ 64\right)^{th}$ value = 44.8th value

From the graph below $P_{70} = 43$



Percentile range = 43 – 17 =26

(iv) Probability that a student selected at random scored below 50 marks. (07 marks)

From the graph number of students who scored below 50 marks = 52

Probability = $\frac{52}{64}$ = 0.8125

27. (a) Show that the equation x -3sinx = 0 has a root between 2 and 3. (03marks)

f(x) = x – 3sinx

f(2) = 2 – 3sin 2 = -0.7279

f(3) = 3 – 3sin3 = 2.5766

since f(2).f(3) = -1.8755<0

there exist a root of x-3sinx =0 between 2 and 3

(b) Show that Newton- Raphson iterative formula for estimating the root of the equation in (a) is given by

$$X_{n+1} = \frac{3(\sin x_n - x_n \cos x_n)}{1 - 3\cos x_n}, n = 0, 1, 2 \ldots.$$

Hence find the root of the equation corrected to 2 decimal places (09 marks)

f'(x) = 1 – 3cos x

$x_{n+1} = x_n - \frac{f(x)}{f'(x)}$

$= x_n - \frac{x_n - 3\sin x_n}{1 - 3\cos x_n}$

$= \frac{x_n - 3x_n \cos x_n - x_n + 3\sin x_n}{1 - 3\cos x_n}$

$x_{n+1} = \frac{3(\sin x_n - x_n \cos x_n}{1 - 3\cos x_n}$

Taking $x_0 = \frac{2+3}{2} = 2.5$

$x_1 = \frac{3(\sin 2.5 - 2.5\cos 2.5}{1 - 3\cos 2.5} = 2.293$

Error = $|2.293 - 2.5| = 0.207 > 0.005$

$x_2 = \frac{3(\sin 2.293 - 2.5\cos 2.293}{1 - 3\cos 2.293} = 2.279$

Error = $|2.279 - 2.293| = 0.014 > 0.005$

$x_3 = \frac{3(\sin 2.279 - 2.5\cos 2.279}{1 - 3\cos 2.279} = 2.279$

Error = $|2.279 - 2.279| = 0.000 < 0.005$

∴ root = 2.279 = 2.28(2D)

28. A force F = (2t i + j – 3t k)N acts on a particle of mass 2kg. The particle is initially at a point (0,0,0) and moving with a velocity (i + 2j-k)ms^{-1}. Determine the:

(d) Magnitude of the acceleration of the particle after 2 seconds (04marks)

F = (2t i + j – 3t k) = $\begin{pmatrix} 2t \\ 1 \\ -3t \end{pmatrix}$N

a = $\frac{F}{m} = \frac{1}{2}\begin{pmatrix} 2t \\ 1 \\ -3t \end{pmatrix} = \begin{pmatrix} t \\ 0.5 \\ -1.5t \end{pmatrix} ms^{-1}$

At t = 2s

$\underline{a}$=2i + 0.5j – 3k

$|\underline{a}| = \sqrt{2^2 + 0.5^2 + (-3)^2}$ = 3.64ms^{-2}

(e) Velocity of the particle after 2seconds (04marks)

$\underline{v} = \int \underline{a} dt = \int \begin{pmatrix} t \\ 0.5 \\ -1.5t \end{pmatrix} dt = \begin{pmatrix} 0.5t^2 \\ 0.5t \\ -7.5t^2 \end{pmatrix}$ + C

At t = 0 initial velocity = (i + 2j –k)

$\begin{pmatrix} 1 \\ 2 \\ -1 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} + C$ => C = $\begin{pmatrix} 1 \\ 2 \\ -1 \end{pmatrix}$

∴ $\underline{v} = \begin{pmatrix} 0.5t^2 + 1 \\ 0.5t + 2 \\ -7.5t^2 - 1 \end{pmatrix}$

At t = 2s

$\underline{v} = \begin{pmatrix} 0.5(2)^2 + 1 \\ 0.5(2) + 2 \\ -7.5(2)^2 - 1 \end{pmatrix} = \begin{pmatrix} 3 \\ 3 \\ -4 \end{pmatrix} ms^{-1}$

(f) Displacement of the particle after 2 seconds (04marks)

$\underline{r} = \int \underline{v} dt \int \begin{pmatrix} 0.5t^2 + 1 \\ 0.5t + 2 \\ -7.5t^2 - 1 \end{pmatrix} dt = \begin{pmatrix} \frac{t^3}{6} + t \\ \frac{t^2}{4} + 2t \\ -t - \frac{t^3}{4} \end{pmatrix}$ + C

At t = 0; $\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} + C$

C = $\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$

$\underline{r} = \begin{pmatrix} t^3 + t \\ \frac{t^2}{4} + 2t \\ -t - \frac{t^3}{4} \end{pmatrix}$

At t = 2s

$\underline{r} = \begin{pmatrix} \frac{2^3}{6} + 2 \\ \frac{2^2}{4} + 2x2 \\ -2 - \frac{2^3}{4} \end{pmatrix} = \begin{pmatrix} \frac{10}{3} \\ 5 \\ -4 \end{pmatrix} m$

29. Two events A and B are such that P(B) = $\frac{1}{8}$, P(A∩B) = $\frac{1}{10}$ and P(B/A) = $\frac{1}{3}$

Determine the

(d) P(A) (03marks)

P(B/A) = $\frac{P(B \cap A)}{P(A)}$

$\frac{1}{3} = \frac{1}{10} \div P(A)$

$P(A) = 3\ x\ \frac{1}{10} = \frac{3}{10}$

(e) P(A∪ B) (03marks)

P(A∪ B) = P(A) + P(B) - P(A∩B)

$= \frac{3}{10} + \frac{1}{8} - \frac{1}{10} = \frac{13}{40}$

(f) P(A/$\bar{B}$) (06marks)

P(A/$\bar{B}$) = $\frac{P(A \cap \bar{B})}{P(\bar{B})}$

$= \frac{P(A) - P(A \cap B)}{1 - P(B)}$

$= \frac{\frac{3}{10} - \frac{1}{10}}{1 - \frac{1}{8}}$

$= \frac{8}{35}$

30. (a) Given that y = e^x and x = 0.62correct to two decimal places, find the interval within which the exact value of y lies. (05marks)

$e_x = 0.005$

$y_{max} = e^{0.625} = 1.8682$

$y_{min} = e^{0.615} = 1.8497$

The interval = (1.8497, 1.8682)

(c) Show that the maximum possible relative error in ysin^2x is $\left|\frac{\Delta y}{y}\right| + 2\cot x\ |\Delta x|$, where$\Delta x$ and Δy are errors in x and y respectively

Hence find the percentage error in calculating ysin^2x if y = 5.2 $\pm$ 0.05 and x = $\frac{\pi}{6} \pm \frac{\pi}{360}$

(07 marks)

z = y$\sin^2$x

$e_z = \Delta y sin^2x$ + 2y$\Delta x cos\ x sinx$

$\frac{e_z}{z} = \frac{\Delta y sin^2x}{y\sin^2 x} + \frac{2y\Delta x cos\ x sinx}{y\sin^2 x}$

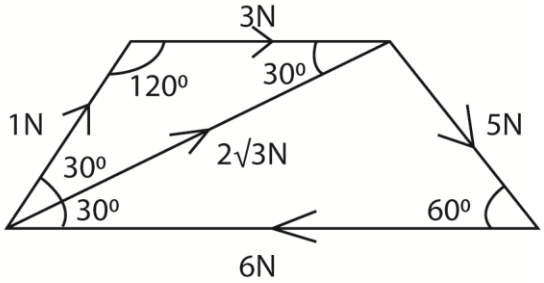
$\left|\frac{e_z}{z}\right| = \left|\frac{\Delta y}{y} + 2cotx.\Delta x\right|$

$\leq \left|\frac{\Delta y}{y}\right| + 2cotx.|\Delta x|$

∴ Maximum possible error is $\left|\frac{\Delta y}{y}\right| + 2cotx.|\Delta x|$

$percentage\ error = \left[\frac{0.05}{5.2} + 2\cot\frac{\pi}{6}.\ \left|\frac{\pi}{360}\right|\right]\ x\ 100\%$ = 3.9845%

31. The diagram below shows a trapezium rule ABCD, AD = DC = CB = 1 and AB = 2meters. Forces of magnitude 1N, 3N, 5N, 6N and $2\sqrt{3}$ N respectively.



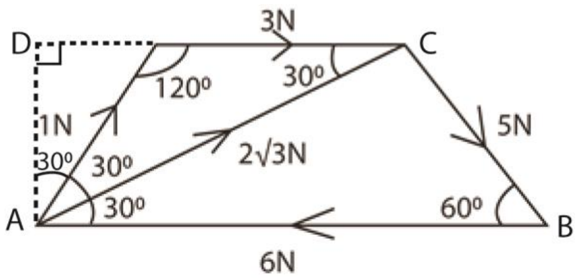
(c) Calculate the magnitude of the resultant force and the angle it makes with side AB (09marks)

$\binom{x}{y} = \binom{-6}{0} + \binom{3}{0} + \binom{2\sqrt{3}\cos 30^0}{2\sqrt{3}\sin 30^0} + \binom{\cos 60^0}{\sin 60^0} + \binom{5\cos 60^0}{-5\sin 60^0} = \binom{3}{-\sqrt{3}}$

$Resultant\ force, R = \sqrt{(3)^2 + \left(-\sqrt{3}\right)^2}$ = 3.464N

$Direction, \alpha = tan^{-1}\left(\frac{\sqrt{3}}{3}\right)$ = 30^0

(d) Given that the line of action of the resultant force meets AB at X, find AX. (03marks)



Equation of the line action of the resultant is given by G-xY + yX = 0

Taking moments about A

G= -3 x 1cos 30^0 – 5 x 2 cos 30^0

= -3 x $\frac{\sqrt{3}}{2}$ -10 x $\frac{\sqrt{3}}{2}$ = $\frac{-13\sqrt{3}}{2}$

By substitution

$\frac{-13\sqrt{3}}{2} + \sqrt{3}x + 3y = 0$

The line of action of the resultant cuts AB when y = 0

$\frac{-13\sqrt{3}}{2} + \sqrt{3}x + 3\ x\ 0 = 0$

$x = 6.5m$

Hence $\overline{AX}$= 6.5m

32. A biased die with faces labelled 1, 2, 3, 4, 5 and 6 is tossed 45 times
Calculate the probability that 2 will appear;

(c) More than 18 times (07marks)

n =45, p = $\frac{2}{6} = \frac{1}{3}$, q = $\frac{2}{3}$

μ = np = 45 x $\frac{1}{3}$ = 15

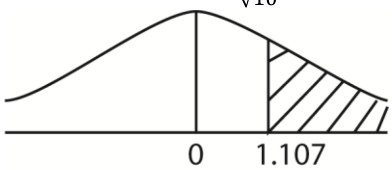
σ = $\sqrt{npq} = \sqrt{45\ x\ \frac{1}{3} x\ \frac{2}{3}} = \sqrt{10}$

Changing binomial to normal distribution.

P(X> x) = P(X> 18 + 0.5) = P(X> 18.5)

Standardizing using z= $\frac{\overline{x-\mu}}{\sigma}$

P(X> 18.5) = P(z > $\frac{18.5-15}{\sqrt{10}}$ = P(z > 1.107)



P(z > 1.107) =0.5 – P(0 < z < 1.107)
= 0.5 – 0.3658
= 0.1342

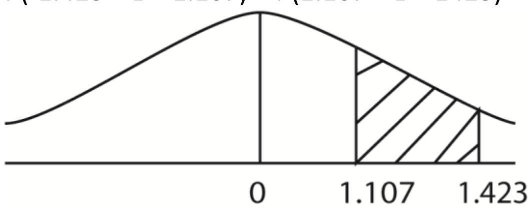
∴ P(X > 18) = 0.1342

(d) Exactly 11 times (05marks)

P(X = 11) = P(11 – 0.5 < X < 11 + 0.5)
= P(10.5 < X < 11.5)
= P$\left(\frac{10.5-15}{\sqrt{10}} < z < \frac{11.5-15}{\sqrt{10}}\right)$
= P(-1.423 < z < 1.107)

By symmetry

P(-1.423 < z < 1.107) = P(1.107 < z < 1423)



P(1.107 < z < 1423) = P(0 < z < 1.423) – P(0 < z < 1.107)
= 0.4226 – 0.3658
= 0.0568

Thank you