BHUTAN CERTIFICATE OF SECONDARY EDUCATION
DECEMBER 2023
MODEL ANSWER & MARKING SCHEME – MATHEMATICS
GENERAL INSTRUCTIONS

1) The Marking Scheme provides general guidelines to reduce subjectivity in the marking. The answers given in the marking scheme are suggested answers. The content is thus indicative. If a student has given any other answer, which is different from the one given in the Marking Scheme, but conveys the meaning, such answers should be given full weighting.

2) Evaluation is to be done as per instructions provided in the marking scheme. It should not be done according to one's own interpretation or any other consideration. The Marking Scheme should be strictly adhered to and strictly followed once the answers are thoroughly standardized.

3) If a question has parts, please award marks in the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin. If a question does not have any parts, marks must be awarded in the left-hand margin.

4) If a candidate has attempted an extra question, it will be cancelled. The extra question attempted will be the last questions in the sequence of the question paper.

5) Some examinees may attempt the questions giving equally correct answers in a different way. If the examiners are convinced that the response given by an examinee is genuinely correct, full weighting should be given.

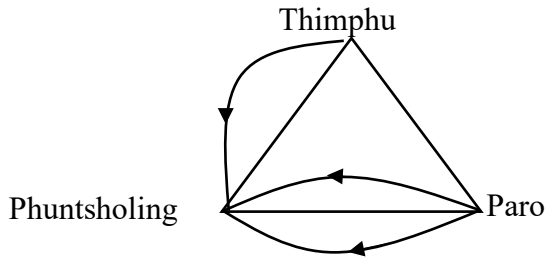
6) If there are questions on distinction between two concepts, in such questions, sometimes some students give one aspect of the difference correctly and the other is either wrong or not given at all, no marks should be awarded.

7) There may be some questions requiring the examinees to give new ideas of their own or pass their own judgments and give valid justifications. In such cases, marks should be awarded for their efforts though there may be several possible answers.

8) If the questions ask for two features/characteristics/points but the examinee writes more than two features/characteristics/points, say, five of which the first is correct, second is incorrect, the best two should be assessed and the remaining should be ignored.

9) It is expected that the Marking Scheme be followed objectively for reliable marking. For instance, if an examinee scores 35 (BCSE) / 35 (BHSEC) marks, his/her marks should not be inflated to 40 (BCSE) / 40 (BHSEC) simply to pass him/her. Similarly, whenever an examinee has answered the question effectively, his/her marks should not be deducted unnecessarily. Do not hesitate to award full marks if the answer deserves it.

10) Marks should be awarded keeping in view the total marks of that particular question and not the total marks of the question paper. For example, if 1 mark is given to a question carrying 3 marks, even if nothing is correct, then that 1 mark constitutes 33% of the total marks ear-marked for this answer. This must be avoided. If a candidate fails in the subject by 1 to 3 marks, the marking may be reviewed.

SECTION A [40 MARKS] ANSWER **ALL** QUESTIONS	
Question 1	**[40]**
Direction: For each question, there are four alternatives: A, B, C and D. Choose the correct alternative and circle it. DO NOT circle more than ONE alternative. If there are more than ONE choice circled, NO score will be awarded.	
i) The digraph shows the number of bus services in three stations.  How many bus services are there between Paro to Phuntsholing? A 2 B 3 (C) 4 D 5	
ii) What is the simplified form of $\sqrt[3]{40}$? A $10\sqrt[3]{2}$ B $2\sqrt[3]{10}$ C $5\sqrt[3]{2}$ (D) $2\sqrt[3]{5}$ *Solution* : $\sqrt[3]{40} = \sqrt[3]{2\times2\times2\times5}$ $= \sqrt[3]{2^3}\times\sqrt[3]{5}$ $= 2\times\sqrt[3]{5}$	
iii) Yuden wants to invest Nu 5,000 in one of her accounts for one year. Account A: 6.0% p.a. simple interest Account B: 5.0% p.a. compounded annually Account C: 3.0% p.a. compounded semiannually Account D: 2.9% p.a. compounded quarterly In which account will she earn more money? (A) Account A B Account B C Account C D Account D	

Solution:

Account A: $Nu\,5000\times 0.06\times 1 = Nu\,300$

$Amount = Nu\,5000 + Nu\,300 = Nu\,5300$

Comparing accounts B, C and D, account B is the best as it has highest rate of interest

Account B: $Nu\,5000\left(1+\frac{0.05}{1}\right)^{1\times 1} = Nu\,5250$

Therefore, account A will earn her more money

iv) In a game of dart, Roshan is awarded the following points as shown.

Mode of scoring	Points
Hit target	15
Miss target	−5

After 20 throws, he scored 60 points. How many times did Roshan hit the target?

A 4

(B) 8

C 12

D 16

Solution:

$x + y = 20 \rightarrow (i)$

$15x - 5y = 60$

$3x - y = 12 \rightarrow (ii)$

$x + y = 20$

$3x - y = 12$

$4x \quad = 32$

$x = \frac{32}{4} = 8$

Roshan hit the target 8 times

v) For the function $f(x) = (2x+3)(4x-2)$, the values of 'p' and 'q' are

A $p = \frac{3}{2}$ *and* $q = -\frac{1}{2}$.

(B) $p = -\frac{3}{2}$ *and* $q = \frac{1}{2}$.

C $p = 3$ *and* $q = -2$.

D $p = -3$ *and* $q = 2$.

Solution:

$f(x) = (2x+3)(4x-2)$

$2x + 3 = 0$

$x = \frac{-3}{2}$

$4x - 2 = 0$

$x = \frac{2}{4} = \frac{1}{2}$

vi) Which pattern best represents the relationship between x and $f(x)$ in the table?

x	$f(x)$
0	5
1	10
2	15
3	20

A $f(x)=10x+5$

B $f(x)=10x-5$

C $f(x)=5x+5$

D $f(x)=5x-5$

Solution:

$Difference = 5$

$f(x)=5x\pm ?$

$x=0 \quad f(x)=5$

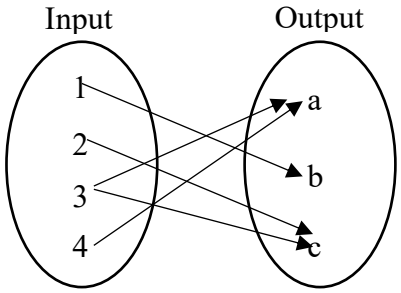
$5=5\times 0+?(5)$

$5=5$

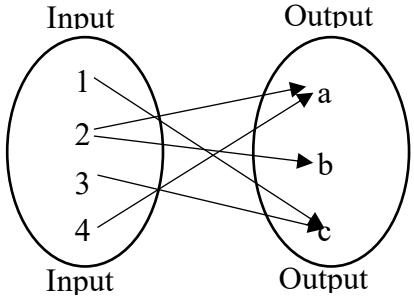
$Therefore, pattern\ is\ f(x)=5x+5$

vii) Which of the following represents a function?

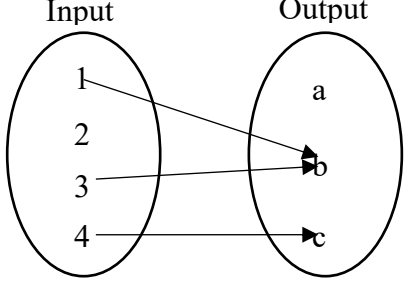
A



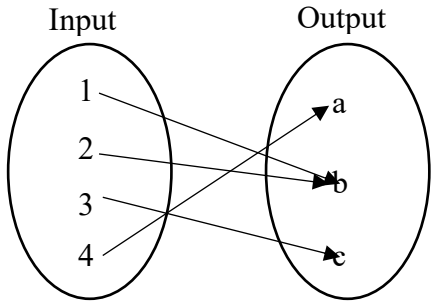
B



C



(D)



viii) The longer leg of a right angled triangle is 4 cm more than the shorter leg. If the hypotenuse is 20 cm, find the length of the shorter leg.

(A) 12 cm
B 16 cm
C 20 cm
D 24 cm

Solution :

let the length of shorter leg be $'x'$

length of longer length $= x+4$

$a^2+b^2=c^2$

$(x+4)^2+x^2=20^2$

$x^2+8x+16+x^2=400$

$2x^2+8x-384=0$

$x^2+4x-192=0$

$x^2+16x-12x-192=0$

$x(x+16)-12(x+16)=0$

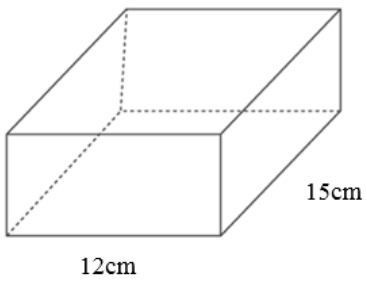
$(x-12)(x+16)=0$

$x-12=0$

$x=12cm$

ix) Khamsum made a wooden jewelry box in the shape of a rectangular prism. The jewelry box had the dimensions as given. If the surface area of the box was $684\,cm^2$, determine the height of the box.

A 3.0 cm
B 3.8 cm
(C) 6.0 cm
D 7.6 cm



Solution :

$l = 15cm \qquad w = 12cm \qquad h = ?$

$SA = 684cm^2$

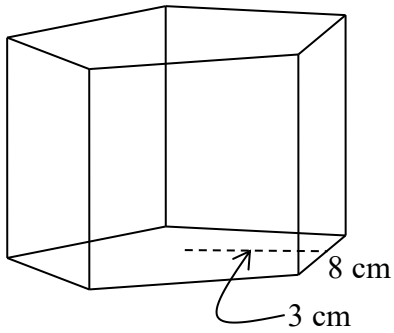
$SA = 2A + hp$

$684cm^2 = 2 \times (12cm \times 15cm) + h \times 54$

$684cm^2 - 360cm^2 = h \times 54cm$

$h = \dfrac{324cm^2}{54cm} = 6cm$

x) A pentagon based prism with the following dimensions was filled with water to a height of 3 cm. When a stone is immersed, the water level increased to a height of 5 cm. What is the volume of the stone?



A 60 cm^3

B 120 cm^3

C 180 cm^3

D 360 cm^3

Solution :

$Change\ in\ height = 5cm - 3cm = 2cm = h$

$V = Ah = \left(\dfrac{5 \times 8cm \times 3cm}{2} \right) \times 2cm$

$V = 120cm^3$

xi) Four square based prisms have a capacity of 360 mL each. Which prism with the following base is the most efficient?

A $7\,cm \times 7\,cm$

B $6\,cm \times 6\,cm$

C $5\,cm \times 5\,cm$

D $4\,cm \times 4\,cm$

Solution :

$V = Ah$

$h = \dfrac{V}{A}$

Prism A	Prism B	Prism C	Prism D
$h = \dfrac{360}{49}$	$h = \dfrac{360}{36}$	$h = \dfrac{360}{25}$	$h = \dfrac{360}{16}$
$h = 7.4cm$	$h = 10cm$	$h = 14.4cm$	$h = 22.5cm$

Therefore, Prism A is most efficient because the height of prism A is closest to the length of the sides of the base.

xii) Which conversion is correct?

A $30° = \frac{\pi}{3} rad$

B $40° = \frac{\pi}{4} rad$

C $60° = \frac{\pi}{6} rad$

(D) $90° = \frac{\pi}{2} rad$

Solution:

$\frac{\pi}{2} rad = \frac{180°}{2} = 90°$

xiii) If $\sin\theta = \frac{3}{5}$ and θ lies in the first quardant, the value of $\tan\theta + \frac{1}{\cos\theta}$ is

A –3.

B –2.

C 2.

(D) 3.

Solution:

$\tan\theta = \frac{O}{A} = \frac{4}{3}$

$\cos\theta = \frac{A}{H} = \frac{3}{5}$

$\tan\theta + \frac{1}{\cos\theta} = \frac{4}{3} + \frac{1}{\frac{3}{5}}$

$= \frac{4}{3} + \frac{5}{3} = \frac{9}{3} = 3$

xiv) An online delivery company delivers a football packed in a cubical box. If the ball exactly fits in the box, what is the radius of the ball?

A 3.0 cm

(B) 3.5 cm

C 4.0 cm

D 4.5 cm

$V_{cube} = 343\ cm^3$

Solution :

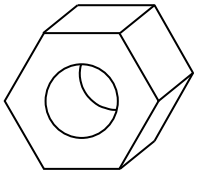
$V_{cube} = e^3 = 343cm^3$

$e = \sqrt[3]{343cm^3}$

$e = 7cm = diameter\ of\ the\ ball$

$r = \frac{7cm}{2} = 3.5cm$

xv) Jigme could tighten this nut in three complete rotations. The order of turn symmetry is



A 6.
B 12.
C 18.
D 24.

Solution :

Order of turn symmetry for the $\text{prism}_{\text{hexagon based}} = 6 \rightarrow$ for single rotation

For 3 rotations $= 3 \times 6 = 18$

xvi) Which of the following statement is true?

A The circumcentre of a right triangle will be on the midpoint of the hypotenuse.
B The point of intersection of the medians is called the orthocentre.
C The circumcentre of an obtuse triangle will be inside the triangle.
D The point of intersection of the altitudes is called the centroid.

xvii) The table shows the weekly expenditure of 200 families.

Expenditure (Nu)	**Frequency**
0 – 1000	28
1000 – 2000	46
2000 – 3000	54
3000 – 4000	42
4000 – 5000	30

What is the median of the weekly expenditure?

A Nu 1478.26
B Nu 2481.48
C Nu 2500.00
D Nu 3523.81

Solution:

Expenditure (Nu)	Frequency	CF
0 – 1000	28	28
1000 – 2000	46	74
2000 – 3000	54	128
3000 – 4000	42	170
4000 – 5000	30	200

$$Q_2 = L + \frac{i}{f}\left(\frac{n}{2} - c\right)$$

$$Q_2 = 2000 + \frac{1000}{54}\left(\frac{200}{2} - 74\right) = Nu\,2481.48$$

xviii) Which of the following pair of variables are negatively correlated?

A The outside temperature and the cold drink sales.

B The amount of time spent in studying and the exam grades.

C The amount of money you save and your financial security.

(D) The time elapsed and the distance left to be covered in a marathon.

xix) Anjuli is taking part in two races. The probability of winning the first race is 0.2. The probability of winning the second race, if she has already won the first race is 0.6. Calculate the probability of Anjuli winning both the races.

(A) 0.12

B 0.40

C 0.80

D 3.00

Solution:

$P(A) = 0.2$

$P(B / A) = 0.6$

$P(A\,and\,B) = P(B / A) \times P(A) = 0.6 \times 0.2 = 0.12$

xx) Which of the following pair of events are independent?

A Event A: Rolling a die and getting a 3
Event B: Getting a total of 4 or more for both rolls

B Event A: Rolling an odd number in the first roll of a die
Event B: Rolling a second time and getting a difference of 1 for both rolls

(C) Event A: Rolling a 3 or 4 on the first roll of a die
Event B: Rolling a number less than 5 on the second roll

D Event A: Rolling an even number in the first roll of a die
Event B: Rolling a number such that the product of the first and second rolls are greater than 4

SECTION B [60 MARKS]
ATTEMPT ANY SIX QUESTIONS
[Under this section, there are 8 questions (Question 2 – 9)]

Question 2

a) Given $K = 2^9 \times 3^6 \times 5^y$. What values of *'y'* if any, would make *'K'* a perfect cube? Explain. **[2]**

Solution :

Any non-negative multiples of 3 ------[1]

In order to become a perfect cube, the exponents should be divisible by 3 ------[1]

b) Palden bought some pens and pencils for a total sum of Nu 600. A pen costs Nu 75 and a pencil costs Nu 15.

i. Write an equation to model the situation. **[1]**

ii. Write a function to calculate the number of pens if you know the number of pencils he bought. **[1]**

iii. Use the function to calculate the number of pens if Palden bought 10 pencils. **[1]**

Solution :

let the number of pens be $'x'$

let the number of pencils be $'y'$

i. $75x + 15y = Nu\,600$ ------[1]

ii. $75x + 15y = Nu\,600$

$75x = Nu\,600 - 15y$ ------[0.5]

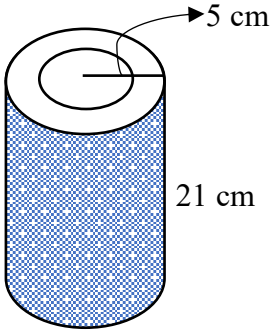
$x = \dfrac{Nu\,600 - 15y}{75}$ OR $f(y) = \dfrac{Nu\,600 - 15y}{75}$ ------[0.5]

iii. $y = 10$

$f(10) = \dfrac{Nu\,600 - 15(10)}{75}$ ------[0.5]

$f(10) = 6\ pens$ ------[0.5]

c) This cylindrical tube has 20 rounds of wrapping paper. **[3]**



Kuenga can wrap 8 cubical boxes of the same dimension using all the wrapping papers. What could be the dimension of the cubical box? (Use $\pi = \frac{22}{7}$)

Solution :

$A_{\text{curved lateral surface}} = 2\pi rh = 2 \times \frac{22}{7} \times 5\,cm \times 21\,cm = 660\,cm^2$ (Area of one round) ------[0.5]

Total surface area of 20 rounds $= 20 \times 660\,cm^2 = 13,200\,cm^2$ ------[0.5]

Amount of paper required for a box $= \frac{13,200\,cm^2}{8} = 1650\ cm^2$ ------[0.5]

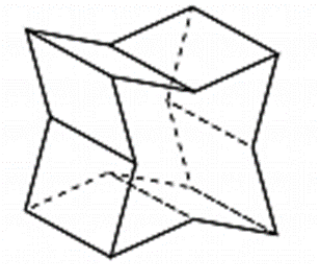
$SA_{cube} = 1650\ cm^2$

$6l^2 = 1650\ cm^2$ ------[0.5]

$l^2 = \frac{1650\ cm^2}{6} = 275\ cm^2$ ------[0.5]

$l = \sqrt{275} = 16.58\,cm$ ------[0.5]

d) Describe the turn symmetry of the 3D shape. **[2]**



Solution :

One axis of rotation from centre of one base to the centre of the opposite base with a turn order of 4. ------[1]

Four axes of rotation from the midpoint of one edge to the midpoint of the opposite edge in the lateral faces with a turn order of 2. ------[1]

Question 3

a) In a high school, the boys and girls basketball teams had their heights measured. The following data was recorded for their heights (in cm).

Girls			
165	155	170	154
164	155	145	160
157	171	162	168

Boys			
177	165	170	172
180	162	165	172
167	160	179	176

i. Construct a double stem and leaf plot for the data. **[2]**

ii. Make a conclusion based on the graph. **[1]**

Solution:

i. Arrange data in ascending order. ------[0.5]

Girls			
145	*154*	*155*	*155*
157	*160*	*162*	*164*
165	*168*	*170*	*171*

Boys			
160	*162*	*165*	*165*
167	*170*	*172*	*172*
176	*177*	*179*	*180*

Girls	*Stem*	*Boys*
5	*14*	
7 5 5 4	*15*	
8 5 4 2 0	*16*	*0 2 5 5 7*
1 0	*17*	*0 2 2 6 7 9*
	18	*0*

Correct data placement ------[1]

Selection of appropriate stem ------[0.5]

ii. Most of the heights of the students measured fall between 160 cm to 170 cm.

OR

The shortest height measured was 154 cm

OR

The tallest height measured was 180 cm

OR

Generally, boys were taller than girls

OR

Students can make conclusion based on mean, median and mode

Any one of the above ------[1]

b) The perimeter of a rectangular swimming pool is 160 m. Its length is 2 m more than twice its width. What are the length and width? **[3]**

Solution:

$width = w$

$length = l$

$l = 2w + 2 \rightarrow (i)$------[0.5]

$P_{\text{rectangle}} = 2(l + w) = 160\,m$

$2l + 2w = 160\,m$

$l + w = 80\,m \rightarrow (ii)$------[0.5]

$Put\,(i)\,in\,(ii)$

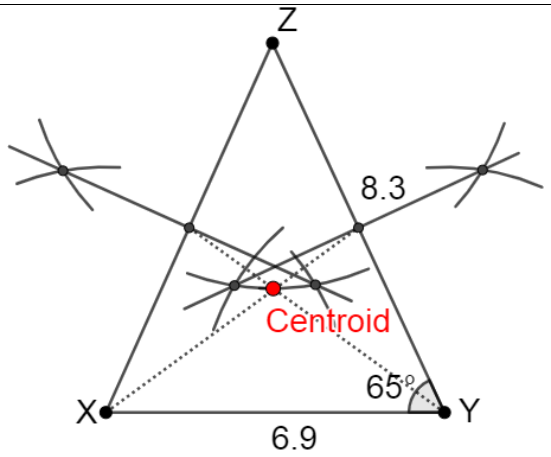
$2w + 2 + w = 80\,m$------[0.5]

$3w = 80 - 2$------[0.5]

$w = \frac{78}{3} = 26\,m$------[0.5]

$l = 2w + 2 = (2 \times 26) + 2 = 54\,m$------[0.5]

c) Draw ΔXYZ: $XY = 6.9$ cm, $YZ = 8.3$ cm and $\angle Y = 65°$ and locate the centroid of the triangle. **[4]**



Solution:

Triangle construction ------[1]

Side bisectors ------[1]

Median construction ------[1]

Location of centriod ------[1]

Question 4

a) The length of a rectangular garden is 4 m more than its width. The area of the garden is 60 m^2. Determine the dimensions of the rectangle. **[4]**

Solution :

$Width = w$

$Length = w + 4$

$A_{\text{rectangle}} = l \times w = 60\,cm^2$ ------[1]

$(w+4) \times w = 60\,cm^2$

$w^2 + 4w - 60 = 0$ ------[1]

$w^2 + 10w - 6w - 60 = 0$

$w(w+10) - 6(w+10) = 0$

$(w-6)(w+10) = 0$ ------[1]

$w - 6 = 0$

$w = 6\,cm$

$l = w + 4 = 6\,cm + 4\,cm = 10\,cm$ ------[1]

b) The table shows the data of three teams in 2021 season of BoB Bhutan Premier League. A win is worth 3 points, a draw is worth 1 point and a loss means no points.

Team	Win	Draw	Loss
Paro FC	14	3	1
Druk Lhayul FC	10	3	5
Gelephu FC	2	1	15

i. Create a matrix for the above situation. **[1]**

ii. Use matrix multiplication to calculate the points secured by each team. **[2]**

Solution:

i. $\begin{bmatrix} 14 & 3 & 1 \\ 10 & 3 & 5 \\ 2 & 1 & 15 \end{bmatrix}$ ------[1]

ii. $\begin{bmatrix} 14 & 3 & 1 \\ 10 & 3 & 5 \\ 2 & 1 & 15 \end{bmatrix} \times \begin{bmatrix} 3 \\ 1 \\ 0 \end{bmatrix}$ ------[1]

$\begin{bmatrix} 45 \\ 33 \\ 7 \end{bmatrix}$ ------[0.5]

∴ Paro FC secured 45 points, Druk Lhayul FC secured 33 points and Gelephu FC secured 7 points. ------[0.5]

c) Prove that $\tan A + \cot A = \frac{1}{\sin A \cos A}$. **[3]**

Solution:

$\tan A + \cot A = \frac{1}{\sin A \cos A}$

$\frac{\sin A}{\cos A} + \frac{\cos A}{\sin A}$ ------[1]

$\frac{\sin A \times \sin A + \cos A \times \cos A}{\sin A \cos A}$ ------[1]

$\frac{\sin^2 A + \cos^2 A}{\sin A \cos A}$ ------[0.5]

$\frac{1}{\sin A \cos A}$ ------[0.5]

Question 5

a) Sonam purchased 300 shares with a face value of Nu 200 each from the market at Nu 225 per share. A dividend rate of 24% is declared at the end of the year. Calculate:

i. rate of premium **[1]**

ii. dividend amount **[1]**

iii. yield percentage **[2]**

Solution:

i. Change in FV $= Nu\,225 - Nu\,200$

$= Nu\,25$ ------[0.5]

$\text{Premium}\% = \frac{25}{200} \times 100$

$= 12.5\%$ ------[0.5]

ii. $DA = r \times FV \times n$

$= 0.24 \times Nu\,200 \times 300$ ------[0.5]

$= Nu\,14,400$ ------[0.5]

iii. $Original\ investment = 300 \times Nu\,225$

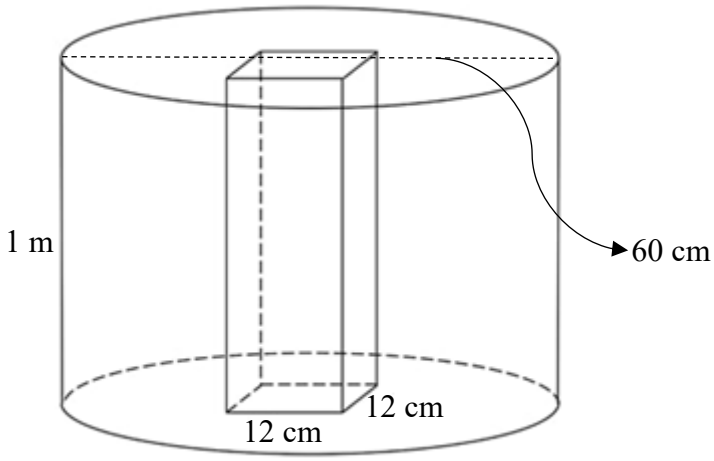
$= Nu\,67,500$ ------[1]

$yield\% = \frac{yield}{Original\ investment} \times 100\%$

$= \frac{14,400}{67500} \times 100\%$ ------[0.5]

$= 21.33\%$ ------[0.5]

b) A cylindrical container is fitted with a heating element. The dimensions of the container and heating element are as given. **[3]**



How much water can the container hold?

Solution:

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

$= \pi \times (30\,cm)^2 \times 100\,cm$

$= 282,743.34\,cm^3$ ------[1]

$V_{\text{rectangular prism}} = l \times w \times h$

$= 12\,cm \times 12\,cm \times 100\,cm$

$= 14,400\,cm^3$ ------[1]

$V_{water} = 282,743.34\,cm^3 - 14,400\,cm^3$

$= 268,343.34\,cm^3$

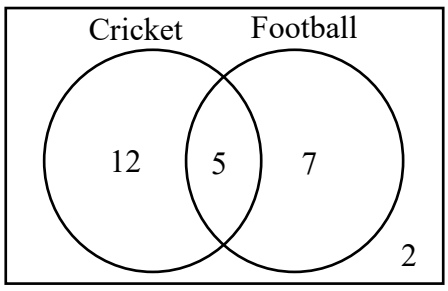
The container can hold $268,343.34\,cm^3$ of water.------[1]

c) In a class, 17 students play cricket, 12 students play football, 5 students play both the games and 2 students play neither. A student is randomly selected. What is the probability that the student plays

i. only cricket? **[1]**

ii. only football? **[1]**

iii. cricket and football? **[1]**



Solution:

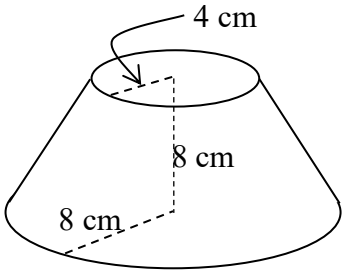
i. $P(only\ cricket) = \frac{12}{36} OR \frac{1}{3}$ ------[1]

ii. $P(only\ football) = \frac{7}{36}$ ------[1]

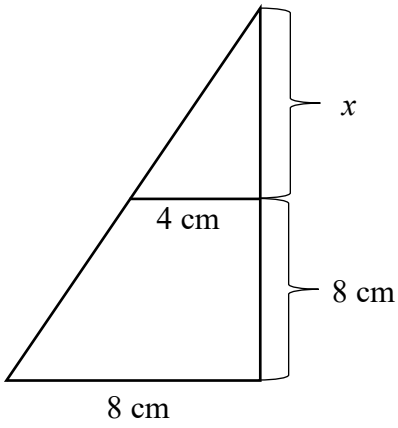
iii. $P(cricket\ and\ football) = \frac{34}{36} OR \frac{17}{18}$ ------[1]

Question 6

a) A pastry bag is a tool used to decorate cakes and cupcakes. It takes the form of a truncated cone. What is the volume of this pastry bag? **[4]**



Solution:



Missing height

$\frac{8}{4} = \frac{8+x}{x}$

$2x = 8 + x$

$x = 8cm$

Height of full cone $= 8cm + 8cm = 16cm$ ------[1]

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

$= \frac{\pi \times (8cm)^2 \times 16cm}{3}$

$= 1072.33cm^3$ ------[1]

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

$= \frac{\pi \times (4cm)^2 \times 8cm}{3}$

$= 134.04cm^3$ ------[1]

$V_{truncated\ cone} = 1072.33cm^3 - 134.04cm^3$

$= 938.29cm^3$ ------[1]

b) Determine the point of intersection of the lines $\frac{3}{4}x - \frac{2}{3}y = 3$ and $\frac{1}{2}x - \frac{1}{2}y = 3$. **[3]**

Solution:

$\left(\frac{3}{4}x - \frac{2}{3}y = 3\right) \times 12$

$\left(\frac{1}{2}x - \frac{1}{2}y = 3\right) \times 2$ ------[0.5]

$9x - 8y = 36 \rightarrow (i)$

$x - y = 6 \rightarrow (ii)$ ------[0.5]

Eliminate y

$9x - 8y = 36$

$-8x + 8y = -48$

$x = -12$ ------[1]

$x - y = 6$

$-12 - y = 6$

$-y = 18$

$y = -18$ ------[1]

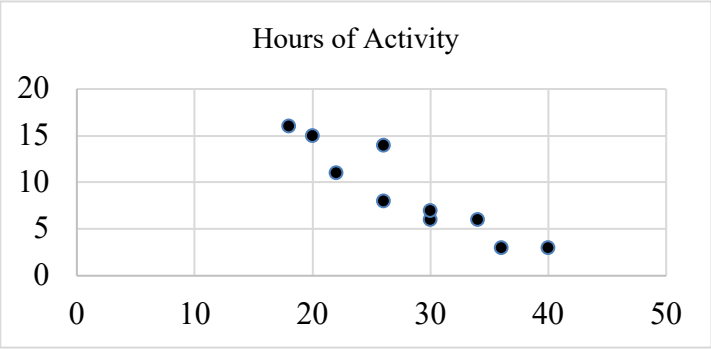
c) This table shows the age of a sample of people and how many hours each person engages in physical activity each week.

Age	Hours of Activity
20	15
22	11
30	6
30	7
34	6
26	14
26	8
18	16
36	3
40	3

i. Create a scatter plot of the data. **[2]**

ii. Identify the type of correlation. **[1]**

Solution:



i. Scatter plot

Appropriate scale and axis ------[0.5]

Plotting the points correctly ------[1.5]

ii. Negative correlation. ------[1]

Question 7

a) Simplify $\frac{\sqrt{5x^3} \times \sqrt{9x^4}}{\sqrt{80x}}$. **[2]**

Solution :

$\frac{\sqrt{5x^3} \times \sqrt{9x^4}}{\sqrt{80x}}$

$\sqrt{\frac{5x^3 \times 9x^4}{80x}}$ ------[1]

$\frac{\sqrt{9x^6}}{\sqrt{16}}$

$\frac{3x^3}{4}$ ------[1]

b) Write the mapping notation for the following functions. **[1]**

i. $f(x) = 2x^2 - 0.5$ **[1]**

ii. $f(x) = -3(x+1)^2 - 4$ **[1]**

iii. $f(x) = (x-3)^2 + 6$

Solution :

i. $f(x) = 2x^2 - 0.5$

$(x, y) \to (x,\ 2y - 0.5)$ ------[1]

ii. $f(x) = -3(x+1)^2 - 4$

$(x, y) \to (x-1,\ -3y - 4)$ ------[1]

iii. $f(x) = (x-3)^2 + 6$

$(x, y) \to (x+3,\ y+6)$ ------[1]

c) The data represents points scored by Bikram in ten basketball matches. **[2]**

17, 11, 9, 11, 14, 22, 20, 18, 20, 19

Calculate 5 number summary of the data.

Solution :

Arrange data in ascending order

9, 11, 11, 14, 17, 18, 19, 20, 20, 22

$\min imum\ value = 9$

$\max imum\ value = 22$ ------[0.5]

$Q_1 = 11$ ------[0.5]

$Q_2 = \dfrac{17+18}{2} = 17.5$ ------[0.5]

$Q_3 = 20$ ------[0.5]

d) If $\cot A = \dfrac{13}{5}$, calculate five other t-ratios. **[3]**

Solution :

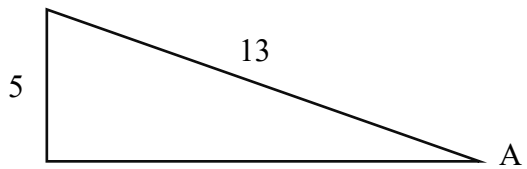
$\cot A = \dfrac{13}{5}$

$Adj = \sqrt{13^2 - 5^2}$

$= \sqrt{169 - 25}$

$= \sqrt{144}$

$= 12$ ------[0.5]



$\therefore \tan A = \dfrac{5}{12} or\ 0.42$ ------[0.5]

$\sin A = \dfrac{5}{13} or\ 0.38$ ------[0.5]

$\cos A = \dfrac{12}{13} or\ 0.92$ ------[0.5]

$\sec A = \dfrac{13}{12} or\ 1.08$ ------[0.5]

$\csc A = \dfrac{13}{5} or\ 2.6$ ------[0.5]

Question 8

a) Sangla invested Nu 25,000 in an account. After three years, the amount of money has grown by Nu 4,450. What was the rate of interest compounded monthly? **[2]**

Solution :

$P = Nu\,25,000$

$A = Nu\,29,450$

$t = 3\ years$

$n = 12$

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

$$Nu\,29,450 = Nu\,25,000\left(1+\frac{r}{12}\right)^{12\times 3}$$

$$\left(\frac{Nu\,29,450}{Nu\,25,000}\right)^{\frac{1}{36}} = \left(1+\frac{r}{12}\right)^{36\times\frac{1}{36}}$$ ------[0.5]

$$1.0046 = 1+\frac{r}{12}$$ ------[0.5]

$$1.0046-1 = \frac{r}{12}$$

$r = 0.0046\times 12$ ------[0.5]

$r = 0.0552\times 100\%$

$r = 5.52\%$ ------[0.5]

b) Sketch the graph of the function $f(x) = -2(x+1)(x-2)$. **[3]**

Solution :

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

$x-$intercepts

$x+1=0$ $\quad$ $x-2=0$

$x=-1$ $\quad$ $x=2$

$(-1,0)$ $\quad$ (2, 0) ------[0.5]

Coordinates of vertex

$$x = \frac{-1+2}{2} = 0.5$$

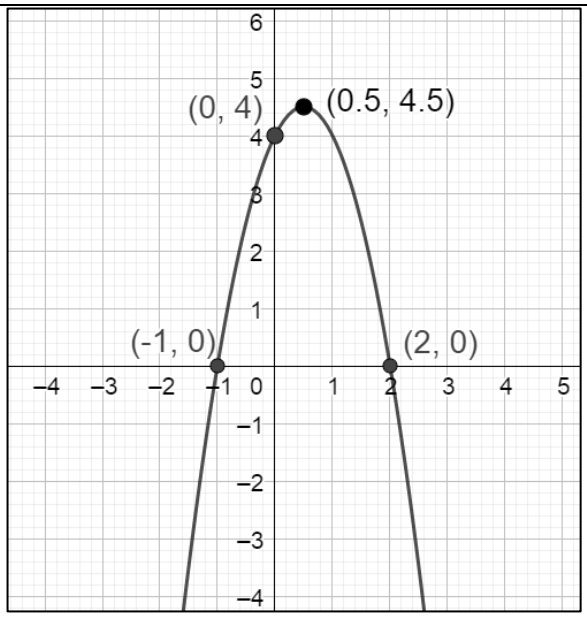
$y = -2(0.5+1)(0.5-2) = 4.5$

$(0.5, 4.5)$ ------[0.5]

$y-$intercept

$f(0) = -2(0+1)(0-2) = 4$

$(0,-4)$------[0.5]

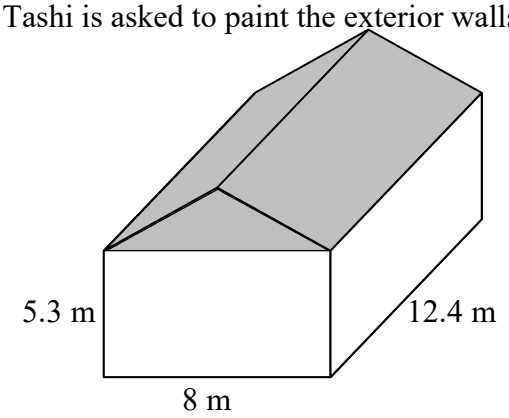


Graphing:

Appropriate axis and scale ------[0.5]

Plotting the points correctly ------[1]

c) Tashi is asked to paint the exterior walls of a structure with the following dimensions. **[3]**



If he is offered Nu 55 per m^2, determine the amount he will get by painting the walls.

Solution :

$l = 12.4\,m$

$w = 8\,m$

$h = 5.3\,m$

$A_{walls} = 2(lh + wh)$

$= 2(12.4\,m \times 5.3\,m + 8\,m \times 5.3\,m)$ ------[1]

$= 2 \times (65.72\,m^2 + 42.4\,m^2)$

$= 216.24\,m^2$ ------[1]

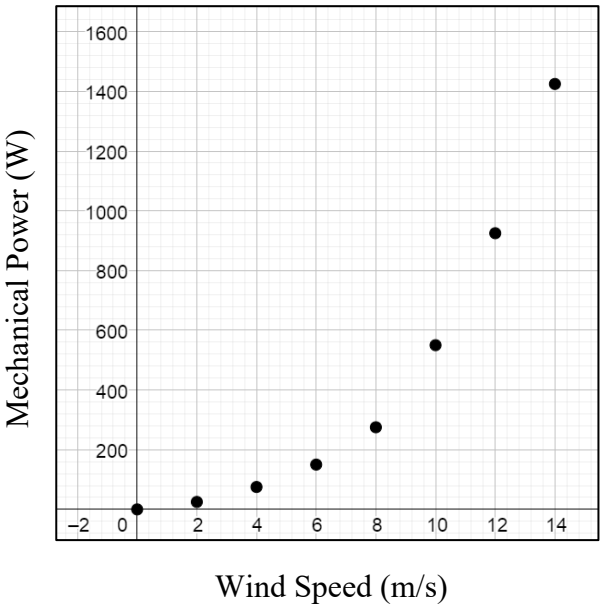
Amount

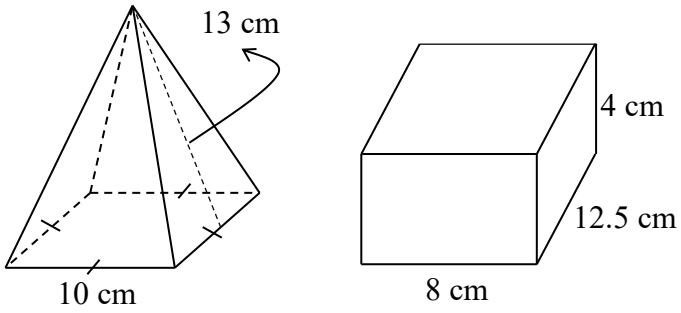
$1\,m^2 \rightarrow Nu\,55$

$216.24\,m^2 \rightarrow 216.24\,m^2 \times Nu\,55$ ------[0.5]

$Nu\,11,893.2$ ------[0.5]

d) The graph shows the relation between wind speed and the mechanical power in a power station.



	i. Identify the independent and dependent variables. ii. What kind of relationship is it? *Solution:* *i. Independent: Wind speed* ------[0.5] *Dependent: Mechanical power* ------[0.5] *ii. Exponential relationship* ------[1]	**[1]** **[1]**
Question 9		
a)	Find the values of 'a' and 'b'. $\begin{bmatrix} a & 2 \\ -3 & 4 \end{bmatrix} + \begin{bmatrix} -4 & 3 \\ 2 & -1 \end{bmatrix} - \begin{bmatrix} 2 & 1 \\ 4 & 3 \end{bmatrix} = \begin{bmatrix} -5 & 4 \\ b & 0 \end{bmatrix}$ *Solution*: $\begin{bmatrix} a & 2 \\ -3 & 4 \end{bmatrix} + \begin{bmatrix} -4 & 3 \\ 2 & -1 \end{bmatrix} - \begin{bmatrix} 2 & 1 \\ 4 & 3 \end{bmatrix} = \begin{bmatrix} -5 & 4 \\ b & 0 \end{bmatrix}$ $a-4-2=-5$ ------[0.5] $a-6=-5$ $a=1$ ------[0.5] $-3+2-4=b$ ------[0.5] $b=-5$ ------[0.5]	**[2]**
b)	Two regular based 3D shapes have a volume of 400 cm^3 each.  i. Calculate the surface area of each shape. ii. Which 3D shape is more efficient? Why?	 **[3]** **[1]**

Solution:

i. $SA_{pyramid} = A_{base} + A_{lateral\ faces}$

$= (10\,cm \times 10\,cm) + \left(4 \times \left(\frac{10\,cm \times 13\,cm}{2}\right)\right)$ ------[0.5]

$= 100\,cm^2 + 260\,cm^2$ ------[0.5]

$= 360\,cm^2$ ------[0.5]

$SA_{\text{rectangular prism}} = 2A + hp$

$= 2 \times (8\,cm \times 12.5\,cm) + 4\,cm \times 41\,cm$ ------[0.5]

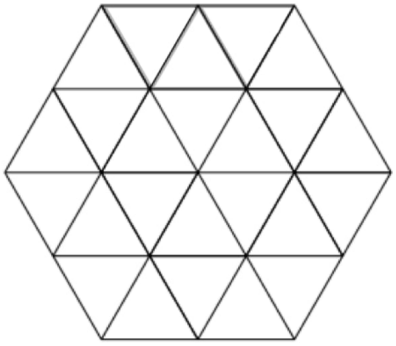
$= 200\,cm^2 + 164\,cm^2$ ------[0.5]

$= 364\,cm^2$ ------[0.5]

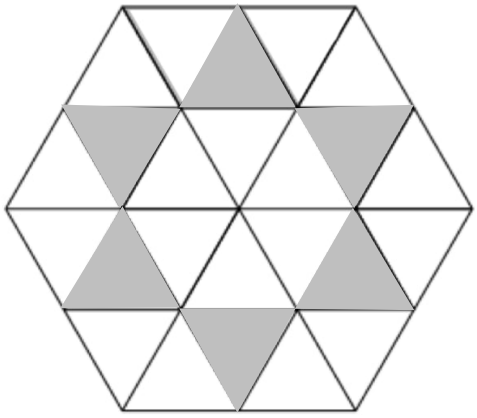
ii. The pyramid is more efficient ------[0.5]

Because it has lesser surface area ------[0.5]

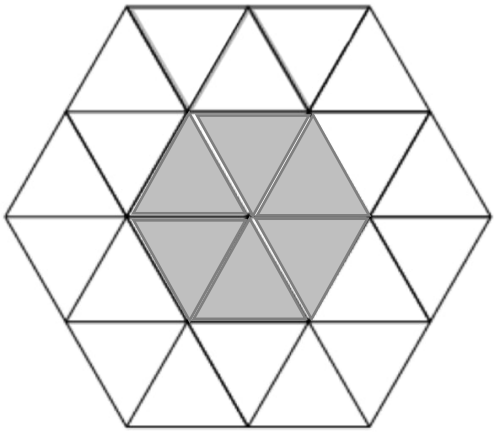
c) Shade six triangles to make a pattern with order of turn symmetry 6. **[2]**



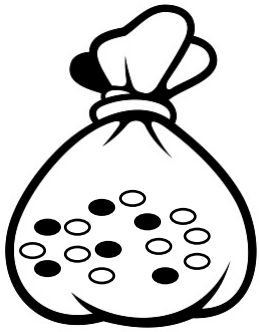
Solution:



OR



Correctly shaded ------[2]

d)	From a bag of counters, a counter is drawn but not replaced, then a second counter is drawn. What is the probability of drawing a black counter, then a white counter?  *Solution*: $P(Black) \times P(White / Black) = P(Black\ and\ White)$ ------[0.5] $\frac{6}{15} \times \frac{9}{14}$ ------[0.5] $= \frac{54}{210} OR \frac{9}{35}$ ------[1]	**[2]**