Sample Question Paper - 13
Mathematics-Basic (241)
Class- X, Session: 2021-22
TERM II

Time Allowed: 120 minutes **Maximum Marks: 40**

General Instructions:

1. The question paper consists of 14 questions divided into 3 sections A, B, C.
2. All questions are compulsory.
3. Section A comprises of 6 questions of 2 marks each. Internal choice has been provided in two questions.
4. Section B comprises of 4 questions of 3 marks each. Internal choice has been provided in one question.
5. Section C comprises of 4 questions of 4 marks each. An internal choice has been provided in one question. It contains two case study based questions.

SECTION A

1. Find the sum of first 8 multiples of 3.

OR

Write the common difference of the A.P. : $\frac{1}{5}, \frac{4}{5}, \frac{7}{5}, \frac{10}{5}, ...$

2. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground where it makes an angle 30°. The distance between the foot of the tree to the point where the top touches the ground is 8 m. Find the height of the tree from where it is broken.

3. Two tangents making an angle of 60° between them are drawn to a circle of radius $\sqrt{3}$ cm, then find the length of each tangent.

4. The curved surface area of a cylinder is 264 m^2 and its volume is 924 m^3. Find the ratio of its height to its diameter.

5. A cylinder, a cone and a hemisphere have same base and same height. Find the ratio of their volumes.

6. The following data gives the distribution of total household expenditure of manual workers in a city.

Expenditure (in Rs)	**Frequency**
1000-1500	24
1500-2000	40
2000-2500	33
2500-3000	28
3000-3500	30
3500-4000	22
4000-4500	16
4500-5000	07

Then, find the average expenditure which is done by the maximum number of manual workers.

OR

The median and mode respectively of a frequency distribution are 26 and 29, find its mean.

Section B

7. If tangents PA and PB drawn from an external point P to a circle with centre O are inclined to each other at an angle of 80°, then find $\angle POA$.

8. From a solid cylinder whose height is 15 cm and the diameter is 16 cm, a conical cavity of the same height and same diameter is hollowed out, Find the total surface area of remaining solid. (Given your answer in terms of π).

9. Following frequency distribution shows the expenditure on milk of 30 households in a locality :

Daily expenditure on milk (Rs.)	0-30	30-60	60-90	90-120	120-150
Number of households	5	6	9	6	4

Find the mode for the above data.

10. Find the median of the following data :

Height (in cm)	Less than 120	Less than 140	Less than 160	Less than 180	Less than 200
No. of students	12	26	34	40	50

OR

The sum of deviations of a set of values x_1, x_2, x_3, ..., x_n, measured from 50 is -10 and the sum of deviations of the values from 46 is 70. Find the value of n and the mean.

Section C

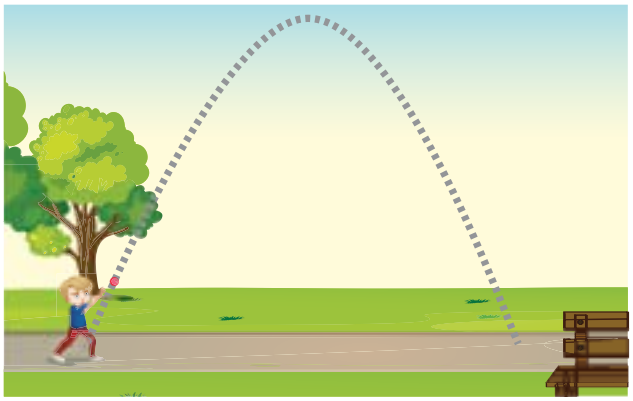
11. The first term of an AP is 3, the last term is 83 and the sum of all its terms is 903. Find the number of terms and the common difference of the AP.

12. Draw a circle of radius 4 cm. Draw two tangents to the circle inclined at an angle of 60° to each other.

OR

Draw a circle of radius 4 cm. Draw two tangents to the circle inclined at an angle of 60° to each other.

13. Height of a Projectile : A projectile is thrown upward with an initial velocity of 176 ft/sec. After t sec, its height $h(t)$ above the ground is given by the function $h(t) = -16t^2 + 176t$.



(i) What is the projectile's height above the ground after 2 sec.
(ii) How many seconds after it is thrown will the projectile strike the ground?

14. Raju is a design engineer at a large pharmacy company. He has to decide the shape of medicine and for this he has to chose between tablet or captab.

a. Tablet : This is circular tablet.
b. Captab : This is long tablet having semicircular at both end.

The volume of medicine is 924 mm^2.

(i) If Raju decide to make tablet of diameter 14 mm, what is the thickness of tablet ?
(ii) If Raju decide to make captab of dimension 7 by 23.5 mm, what is the thickness of captab?

Solution

MATHEMATICS BASIC 241

Class 10 - Mathematics

Time Allowed: 120 minutes **Maximum Marks: 40**

General Instructions:

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SECTION A

1. Find the sum of first 8 multiples of 3.

Sol :

First 8 multiples of 3 are 3, 6, 9, 12, 15, 18, 21, 24 which are in AP where $a = 3$, $d = 3$ and $n = 8$.

Now $S_n = \frac{n}{2}[2a + (n-1)\,d]$

$S_8 = \frac{8}{2}[2 \times 3 + (8-1)\,3]$

$= 4[6 + 21]$

$S_8 = 4 \times 27 = 108$

Thus, sum of first 8 multiples of 3 is 108.

or

Write the common difference of the A.P. : $\frac{1}{5}, \frac{4}{5}, \frac{7}{5}, \frac{10}{5}, \ldots$

Sol :

Common difference $d = \frac{4}{5} - \frac{1}{5} = \frac{3}{5}$

We have, $a = -2$ and $d = 3$

Now, $a_n = a + (n-1)\,d$

$a_8 = a + (8-1)$

$= a + 7d$

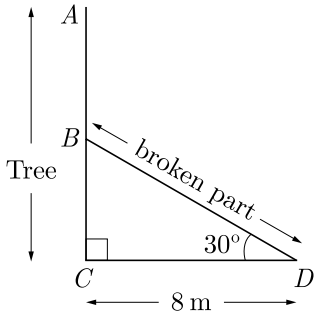
$= -2 + 7 \times 3$

$= 19$

2. A tree breaks due to storm and the broken part bends so that the top of the tree touches the ground where it makes an angle 30°. The distance between the foot of the tree to the point where the top touches the ground is 8 m. Find the height of the tree from where it is broken.

Sol :

Let the tree be AC and is broken at point B. The broken part touches at the point D on the ground as shown in figure below.



In right ΔBCD,

$\tan 30^\circ = \frac{BC}{CD}$

$\frac{1}{\sqrt{3}} = \frac{BC}{8}$

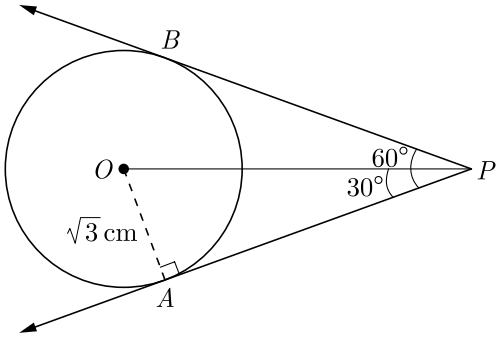
$BC = \frac{8}{\sqrt{3}}$

Hence, height from where tree is broken is $\frac{8}{\sqrt{3}}$ m.

3. Two tangents making an angle of 60° between them are drawn to a circle of radius $\sqrt{3}$ cm, then find the length of each tangent.

Sol :

As per the given question we draw the figure as below.



Since, $\tan\theta = \frac{OA}{AP}$

So. $\tan 30^\circ = \frac{OA}{AP}$

$\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{AP}$

$AP = \sqrt{3} \times \sqrt{3} = 3$ cm.

4. The curved surface area of a cylinder is 264 m^2 and its volume is 924 m^3. Find the ratio of its height to its diameter.

Sol :

Curved Surface area of cylinder is $2\pi rh$ and volume of cylinder $\pi r^2 h$.

Now $\frac{\pi r^2 h}{2\pi rh} = \frac{924}{264}$

$\frac{r}{2} = \frac{7}{2} \Rightarrow r = 7$

Substituting $r = 7$ in $2\pi rh = 264$ we have

$2 \times \frac{22}{7} \times 7 \times h = 264$

$h = 6$ m

Now $\frac{h}{2r} = \frac{6}{14} = \frac{3}{6}$

Hence, $h : d = 3 : 7$

5. A cylinder, a cone and a hemisphere have same base and same height. Find the ratio of their volumes.

Sol :

$V_{\text{cylinder}} : V_{\text{cone}} : V_{\text{hemisphere}} = \pi r^2 h : \frac{1}{3}\pi r^2 h : \frac{2}{3}\pi r^3$

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

$= 1 : \frac{1}{3} : \frac{2}{3}$

$= 3 : 1 : 2$

6. The following data gives the distribution of total household expenditure of manual workers in a city.

Expenditure (in Rs)	**Frequency**
1000-1500	24
1500-2000	40
2000-2500	33
2500-3000	28
3000-3500	30
3500-4000	22
4000-4500	16
4500-5000	07

Then, find the average expenditure which is done by the maximum number of manual workers.

Sol :

We observe that the class 1500-2000 has maximum frequency 40. Therefore, this is the modal class.

We have $l = 1500$, $h = 500$, $f_1 = 40$, $f_0 = 24$ and $f_2 = 23$

$M_o = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$

$= 1500 + \frac{40 - 24}{80 - 24 - 33} \times 500$

$= 1500 + \frac{16}{23} \times 500$

$= 1847.26$

or

The median and mode respectively of a frequency distribution are 26 and 29, find its mean.

Sol :

We have $M_o = 3M_d - 2M$

$29 = 3 \times 26 - 2M$

$2M = 78 - 29 = 49$

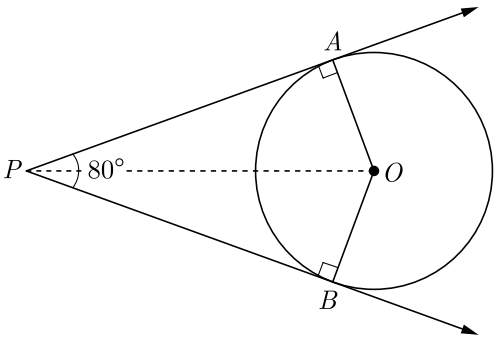
$M = \frac{49}{2} = 24.5$

Section B

7. If tangents PA and PB drawn from an external point P to a circle with centre O are inclined to each other at an angle of 80°, then find $\angle POA$.

Sol :

As per given information we have drawn the figure below.



Since PA and PB are the tangents, PO will be angle bisector of $\angle P$

Hence, $\angle APO = 40^\circ$

Now, in ΔAPO, $\angle PAO$ is 90° because this is angle between radius and tangent.

Now $\angle PAO + \angle APO + \angle POA = 180^\circ$

$90^\circ + 40^\circ + \angle POA = 180^\circ$

$\angle POA = 50^\circ$

8. From a solid cylinder whose height is 15 cm and the diameter is 16 cm, a conical cavity of the same height and same diameter is hollowed out, Find the total surface area of remaining solid. (Given your answer in terms of π).

Sol :

Height of cylinder, $h = 15$ cm

Radius of cylinder, $r = \frac{16}{2} = 8$ cm

Radius of base of cone, $r = 8$ cm

Let slant height of cone be l, then we have

$l = \sqrt{r^2 + h^2} = \sqrt{8^2 + 15^2}$

$= \sqrt{64 + 225} = \sqrt{289}$

Thus $l = 17$ cm

TSA of reaming solid

= Top area of cylinder+

+ CSA of cylinder + CSA of conical cavity

$= \pi r^2 + 2\pi rh + \pi rl$

$= \pi r(r + 2h + l)$

$= \pi \times 8(3 + 2 \times 15 + 17$

$= \pi \times 8 \times 55 = 440\pi$

TSA of reaming solid is 440π.

9. Following frequency distribution shows the expenditure on milk of 30 households in a locality :

Daily expenditure on milk (Rs.)	0-30	30-60	60-90	90-120	120-150
Number of households	5	6	9	6	4

Find the mode for the above data.

Sol :

Class 60-90 has the maximum frequency 9, therefore this is model class.

Here, $l_1 = 60$, $f_1 = 9$, $f_0 = 6$, $f_2 = 6$ and $h = 30$

Mode, $M_o = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right)h$

$= 60 + \left(\frac{9 - 6}{2 \times 9 - 6 - 6}\right. \times 30$

$= 60 + \frac{30 \times 3}{6} = 60 + 15 = 75$

10. Find the median of the following data :

Height (in cm)	Less than 120	Less than 140	Less than 160	Less than 180	Less than 200
No. of students	12	26	34	40	50

Sol :

We prepare following cumulative frequency table to find median class.

Height	Frequency	$c.f.$
100-120	12	12
120-140	14	26
140-160	8	34
160-180	6	40
180-200	10	50
Total	$N = 50$	

We have $N = 50$; $\frac{N}{2} = 25$

Cumulative frequency just greater than $\frac{N}{2}$ is 26 and the corresponding class is 120-140. Thus median class is 120-140.

Now, $l = 120$, $f = 14$, $F = 12$ and $h = 20$

Median, $M_d = l + \left(\frac{\frac{N}{2} - F}{f}\right)h$

$= 120 + \left(\frac{25 - 12}{14}\right) \times 20$

$$= 120 + \frac{260}{14}$$

$$= 120 + 18.57$$

$$= 138.57$$

or

The sum of deviations of a set of values x_1, x_2, x_3, ..., x_n, measured from 50 is -10 and the sum of deviations of the values from 46 is 70. Find the value of n and the mean.

Sol :

We have,

$$\sum_{i=1}^{n}(x_i - 50) = -10 \text{ and } \sum_{i=1}^{n}(x_i - 46) = 70$$

$$\sum_{i=1}^{n} x_i - 50n = -10 \qquad ...(1)$$

and $$\sum_{i=1}^{n} x_i - 46n = 70 \qquad ...(2)$$

Subtracting (2) from (1) we get,

$$-4n = -80 \Rightarrow n = 20$$

Substituting this value of n in equation (1) we have

$$\sum_{i=1}^{n} x_i - 50 \times 20 = -10$$

$$\sum_{i=1}^{n} x_i = 990$$

Mean $$M = \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right) = \frac{990}{20} = 49.5$$

Hence, $n = 20$ and mean $= 49.5$

Section C

11. The first term of an AP is 3, the last term is 83 and the sum of all its terms is 903. Find the number of terms and the common difference of the AP.

Sol :

First term, $a = 3$

Last term, $a_n = 83$

Sum of n terms, $S_n = 903$

Since, $$S_n = \frac{n}{2}(a + a_n)$$

$$903 = \frac{n}{2}(3 + 83)$$

$$1806 = 86n$$

$$n = \frac{1806}{86} \Rightarrow n = 21$$

Now $$S_n = \frac{n}{2}[2a + (n-1)d]$$

$$903 = \frac{21}{2}[2 \times 3 + (21-1)d]$$

$$1806 = 21(6 + 20d)$$

$$6 + 20d = 86$$

$$20d = 80 \Rightarrow d = 4$$

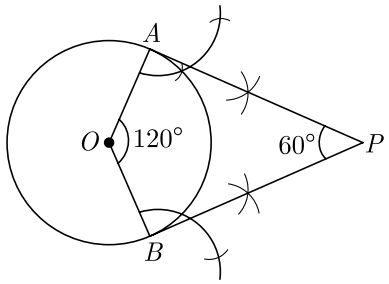
Hence, the common difference is 4.

12. Draw a circle of radius 4 cm. Draw two tangents to the circle inclined at an angle of 60° to each other.

Sol :

Steps of Construction :

1. Draw a circle with centre O and radius 6 cm.
2. Draw two radii OA and OB inclined to each other at an angle of 120°.
3. Draw $AP \perp OA$ at A and $BP \perp OB$ at B, which meet at P.
4. PA and PB are the required tangents inclined to each other an angle of 60°.



or

Draw a circle of radius 4 cm. Draw two tangents to the circle inclined at an angle of 60° to each other.

Sol :

Steps of Construction :

1. Draw a circle with centre O and radius 6 cm.
2. Draw two radii OA and OB inclined to each other at an angle of 120°.
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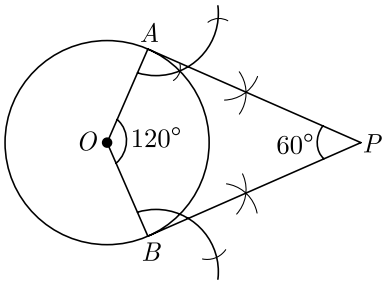
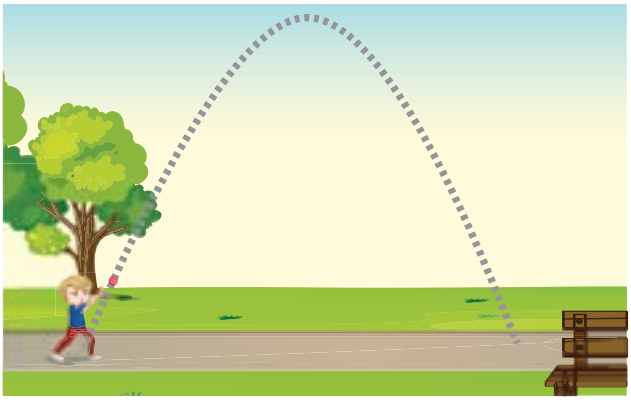


13. Height of a Projectile : A projectile is thrown upward with an initial velocity of 176 ft/sec. After t sec, its height $h(t)$ above the ground is given by the function $h(t) = -16t^2 + 176t$.

(i) What is the projectile's height above the ground after 2 sec.

(ii) How many seconds after it is thrown will the projectile strike the ground?



Sol :

(i) At $t = 2$ sec we have

$$h(2) = -16 \times 2^2 + 176 \quad 2$$
$$= 288 \text{ feet}$$

(ii) At ground, $h(t) = 0$, then

$$0 = -16t^2 + 176t$$
$$0 = -16t(t - 11)$$
$$t = 0, 11 \text{ sec}$$

14. Raju is a design engineer at a large pharmacy company. He has to decide the shape of medicine and for this he has to chose between tablet or captab.

a. Tablet : This is circular tablet.

b. Captab : This is long tablet having semicircular at both end.

The volume of medicine is 924 mm^2.

(i) If Raju decide to make tablet of diameter 14 mm, what is the thickness of tablet ?

(ii) If Raju decide to make captab of dimension 7 by 23.5 mm, what is the thickness of captab ?

Sol :

(i) Surface area of tablet,

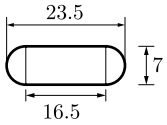
$$S_t = \pi\left(\frac{d}{2}\right)^2 = \frac{22}{7} \times \left(\frac{14}{2}\right)^2 = \frac{22}{7} \times 7^2$$
$$= 22 \times 7 = 154 \text{ mm}^2$$

Let t_t be thickness of tablet, then volume of tablet must be 924 mm^3.

Thus, $924 = 154 \times t_t$

$$t_t = \frac{924}{154} = 6 \text{ mm}$$

(ii) Now we make the digram of captab as follows



Surface area of cabtab

$$S_c = \pi\left(\frac{7}{2}\right)^2 + 16.5 \times 7$$

Let t_c be thickness of cabtab, then volume of captab must be 924 mm^2.

$$924 = \left[\pi\left(\frac{7}{2}\right)^2 + 16.5 \times 7\right] t_c$$
$$924 = \left[\frac{22}{7} \times \frac{7^2}{2^2} + 16.5 \times 7\right] t_c$$
$$924 = \left[11 \times \frac{7}{2} + 16.5 \times 7\right] t_c$$
$$924 = \frac{11 \times 7}{2}[1 + 3] t_c$$
$$924 = 77 \times 2\, t_c$$
$$t_c = \frac{924}{77 \times 2} = 6 \text{ mm}$$

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