SECTION A [40 MARKS]

ANSWER **ALL** QUESTION

Question 1 **[40]**

For each question there are FOUR responses: A, B, C and D. Choose the corresponding letter of your response and CIRCLE it neatly. NO score will be awarded, if you circle more than ONE letter.

i. Which of the following matrices is an identity matrix?

A $\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$

(B) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

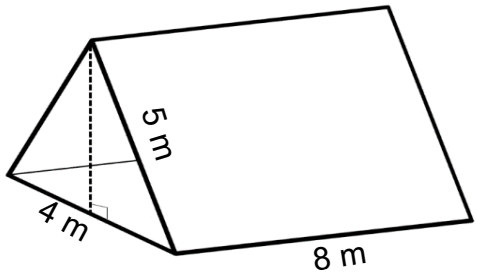
C $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

D $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

Criteria	Marks
Circles the correct option	2
Circles more than ONE alternative	0
Circles none of the alternatives	0

Answer: B $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

ii. Penjor needs to find two poles of the right height to support the tent which has the total surface area of 136 m^2. What would be the height of the pole?



A 32 m

B 16 m

(C) 6 m

D 3 m

Answer: C 6

$TSA_{tent} = 2A_b + hP$

$136 = 4h + 112$

$136 - 112 = 4h$

$24 = 4h$

$\frac{24}{4} = h$

$6\,cm = h$

iii. Which of the following pairs of quadratic functions are equivalent?

A $f(x) = x^2 - 5x - 6$ *and* $h(x) = (x-2)(x-3)$

B $f(x) = 2x^2 + 4x + 2$ *and* $h(x) = (x+1)^2 + 2$

(C) $f(x) = x^2 + 6x + 9$ *and* $h(x) = (x+3)^2$

D $f(x) = x^2 - 4x + 4$ *and* $h(x) = (x+2)^2$

Answer : C $f(x) = x^2 + 6x + 9$ *and* $h(x) = (x+3)^2$

Solution :

$f(x) = x^2 + 6x + 9$

$h(x) = (x+3)^2$

$= x^2 + 6x + 9$

$\therefore f(x) = h(x)$

iv. Pema saved Nu 2,500 for her summer break. She plans to spend Nu 500 each week. Which of the following linear models represents the total amount of money Pema will have left after a week?

A $M(w) = 2500 - 500w$

B $M(w) = 2500w - 500$

C $M(w) = 2500 + 500w$

D $M(w) = 2500w + 500$

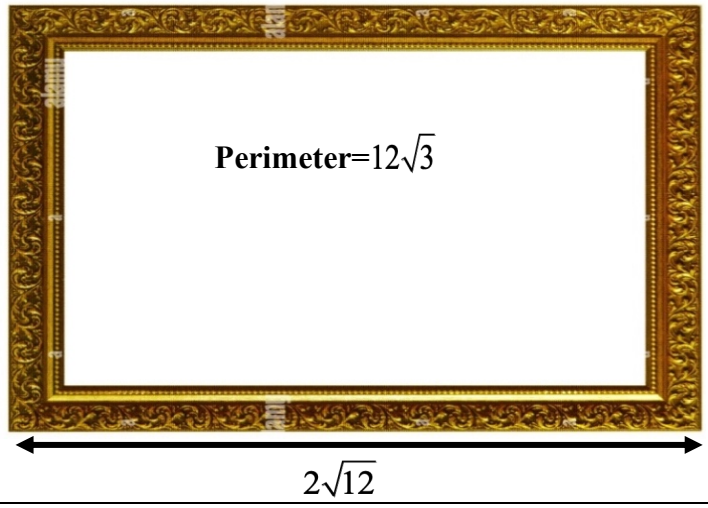
Answer : A $M(w) = 2500 - 500w$

Amount spent per week : *Nu* 500

After w weeks, the total amount of money Pema will have left can be represented by the linear function

$M(w) = 2500 - 500w$

v. The missing dimension of the rectangular frame is



A $\frac{\sqrt{3}}{4}$.

(B) $2\sqrt{3}$.

C $3\sqrt{2}$.

D $\sqrt{12}$.

Answer: B and D

$P_{rect.} = 2(l + w)$

$12\sqrt{3} = 2\left(2\sqrt{12} + w\right)$

$12\sqrt{3} = 4\sqrt{12} + 2w$

$12\sqrt{3} - 4\sqrt{12} = 2w$

$12\sqrt{3} - 4\sqrt{4 \times 3} = 2w$

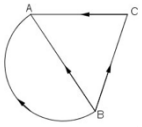
$12\sqrt{3} - 8\sqrt{3} = 2w$

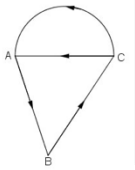
$4\sqrt{3} = 2w$

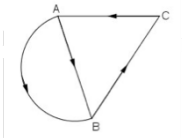
$2\sqrt{3} = w$

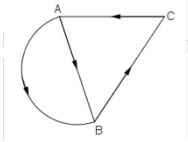
vi. For the following adjacency matrix, the network is represent by

$$\begin{array}{c} \\ A \\ B \\ C \end{array}\begin{array}{c} \begin{array}{ccc} A & B & C \end{array} \\ \begin{bmatrix} 0 & 2 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix} \end{array}$$

A 

B 

C 

(D) 

Answer: D

vii. An investor buys 200 shares with a face value of Nu 50 each. At the end of year the investor received Nu 3,500 from the share. What is the rate applied?

A 25%

B 30%

(C) 35%

D 45%

Answer: C 35%

$$Dividend\ \ Amount = r\% \times no.of\ \ share \times F.V(NV)$$

$$3500 = r\% \times 200 \times 50$$

$$r\% = \frac{3500}{200 \times 50}$$

$$r\% = 35\%$$

viii. Ram is trying to determine the orientation of a ramp on a hillside. He knows that the sine of the angle θ between the ramp and the ground is $-\frac{1}{\sqrt{2}}$ and the tangent of the angle θ is 1. In which quadrant does the angle θ lie?

A First quadrant

(B) Third quadrant

C Second quadrant

D Fourth quadrant

Answer: B Third quadrant

ix. A gardener observes the growth of her plant as shown in the table:

Week	Height (cm)
1	10
2	12
3	14
4	16

Is the height of the plant a function of the week?

A Yes, because the height increases over time.

(B) Yes, because each week has a unique height.

C No, because the height depends on external factors.

D No, because the height can be the same in different weeks.

Answer: B Yes, because each week has a unique height.

x. The location of the circumcenter in a right angle triangle is

A inside the right angle triangle.

B outside the right angle triangle.

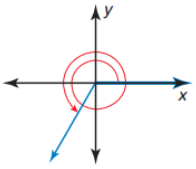
(C) at the mid-point of the hypotenuse.

D at the vertex of the right angle triangle.

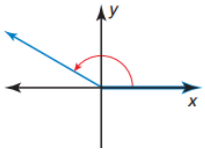
Answer: C at the mid-point of the hypotenuse.

xi. You are given an angle $\frac{5\pi}{6}$. Select the graph that correctly represents this angle in standard position.

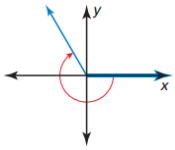
A



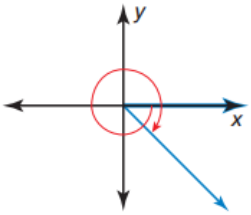
B



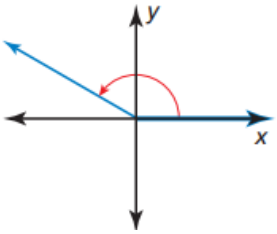
C



D



Answer B



xii. The equation $y = x^2$ undergoes a transformation where it is shifted 3 units to the right and 2 units up. What is the new equation after this transformation?

A $y = (x-3)^2 + 2$

B $y = (x+3)^2 - 2$

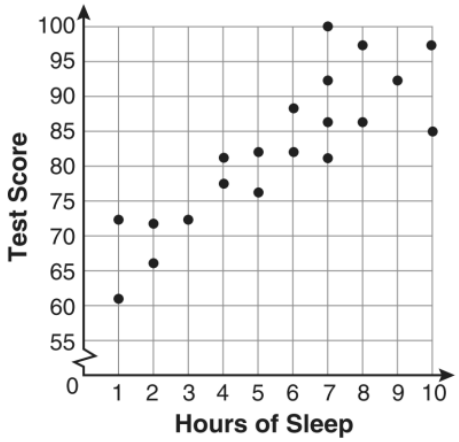
C $y = (x+3)^2 + 2$

D $y = (x-3)^2 - 2$

Answer : A $y = (x-3)^2 + 2$

Horizontal shift: Shifting the parabola 3 units to the right involves replacing x with $(x-3)$.
Vertical shift : Shifting the parabola 2 units up involves adding 2 to the equation.

xiii. The correlation coefficient between independent and dependent variable in the scatter plot shown below is



A Close to -1.

(B) Close to 1.

C 1.

D -1.

Answer : B Close 1.

xiv. The radius of a cylinder is doubled and the height unchanged. The ratio between the volumes of the new cylinder to original cylinder is

A $1:2$.

B $1:3$.

(C) $1:4$.

D $1:8$.

Answer C $1:4$

$radius\ of\ original\ cylinder = r$

$radius\ of\ new\ cylinder = 2r$

$vol_{new\ cylinder} = \pi(2r)^2 h$

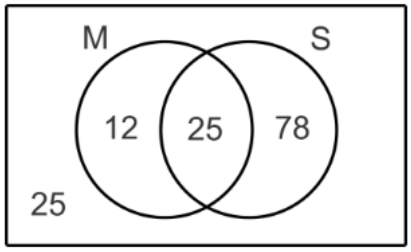
$= 4\pi r^2 h$

$\therefore \dfrac{ratio\ of\ new\ cylinder}{ratio\ of\ original\ cylinder} = \dfrac{4\cancel{\pi r^2 h}}{\cancel{\pi r^2 h}}$

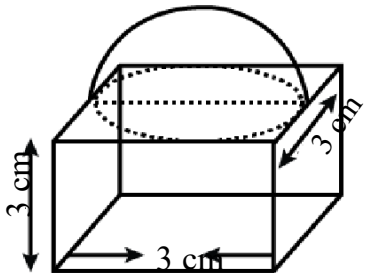
$\dfrac{ratio\ of\ new\ cylinder}{ratio\ of\ original\ cylinder} = \dfrac{4}{1}$

$\therefore ratio\ of\ between\ new\ cylinder\ and\ original\ cylinder \quad 1:4$

xv. For the equation $x^2 - 7x + 10 = 0$, the $x-$intercepts are

(A) $x=2$ *and* $x=5$. B $x=-2$ *and* $x=5$. A $x=2$ *and* $x=-5$. D $x=-2$ *and* $x=-5$.	
Answer: A $x=2$ *and* $x=5$ $x^2-7x+10=x^2-5x-2x+10$ $=x(x-5)-2(x-5)$ $=(x-5)(x-2)$ $\therefore x=5$ *and* $x=2$	
xvi. If M is the set of students who study music and S is the set of students who play sports as represented in the Venn Diagram. Determine the probability that if a student is selected at random, he or she will study music given that he or she plays a sport.  	
A. $\frac{78}{140}$ B. $\frac{78}{103}$ (C.) $\frac{25}{103}$ D. $\frac{37}{140}$	
Answer : C $\frac{25}{103}$ $P(M/S)=\frac{P(M\cap S)}{P(S)}$ $=\frac{\frac{25}{140}}{\frac{103}{140}}=\frac{25}{103}$	

xvii. Determine the volume of the given shape.



A $56.52\ cm^3$

B $48.45\ cm^3$

C $42.39\,cm^3$

(D) $34.08\ cm^3$

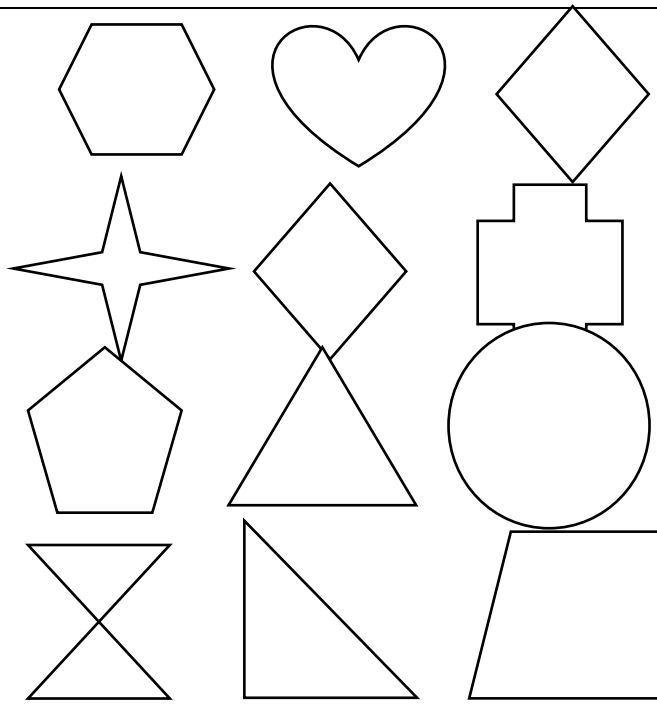
Answer D $34.08\ cm^3$

$$Vol_{cube} = S^3$$
$$= 27\,cm^3$$
$$Vol_{\ hemisphere} = \frac{2}{3}\pi r^3$$
$$= \frac{2}{3}\pi(1.5)^3$$
$$= 7.08\ cm^3$$
$$Vol_{shape} = 27\,cm^3 + 7.08\ cm^3$$
$$= 34.08\,cm^3$$

xviii. Which of the following groups of the figures have both horizontal and vertical mirror symmetry?

A

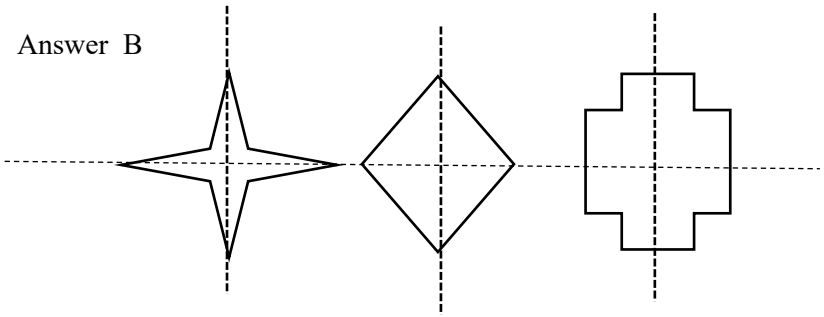
(B)



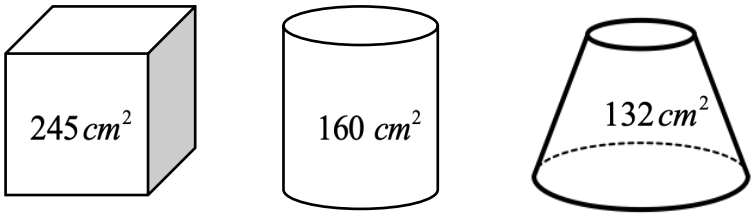
C

D

Answer B



xix. The following shapes have the same volume of $350\,cm^3$.



The correct order arranged from the least efficient to the most efficient is

A Cube ,Cylinder, Truncated cone
B Cube, Truncated cone , Cylinder
C Truncated cone, Cube, Cylinder
(D) Truncated cone , Cylinder, Cube

3-D shape	Volume $\left(cm^3\right)$	Surface Area $\left(cm^2\right)$	Ratio
Cube	350	245	0.70
Cylinder	350	160	0.45
Truncated cone	350	132	0.38

Answer : A and D .

xx. If a histogram shows a right-skewed distribution, how would this be represented in the corresponding box plot?

A The median will be centered, the whiskers will be of equal length.
B The median will be closer to the upper quartile, the left whisker will be longer.
(C) The median will be closer to the lower quartile, the right whisker will be longer.
D The median will be closer to the lower quartile, the left whisker will be longer.

Answer:

C The median will be closer to the lower quartile, the right whisker will be longer

SECTION B (60 MARKS)

ANSWER **ANY SIX** QUESTIONS

Question 2

a) Fill in the blanks using the standard trigonometric ratios for the given angles. [2]

Angle	0^o	30^o	45^o	60^o	90^o
sin	0	$\frac{1}{2}$			
cos				$\frac{1}{2}$	
tan		.....*p*....	1		
cosec				.....*q*....	
sec		.....*r*....			
Cot					.....*s*....

Solution:

$p = \frac{1}{\sqrt{3}}$.....[0.5]

$q = \frac{2}{\sqrt{3}}$.....[0.5]

$r = \frac{2}{\sqrt{3}}$.....[0.5]

$s = 0$.....[0.5]

Calculator value are accepted.

b) A man borrowed Nu 20,000 and repaid the loan at the end of 4 years with a single payment of Nu 35,608. What interest rate was charged if compounded semi-annually? [3]

Solution :

Given :

$A = Nu\,35,608$

$p = Nu\,20,000$

$r = ?$

$n = 2$

$t = 4$

$A = P\left(1+\frac{r}{n}\right)^{nt}$

$35608 = 20000\left(1+\frac{r}{2}\right)^{2\times4}$ .....[0.5]

$\frac{35608}{20000} = \left(1+\frac{r}{2}\right)^{8}$

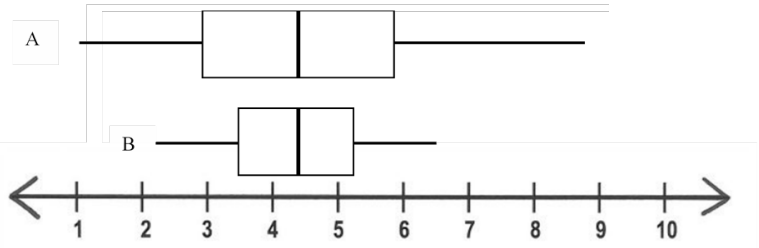
$1.7804 = \left(1+\frac{r}{2}\right)^{8}$ .....[0.5]

$(1.7804)^{\frac{1}{8}} = 1+\frac{r}{2}$.....[1]

$r = 0.149$

$r\% = 14.9\ \%$.....[1]

c) The given box and whisker plots represents the income from source A and source B. Which of source appears to be more reliable? Explain. [2]



Solution :

The income from source B is more reliable and consistent. The data in source B is clearly clustered around median. There is no extreme values and smaller range.

- Its income values are spread over a smaller range. This means the income are more consistent.
- The median of source B is more centrally placed indicating less variation around the typical income.

  Therefore source B appears to be more reliable than source A .

d) The sum of two consecutive numbers is 36 more than the difference between the numbers. What are the numbers? [3]

Solution :

let the numbers be x *and* $x+1$.....[0.5]

**framing of equation can be done different ways

$sum = x + (x+1)$

$= 2x + 1$

$difference = x - (x-1)$

$= x - x - 1$

$= 1$

$\therefore$ *the equation become*,

$2x + 1 = 36 + 1$ *or* $2x + 1 = 36 + x - x + 1$.....[1]

$2x = 36$.....[0.5]

$x = 18$.....[0.5]

the other number $= 18 + 1$

$= 19$.....[0.5]

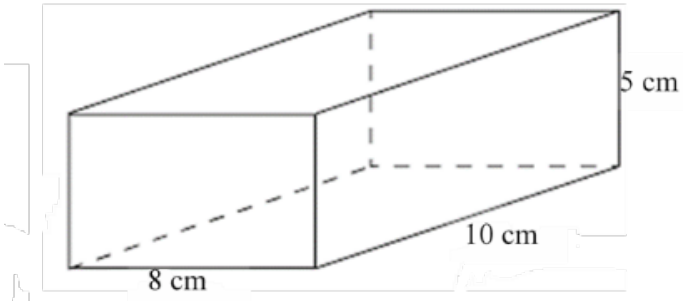
Question 3

a) Describe how the occurrence of a dependent event affects the probability of another event occurring. [1]

Solution :

For dependent events, the total number of favorable outcomes changes for the second event because the outcome of the first event affects the sample space and the number of favorable outcomes for the second event.

b) [3]



Determine its surface area of the given shape. If a sphere has the same surface area as the rectangular prism, what is the diameter of the sphere?

$SA_{rectangular\ prism} = 2(lw + wh + hl)$

$= 2(10\times 8 + 8\times 5 + 5\times 10)$

$= 2(170)$

$= 340\,cm^2$.....[1]

$SA_{Sphere} = 4\pi r^2$

$340 = 4\pi r^2$

$\frac{340}{4\pi} = r^2$

$5.02\ cm = r$.....[1]

$diameter = 2r$

$diameter = 2\times 5.02$

$= 10.4\,cm$.....[1]

c) Let x and y be two numbers. Use the statement given in the box, find the solutions. [3]

y is $\frac{1}{3}$ more than 4 times the value of x

The difference of $3y$ and $2x$ is 1

Solution:

$y = 4x + \frac{1}{3}$, $3y - 2x = 1$.....[0.5 + 0.5]

$u\sin g$ *subsitution method*

$3\left(4x + \frac{1}{3}\right) - 2x = 1$.....[0.5]

$12x + 1 - 2x = 1$

$10x = 0$

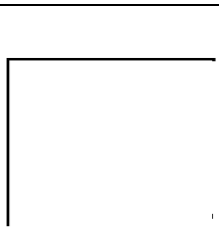
$x = 0$ .....[1]

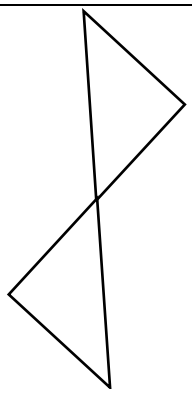
$y = 4\times 0 + \frac{1}{3}$

$y = \frac{1}{3}$ .....[0.5]

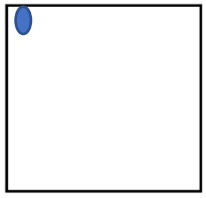
d) [2]

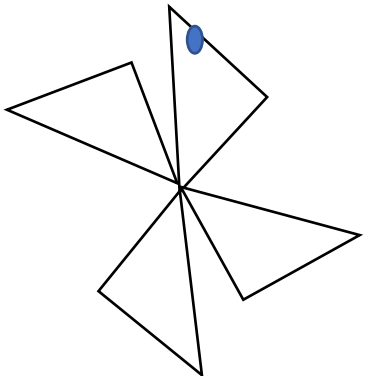
i. Complete each shape so that it has rotational symmetry of order 4.



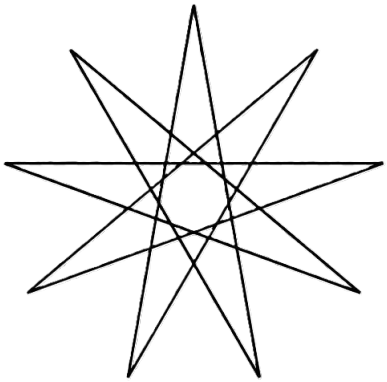


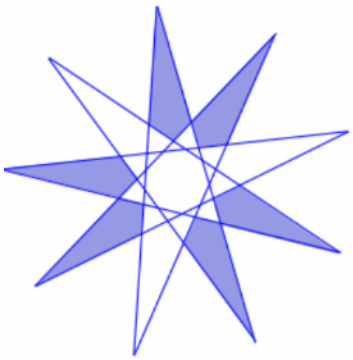
Solution:



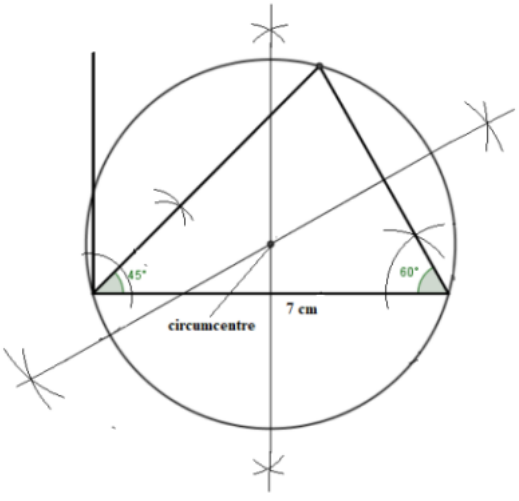


ii. The star has nine points, shade six points to make a pattern with order of turn symmetry 3. [1]





Question 4

a) The 12 letters of the word "MEASUREMENTS" are written on 12 cards and placed in a bag. Two cards are drawn from the bag, one after the other.	
i. You draw a card with the letter E and then replace it. What is the probability that you will draw a card with the letter E on the second draw?	[0.5]
solution $P(E) = \frac{3}{12} = \frac{1}{4}$.....[0.5]	
ii. You draw a card with the letter E and do not replace it. What is the probability that you will draw a card with the letter E on the second draw?	
solution $P(E) = \frac{2}{11}$.....[0.5]	
iii. Which is dependent, the two events in question i or the two events in question ii.	[1]
Solution : the two events in question ii. is dependent.....[1]	
b) Construct Δ ABC, where AB = 7 cm, $\angle A = 45^o$ *and* $\angle B = 60^o$. Then, construct a circle that passes through all three vertices of ΔABC.	[3]
Solution:  - Construction of 45^o ----- (0.5) - Construction of 60^o ----- (0.5) - Drawing the triangle----- (0.5) - Angle perpendicular bisector ------(0.5)	

	- Drawing the circumcircle ----- (1)	
b)	The school football team committee submitted equipment list to participate in the Bhutan Higher Secondary School football competition 2024. **Equipment Required** 20 uniforms 40 balls 25 stockings The price of each uniform at **Shop A** is Nu 950, each ball costs Nu 400, and each stocking costs Nu 250. At **Shop B**, the price of each uniform is Nu 800, each ball costs Nu 500, and each stocking costs Nu 350. Use matrix multiplication to calculate the total cost of these items from both shops. Determine from which shop you should buy the equipment if you want to minimize the total cost.	[2]
	Solution : $\begin{bmatrix}20 & 40 & 25\end{bmatrix}\begin{bmatrix}950 & 800\\ 400 & 500\\ 250 & 350\end{bmatrix}$.....[0.5] $=\begin{bmatrix}20\times950+40\times400+25\times250\\ 20\times800+40\times500+25\times350\end{bmatrix}$ $=\begin{bmatrix}41250\\ 44750\end{bmatrix}$.....[1] $\because$ *Since sthe total* cost *of equiment offered by shop A less we can buy from shop*.....[0.5]	
c)		[2]
i.	A utility van travels $7\sqrt{3}$ km east from Gelephu, then $4\sqrt{6}$ km north to reach Jigmecholing. Calculate the distance to help the driver find a more fuel efficient route between the Gelephu and Jigmecholing.	

Solution :

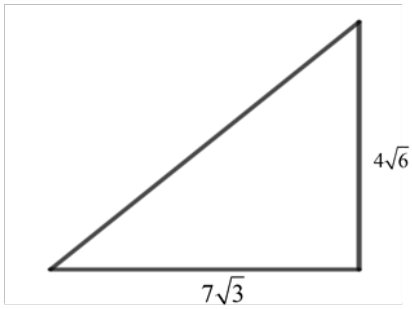


Diagram …….[0.5]

$$\left.\begin{array}{l} \textit{Applying pythagorean theorem} \\ d=\sqrt{\left(7\sqrt{3}\right)^2+\left(4\sqrt{6}\right)^2} \\ d=\sqrt{49\times 3+16\times 6} \\ d=\sqrt{147+96} \end{array}\right\} \text{.....[1]}$$

$$\left.\begin{array}{l} d=\sqrt{243} \\ d=\sqrt{81\times 3} \\ d=9\sqrt{3}\ \textit{miles} \end{array}\right\} \text{.....[0.5]}$$

i. For what values of *m* will the simplified form of the expression $\sqrt{2^m}$ contain a radical? Explain. [1]

Solution :

For the expression to contain a radical, the exponent $\frac{m}{2}$ must be a fraction, which means m must be odd

Question 5

a) In a class of 20 students, test scores from a recent mathematics exam are normally distributed, with most students scoring around the same range. However, one student scored a 98, which is significantly higher than the rest of the class. If the teacher wants to summarize the class performance for a parent-teacher meeting, how does this outlier affect the central tendency? [2]

Solution :

The mean is sensitive to outlier values. An outlier of 98, which is higher than rest of the score will increase the mean.

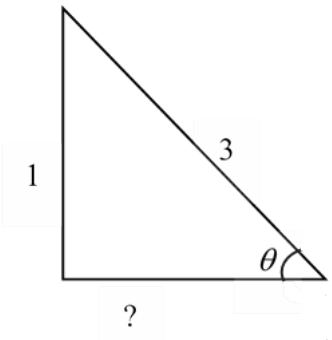
Median is less sensitive to the outlier. The outlier score of 98 might not change the median significantly

b) [3]

i. If $\sin\theta=\frac{1}{3}$, then find the value of $2\cot^2\theta+2$.

Sample Solution:
Given

$\sin\theta = \frac{1}{3}$,



$H^2 = A^2 + O^2$

$3^2 = x^2 + 1^2$

$9 = x^2 + 1$

$x^2 = 8$

$x = \sqrt{8}$.....[0.5]

Correct diagram

……..[0.5]

$\left.\begin{array}{l}\tan\theta = \frac{1}{\sqrt{8}} \\ \therefore \cot\theta = \sqrt{8}\end{array}\right\}$.....[1]

$\therefore \quad \left.\begin{array}{l} 2\cot^2\theta + 2 = 2\cot^2\theta + 2 \\ \quad = 2\left(\sqrt{8}\right)^2 + 2 \\ \quad = 2\times 8 + 2 \\ \quad = 16 + 2 \\ \quad = 18 \end{array}\right\}$.....[1]

ii. Why is $\cos\theta = \frac{5}{4}$ not a feasible value? [1]

Solution :
The value of $\cos\theta$ will always lie be between -1 *and* 1

c) An object is dropped from a 64 feet tall building. The height of the object above the ground after t seconds is given by $h(t) = 64 - 16t^2$. [2]

If $t = 1$ second, can the object reach the ground? If not, what is the time required for the object to reach the ground?

Solution

$$\left.\begin{array}{l} when\ t = 1\,\text{sec}\,ond \\ h(1) = 64 - 16\times 1 \\ h(1) = 48 \\ the\ object\ will\ not\ reach\ the\ ground.... \end{array}\right\} .....[0.5]$$

To find t,

$h(t) = 0$.....[0.5]

$$\left.\begin{array}{l} 64 - 16t^2 = 0 \\ 64 = 16t^2 \\ \dfrac{64}{16} = t^2 \\ 4 = t^2 \\ \pm 2 = t \end{array}\right\} .....[0.5]$$

$\therefore t = 2$ sec *conds*.....[0.5]

d) Graph the function $f(x) = -(x+1)(x-3)$.

Solution

$x - \text{int}\,ercept$

$f(x) = 0$

$0 = -(x+1)(x-3)$

$-x - 1 = 0 \quad or \quad x - 3 = 0$

$x = -1 \quad or \quad x = 3$

$x - \text{int}\,ercept(-1,0)\,and\,(3,0)$.....[0.5]

Vertex

$x - coordinate : \dfrac{-1+3}{2} = 1$

$y - coordinate : f(1) = -(1+1)(1-3)$

$= 4$

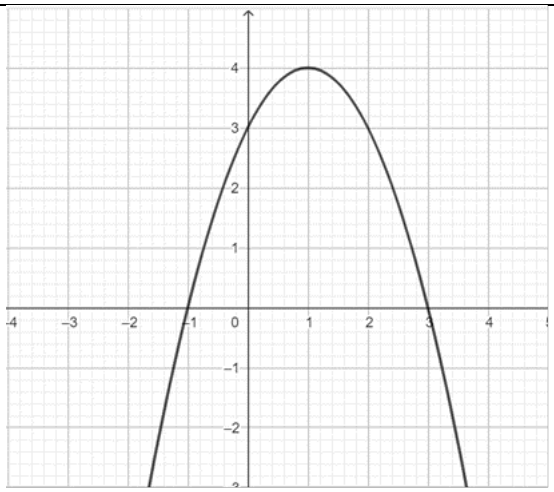
vertex coordiante$(1,4)$.....[0.5]

$y - \text{int}\,ercept : \ x = 0$

$f(x) = -(0+1)(0-3)$

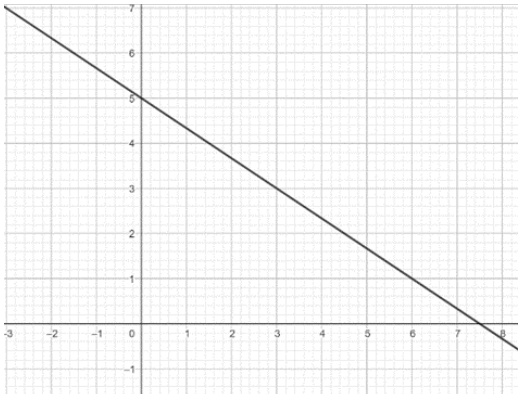
$= 3$.....[0.5]

Correct graph.....[0.5]



Question 6

a) Determine slope and y- intercept from the graph. [2]

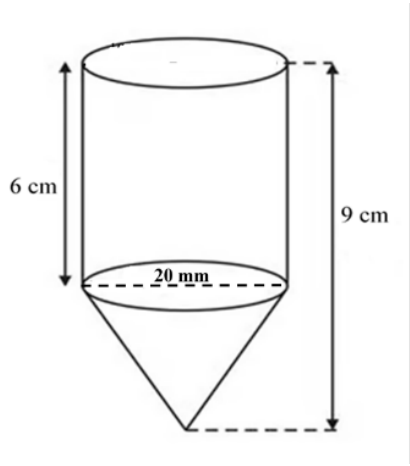


Solution

y-intercet= 5 ……[1]

slope= $-\frac{2}{3}$ ……[1]

b) Pema wants to estimate the amount of wax needed to make crayon. About how many cubic centimeters of wax are needed to make this crayon. [3]



Solution:

$$V_{cone} = \frac{1}{3}\pi r^2 h$$

$$\left.\begin{aligned} h &= 3\,cm \\ d &= 20mm = 2cm \\ r &= 1\,cm \end{aligned}\right\} \text{.....[0.5]}$$

$$\therefore V_{cone} = \frac{1}{3}\times\pi\times 1^2\times 3$$

$$= 3.14\,cm^3 \;\; or \;\; \pi\,cm^3 \text{.....[1]}$$

$$V_{cylinder} = \pi r^2 h$$

$$= \pi\times 1^2\times 6$$

$$= 18.84\,cm^3 \;\; or \;\; 6\pi\,cm^3 \text{.....[1]}$$

$$Total\ vol. = V_{cone} + V_{cylinder}$$

$$= 3.14\,cm^3 + 18.84\,cm^3$$

$$= 21.98\ cm$$

$$\therefore \;\; Total\ vol \approx 22\,cm^3 \text{.....[0.5]}$$

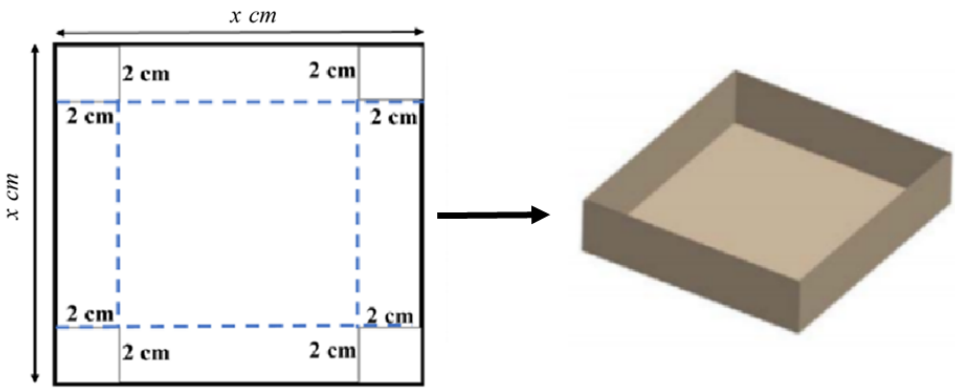
OR

$$Total\ vol. = V_{cone} + V_{cylinder}$$

$$= \pi\,cm^3 + 6\pi\,cm^3$$

$$= 7\pi\,cm^3$$

$$\therefore \;\; Total\ vol \approx 22\,cm^3 \text{.....[0.5]}$$

c)	Sherab is purchasing a new laptop for Nu 60,000 and he has been offered two options: **Option A:** Pay Nu 2,750 at the end of each month, for a period of one year. **Option B:** The amount will be paid semi-annually for the period of one year with the interest rate of 12%. Which option is better for Sherab and why?	[2]
	Option A No of months=12 Total paid amount = 2750*12 =Nu 33,000……..[0.5] Option 2 : A= $60{,}000\left(1+\frac{0.12}{2}\right)^{2\times1}$ A= $60{,}000(1.06)^2$ A= 67,416…….[0.5] Option A is clearly better for sherab because it cost signficantly less……[0.5+0.5]	
d)	An open box can be made by cutting equal squares out of the corners and folding up the edges of a square sheet of cardboard as shown in the diagram below. What is the length of each side of the cardboard sheet if the volume of the box is to be 50 cubic centimetre?  	[3]

Solution:

$Vol.\ of\ \ box = length \times width \times height$

$50 = (x-4)(x-4)\times 2$ .....[1]

$50 = (x^2 - 4x - 4x + 16)\times 2$

$50 = (x^2 - 8x + 16)\times 2$

$50 = 2x^2 - 16x + 32$ .....[1]

$2x^2 - 16x - 18 = 0$

$x^2 - 8x - 9 = 0$

$x = \dfrac{8 \pm \sqrt{64+36}}{2}$

$x = \dfrac{8 \pm \sqrt{100}}{2}$

$x = \dfrac{8+10}{2} \quad or\ x = \dfrac{8-10}{2}$ .....[1]

$x = 9\,cm \quad or\ \ x = \dfrac{-6}{2}$

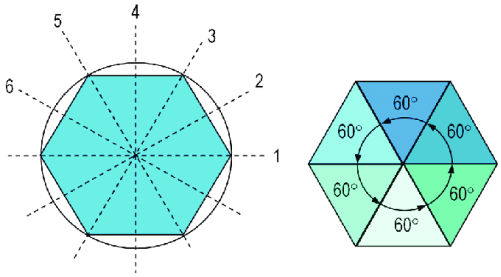
- Quadratic equations
- Forming equations from real-life situations

Question 7

a) Explain different types of symmetry of a regular hexagon? [2]

Solution:

A regular hexagon has both rotational symmetry (it can be rotated by multiples of 60 degrees and still look the same) and reflection symmetry (it can be mirrored across its axes passing through opposite vertices or midpoints of opposite sides and remain unchanged). Therefore, it demonstrates both rotational and reflection symmetry.



OR

A **regular hexagon** has **two types of symmetry**:

1. Line symmetry

A regular hexagon has **6 lines of symmetry**.

- **3 lines** pass through **opposite vertices**.
- **3 lines** pass through the **midpoints of opposite sides**.

Each line divides the hexagon into **two equal mirror images**.

2. Rotational symmetry

A regular hexagon has **rotational symmetry of order 6**.

- It looks the same after a rotation of **60°** (and its multiples).

Therefore, a regular hexagon has 6 lines of symmetry and rotational symmetry of order 6.

b) A squared based solid structure with a single point at the top has a fixed volume of 1000 cubic meter. The side length of the base is twice its height. Calculate the dimensions. [3]

Solution:

Let

side length of base be s
height of pyramid as h
slant height as l
$s = 2h$

.....[0.5] *For identifying pyramid*.

$v = \frac{1}{3} \times Area_{base} \times h$

$1000 = \frac{1}{3} \times s^2 \times h$

$1000 = \frac{1}{3} \times (2h)^2 \times h$

$3000 = 4h^3$

$h^3 = 750$

$h = 9.08$

.....[1]

$s = 2h$

$S = 2 \times 9.08$

$= 18.16m$

.....[0.5]

$$\left.\begin{array}{l} slant\ height\ l \\ l=\sqrt{\left(\frac{s}{2}\right)^2+h^2} \\ =\sqrt{\left(\frac{18.16}{2}\right)^2+(9.08)^2} \\ =\sqrt{(9.08)^2+(9.08)^2} \end{array}\right\} \text{.....[0.5]}$$

$$\left.\begin{array}{l} =\sqrt{(9.08)^2+(9.08)^2} \\ =\sqrt{164.90} \\ =12.84m \end{array}\right\} \text{.....[0.5]}$$

OR

Solution :

$$\left.\begin{array}{l} s=2h \end{array}\right\} \text{.....[1] } \textit{For identifying pyramid.}$$

$$\left.\begin{array}{l} v=\frac{1}{3}\times Area_{base}\times h \\ 1000=\frac{1}{3}\times s^2\times h \\ 1000=\frac{1}{3}\times(2h)^2\times h \\ 3000=4h^3 \\ h^3=750 \\ h=9.1m \end{array}\right\} \text{.....[1.5]}$$

$$\left.\begin{array}{l} s=2h \\ =2\times 9.08 \\ =18.16m \end{array}\right\} \text{.....[0.5]}$$

A **pyramid** is defined as:

- A solid with a **polygonal base** (here, a square), and
- All base vertices connected to **one single point** not in the base plane, called the **apex**.

So your description matches perfectly:

- **Square base** → square pyramid
- **Single point at the top** → the apex

- **Solid (3D)** → a geometric pyramid

"A squared based solid structure" (which suggests the base is a square).
"With a single point at the top" (which strongly suggests a shape that tapers to one point above the base).

These clues point to a pyramid (specifically, a square pyramid).

c) Five years ago, Pema's age was seven times that of her son. Five years from now, her age will be three times that of her son. What are their present ages? [3]

Solution :

Let the present age of Pema and her son be x *and* y *respectively*
Then,
Their ages five years ago are $x-5$ *and* $y-5$
Their ages five years from now are $x+5$ *and* $y+5$ .....[0.5]
then,

$$\left.\begin{aligned} x-5&=7(y-5)\\ x-5&=7y-35\\ x-7y&=-30 \quad \ldots\ldots eqn(1)\end{aligned}\right\} \ldots\ldots[0.5]$$

$$\left.\begin{aligned} x+5&=3(y+5)\\ (x+5)&=3(y+5)\\ x+5&=3y+15\\ x-3y&=10 \quad \ldots\ldots eqn(2)\end{aligned}\right\} \ldots\ldots[0.5]$$

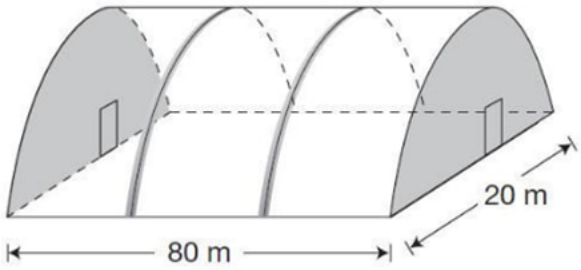
solving simulaneously (*any method*) .....[0.5]

$x=40$.....[0.5]

$y=10$.....[0.5]

Therefore, Pema's present age is 40years and her son's age is 10years.

d) If the cost of the plastic material needed to cover the roof of green house is Nu. 15 per square meter, what is the total amount required to cover the entire roof? [2]



Solution :

Solution

Surface area of roof $= \pi rh$

$= 3.14 \times 10 \times 80$ .....[1]

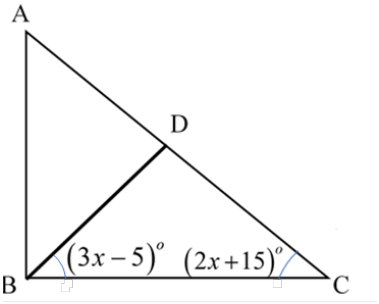
$= 2512m^2$

Amount required $= 2512 \times 15$

$= Nu.37,680$ .....[1]

Question 8

a) The length BD is an altitude of triangle ABC. Find the measure of $\angle DBC$ *and* $\angle DCB$.. [2]



Solution:

Since the altitude is perpendicular line segment drawn from the vertex of a triangle to its opposite side

$\angle BDC = 90^0$.....[0.5]

$(3x-5)+(2x+15)+90=180$

$3x-5+2x+15+90=180$

$5x+100=180$

$5x=80$

$x=\frac{80}{5}$

$x=16$ .....[0.5]

$\therefore 3x-5=48-5$

$=43^0$ .....[0.5]

$\therefore 2x+15=32+15$

$=47^0$ .....[0.5]

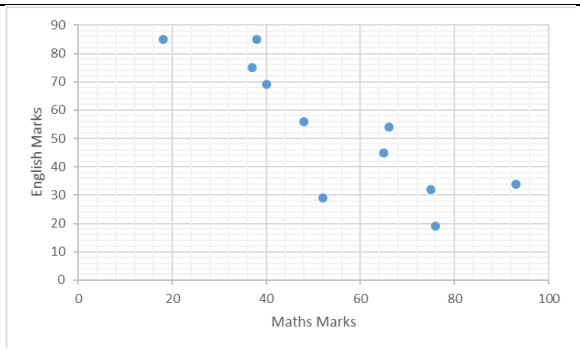
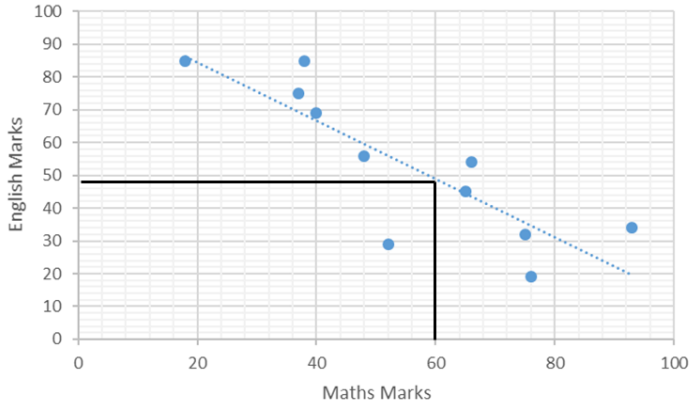
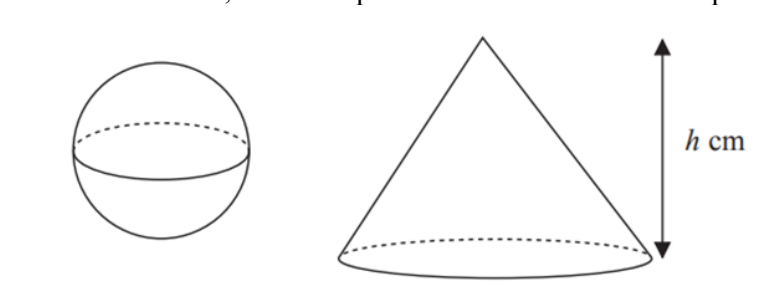
the **altitude of a triangle** is a **perpendicular line drawn from a vertex to the opposite side (or its extension)**.

Key points to remember

- An altitude is always at **90°** to the base

b) The table presents scores of 11 students in the Mathematics and English Examination.

Mathematics	37	65	18	76	38	40	66	93	52	75	48
English	75	45	85	19	85	69	54	34	29	32	56

i.	Create a scatter plot of the data.	[1]
		
i.	Using the scatter plot, predict the English mark of a student who scored 60 in Mathematics. Draw the line of best fit on the scatter plot and use it to make your prediction.	[2]
		
ii.	What type of correlation is shown?	[1]
	There is **negative correlation** between Mathematics and English marks	
c)	Study the cone and the sphere given below. The cone has height h cm. The radius of the base of the cone is 3 times the radius of the sphere. Given that the volume of the sphere is equal to the volume of the cone, find an expression for the radius of the sphere in terms of h. 	[2]

Solution:

$Vol_{Sphere} = \frac{4}{3}\pi r^3$

$Vol_{cone} = \frac{1}{3}\pi R^2 h$

given:

$\left.\begin{array}{l} \frac{4}{3}\pi r^3 = \frac{1}{3}\pi R^2 h \\ Given \;\; R = 3r \end{array}\right\}$.....[1]

$\frac{4}{3}\pi r^3 = \frac{1}{3}\pi (3r)^2 h$

$\left.\begin{array}{l} \frac{4}{3}\pi r^3 = \frac{1}{3}\pi 9r^2 h \\ 4r^3 = 9r^2 h \end{array}\right\}$.....[0.5]

$r = \frac{9h}{4}$.....[0.5]

d) Prove the following: [2]

i. $\sec x - \tan x \sin x = \frac{1}{\sec x}$

Solution

$\sec x - \tan x \sin x =$

$\left.\begin{array}{l} = \frac{1}{\cos x} - \frac{\sin x}{\cos x}\sin x \\ = \frac{1-\sin^2 x}{\cos x} \end{array}\right\}$.....[0.5]

$\left.\begin{array}{l} = \frac{\cos^2 x}{\cos x} \\ = \cos x \\ = \frac{1}{\sec x} = RHS \end{array}\right\}$.....[0.5]

ii. $\tan x \cot x - sin^2 x = cos^2 x$

Solution

$\tan x \cot x - \sin^2 x = \tan x \frac{1}{\tan x} - \sin^2 x$.....[0.5]

$\left.\begin{array}{l} = 1 - \sin^2 x \\ = \cos^2 x \end{array}\right\}$.....[0.5]

Question 9

a) Write the equation using the pair of roots $(x-4)$ and $(x+3)$. Identify the coefficients from the equation. [2]

Solution:

$(x-4)(x+3)=0$.....[0.5]

$x^2+3x-4x-12=0$

$x^2-x-12=0$.....[0.5]

$s\tan dard \quad form:$

$ax^2+bx+c=0$

$a=1, \ and \ \ b=-1$ .....[1]

b) The following data shows the scores of students in a test:

10, 20, 5, 15, 25, 8, 30.

Find the third quartile and what does the value indicate about the students' scores.

Solution:

$5,8,10,15,20,25,30$

$$Q_3=\left(\frac{3(n+1)}{4}\right)^{th} term$$

$$=\left(\frac{3(7+1)}{4}\right)^{th} term$$

$$=6 \ th \ term$$

$Q_3=25$.....[1]

Interpretation of Q3

-This means that 75% of the students scored 25 or below in the test.
- It also indicates that the top 25% of the students scored above 25.
- Q3 provides a measure of the upper spread of the data, showing how well the higher-performing students did.
-Knowing Q3 helps identify the range in which the majority of students' scores fall and highlights those who are scoring significantly higher than the majority. This can be useful for understanding the distribution of scores and identifying both high achievers and those who may need additional support.

c) If A, B, C are 2 x 2 matrices. Can $A(B+C)$ *and* $(B+C)A$ be equal? Justify using the given matrices. [3]

d) $A=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix} \quad B=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix} \quad C=\begin{bmatrix}2 & 0\\ 0 & 2\end{bmatrix}$

Solution

$A(B+C)=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}\left(\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}+\begin{bmatrix}2 & 0\\ 0 & 2\end{bmatrix}\right)$

$=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}\begin{bmatrix}2 & 1\\ 1 & 2\end{bmatrix}$

$=\begin{bmatrix}4 & 5\\ 10 & 11\end{bmatrix}$.....[1]

$(B+C)A=\left(\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}+\begin{bmatrix}2 & 0\\ 0 & 2\end{bmatrix}\right)\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$

$=\begin{bmatrix}5 & 8\\ 7 & 10\end{bmatrix}$.....[1]

No, $A(B+C)\neq(B+C)A$.....[0.5]

For justification ……[0.5]

Matrix multiplication is not commutative, which means that in general, $AB \neq BA$

When you multiply A *by* $(B+C)$, each element of $(B+C)$is being weighted by the corresponding row of A.

When you multiply $(B+C)$ *by* A, each element of A is being weighted by the corresponding row of $(B+C)$.

The structure and dimensions of the resulting matrices depend on the order of multiplication. Switching the order changes how rows and columns interact, leading to different results.

e) If $x=\sqrt{48}$, $y=\sqrt{36x^m}$ and $q=24x^7\sqrt{3x}$, evaluate the value of m if $x\times y=q$. [2]

$x\times y=q$

$\sqrt{48}\times\sqrt{36x^m}=24x^7\sqrt{3x}$

$\sqrt{16\times3}\times6\sqrt{x^m}=24x^7\sqrt{3x}$ .....[0.5]

$24\sqrt{3}\sqrt{x^m}=24x^7\sqrt{3x}$ .....[0.5]

$\sqrt{3}\sqrt{x^m}=x^7\sqrt{3}\sqrt{x}$

$\sqrt{x^m}=x^7\sqrt{x}$.....[0.5]

$\frac{m}{2}=\frac{15}{2}$

$m=15$.....[0.5]