Sample Question Paper - 26
Mathematics-Basic (241)
Class- X, Session: 2021-22
TERM II

Time Allowed : 2 hours *Maximum Marks : 40*

General Instructions :

1. *The question paper consists of 14 questions divided into 3 sections A, B, C.*
2. *Section A comprises of 6 questions of 2 marks each. Internal choice has been provided in two questions.*
3. *Section B comprises of 4 questions of 3 marks each. Internal choice has been provided in one question.*
4. *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. How many terms of the A.P. 27, 24, 21, ... should be taken so that their sum is zero?

2. Find the mean of the following data :

Class	1-3	3-5	5-7	7-9
Frequency	10	20	25	19

3. Which term of the progression $20, 19\frac{1}{4}, 18\frac{1}{2}, 17\frac{3}{4}, ...$ is the first negative term?

OR

For what value of k, the numbers x, $2x + k$ and $3x + 6$ are three consecutive terms of an A.P.?

4. The dimensions of a metallic cuboid are 100 cm × 80 cm × 64 cm. It is melted and recast into a cube. Find the side of the cube.

5. If the mean of x, $x + 3$, $x + 6$, $x + 9$ and $x + 12$ is 10, then find the value of x.

6. Draw a circle of radius 2.4 cm. Take a point P on it. Without using the centre of the circle, draw a tangent to the circle at point P.

OR

Draw a line segment of length 7.8 cm and divide it in the ratio 5 : 8.

SECTION - B

7. The altitude of a right-angled triangle is 8 more than its base. If the hypotenuse is 40 cm, then, find the length of the base.

8. In the given figure, if $AP = PB$, then show that $AC = BC$.

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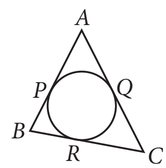
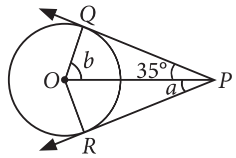


OR

In the given figure, PQ and PR are tangents drawn from point P to a circle with centre O. If $\angle OPQ = 35°$, then find the values of a and b.



9. The angle of elevation of the top of a building from the foot of the tower is 30° and the angle of elevation of the top of the tower from the foot of the building is 60°. If the tower is 60 m high, then find the height of the building.

10. If 4 times the fourth term of an A.P. is equal to 18 times its 18^{th} term, then find its 22^{th} term.

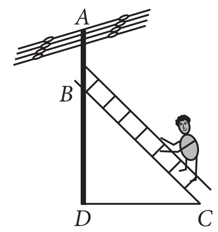
SECTION - C

11. From the top of a building 60 m high, the angles of depression of the top and bottom of a vertical lamp post are observed to be 30° and 60° respectively. Find

(i) the horizontal distance between the building and the lamp post.

(ii) the height of the lamp post.

[Use $\sqrt{3} = 1.732$]



OR

An electrician has to repair an electric fault on a pole of height 5 m. He has to reach a point 1.3 m below the top of the pole to undertake the repair work(see figure). What should be the length of the ladder that he should use which, when inclined at an angle of 60° to the horizontal, would enable him to reach the required position? Also, how far from the foot of the pole he should place the foot of the ladder?

[Use $\sqrt{3}$ = 1.73].

12. The sum of the radius of base and height of a solid right circular cylinder is 37 cm. If the total surface area of the cylinder is 1628 sq. cm, then find the volume of the cylinder. $\left(\text{Use } \pi = \frac{22}{7}\right)$

Case Study - 1

13. Consider the situation where we want to check the knowledge of a student studying in a renowned coaching institute. For this test scores of 100 students is collected. Take a look at the table below to understand the concept better.

Marks obtained in the test (Class interval)	0-5	5-10	10-15	15-20	20-25	25-30
Number of students (Frequency)	3	11	38	34	9	5

Based on the above information, answer the following questions :

(i) What is the class mark for the interval 15-20.

(ii) What is the median class of the given data.

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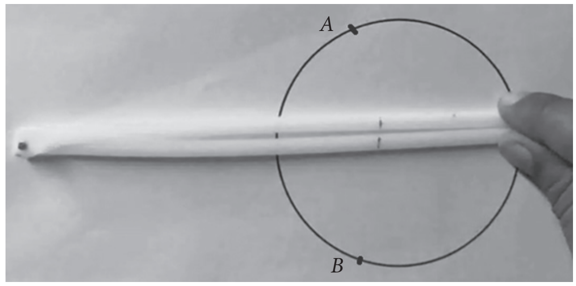
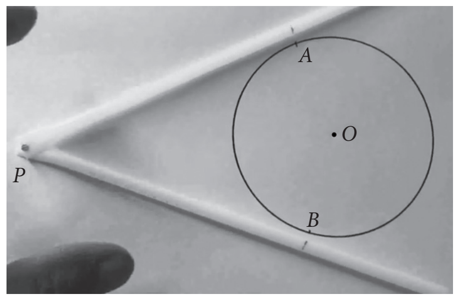
Case Study - 2

14. Prem did an activity on tangents drawn to a circle from an external point using 2 straws and a nail for maths project as shown in figure.





Based on the above information, answer the following questions :

(i) If $\angle AOB = 150°$, then find the measure of $\angle APB$.

(ii) If $\angle APB = 40°$, then find the measure of $\angle BAO$.

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Solution

MATHEMATICS BASIC 241

Class 10 - Mathematics

1. Let a be the first term and d be the common difference of A.P.

Sum of n terms is given as $S_n = \frac{n}{2}[2a+(n-1)d]$

Here, $a = 27$, $d = 24 - 27 = -3$

According to the question,

$0 = \frac{n}{2}[2(27)+(n-1)(-3)]$

$\Rightarrow$ $n[54 - 3n + 3] = 0$ $\Rightarrow$ $n(57 - 3n) = 0$

$\Rightarrow$ $3n = 57$ $\quad (\because\ n \neq 0)$

$\Rightarrow$ $n = 19$

2. The frequency distribution table from the given data can be drawn as :

Class	Class marks (x_i)	Frequency (f_i)	$f_i x_i$
1-3	2	10	20
3-5	4	20	80
5-7	6	25	150
7-9	8	19	152
Total		$\Sigma f_i = 74$	$\Sigma f_i x_i = 402$

$\therefore$ Mean $= \frac{\sum f_i x_i}{\sum f_i} = \frac{402}{74} = 5.43$

3. Given sequence is an A.P. in which $a = 20$ and $d = 19\frac{1}{4} - 20 = \frac{77}{4} - 20 = \frac{-3}{4}$

Let n^{th} term of the given A.P. be the first negative term.

i.e., $a_n < 0 \Rightarrow a + (n-1)d < 0$

$\Rightarrow$ $20 + (n-1)\left(\frac{-3}{4}\right) < 0$ $\Rightarrow$ $80 - 3n + 3 < 0$

$\Rightarrow$ $83 - 3n < 0$

$\Rightarrow$ $3n > 83$ $\Rightarrow$ $n > 27\frac{2}{3}$ $\Rightarrow$ $n = 28$

OR

Since, x, $2x + k$ and $3x + 6$ are in A.P.

$\therefore$ $3x + 6 - (2x + k) = 2x + k - x$

$\Rightarrow$ $x + 6 - k = x + k$ $\Rightarrow$ $6 = 2k$ $\Rightarrow$ $k = 3$

4. Volume of given cuboid $= 100 \times 80 \times 64$

$= 512000\ \text{cm}^3$

Let side of the cube be a cm.

$\therefore$ Volume of the cube = Volume of the cuboid

$\Rightarrow$ $a^3 = 512000 \Rightarrow a = 80$

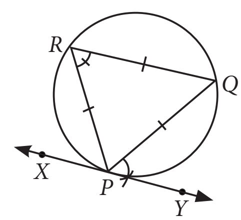
Hence, side of the cube is 80 cm.

5. Mean, $\bar{x} = \frac{\text{Sum of all observations}}{\text{Total number of observations}}$

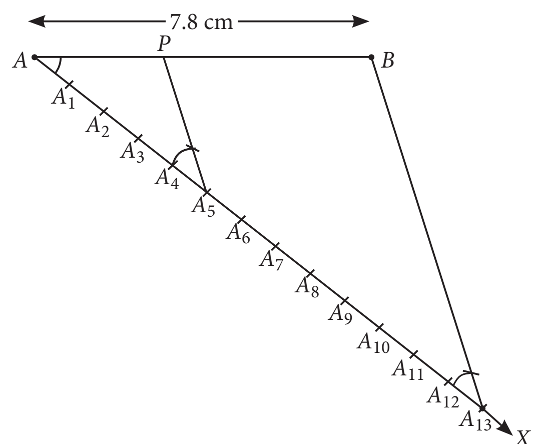
$\Rightarrow$ $10 = \frac{x+(x+3)+(x+6)+(x+9)+(x+12)}{5}$ [Given]

$\Rightarrow$ $50 = 5x + 30 \Rightarrow 5x = 20 \Rightarrow x = 4$

6.



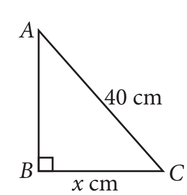
OR



7. Let ΔABC is the given triangle.

Let base, $BC = x$ cm, then altitude, $AB = (x + 8)$ cm

By Pythagoras theorem, we have



$(AB)^2 + (BC)^2 = (AC)^2$

$\Rightarrow$ $(x + 8)^2 + x^2 = 40^2$

$\Rightarrow$ $x^2 + 64 + 16x + x^2 = 1600$

$\Rightarrow$ $2x^2 + 16x - 1536 = 0$

$\Rightarrow$ $x^2 + 8x - 768 = 0$

$\Rightarrow$ $x^2 + 32x - 24x - 768 = 0$

$\Rightarrow$ $x(x + 32) - 24(x + 32) = 0$

$\Rightarrow$ $(x + 32)(x - 24) = 0 \Rightarrow x = -32$ or $x = 24$

But side of a triangle can't be negative.

$\therefore$ $x = 24$

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8. Since, the tangents drawn from an external point to a circle are equal in length.

$\therefore \; AP = AQ$ ...(i)

$BP = BR$ ...(ii)

and $CR = CQ$ ...(iii)

Now, $AP = PB$ [Given]

$\Rightarrow \; AQ = BR$ [Using (i) and (ii)]

$\Rightarrow \; AQ + QC = BR + QC$ [Adding QC on both sides]

$\Rightarrow \; AC = BR + RC$ [Using (iii)]

$\Rightarrow \; AC = BC$

OR

Since, PQ is a tangent.

$\therefore \; \angle OQP = 90°$

In ΔPQO, $\angle OQP + \angle OPQ + \angle QOP = 180°$

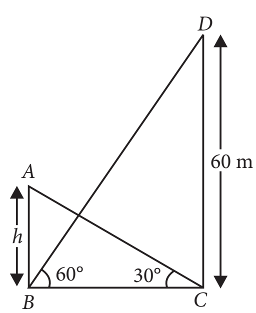
[By angle sum property]

$\Rightarrow \; 90° + 35° + b = 180° \Rightarrow b = 180° - 125° = 55°$

Clearly, the tangents from an external point P to the circle are equally inclined to OP.

$\therefore \; \angle RPO = \angle OPQ \Rightarrow a = 35°$

9. Let AB be the building of height h m and CD be the tower.



Given, $\angle ACB = 30°$,

$\angle CBD = 60°$ and $CD = 60$ m

In ΔBCD, $\cot 60° = \dfrac{BC}{CD}$

$\Rightarrow \; BC = 60 \times \dfrac{1}{\sqrt{3}}$

$= 20\sqrt{3}$ m ...(i)

In ΔACB, $\tan 30° = \dfrac{AB}{BC}$

$\Rightarrow \; \dfrac{1}{\sqrt{3}} = \dfrac{h}{20\sqrt{3}} \Rightarrow h = 20$ m (Using (i))

Thus, the height of the building is 20 m.

10. Let a and d be the first term and common difference respectively of an A.P.

Given, $4a_4 = 18(a_{18})$

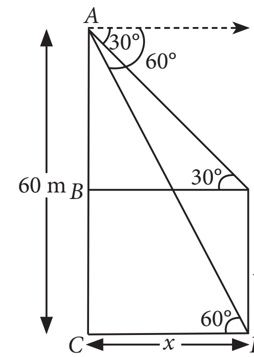
$\Rightarrow \; 4(a + 3d) = 18(a + 17d) \Rightarrow 4a + 12d = 18a + 306d$

$\Rightarrow \; 14a + 294d = 0$ ...(i)

$\Rightarrow \; 14a = -294d$ or $a = -21d$

Now, $a_{22} = a + (22 - 1)d = a + 21d = -21d + 21d = 0$ [From (i)]

11. Let $AC = 60$ m is the height of building and DE is the lamp post. Let x be the horizontal distance between the building and the lamp post and y be the height of the lamp post.



$CD = BE = x$,

$ED = BC = y$

$\therefore \; AB = AC - BC = 60 - y$

(i) Now, in ΔACD,

$$\tan 60° = \frac{AC}{CD} = \frac{60}{x}$$

$$\Rightarrow \; \sqrt{3} = \frac{60}{x} \Rightarrow x = \frac{60}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$\Rightarrow \; x = 20\sqrt{3}$

$\Rightarrow \; x = 20 \times 1.732 = 34.64$ m

Thus, the horizontal distance between the building and the lamp post = 34.64 m

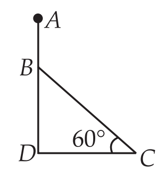
(ii) In ΔABE, $\tan 30° = \dfrac{AB}{BE} = \dfrac{60 - y}{x}$

$$\Rightarrow \; \frac{1}{\sqrt{3}} = \frac{60 - y}{x} \Rightarrow x = \sqrt{3}(60 - y)$$

$\Rightarrow \; 20 = 60 - y \Rightarrow y = 60 - 20 = 40$ m $\left[\because \; x = 20\sqrt{3}\right]$

$\therefore$ Height of the lamp post = 40 m.

OR



In figure, the electrician is required to reach the point B on the pole AD.

So, $BD = AD - AB = (5 - 1.3)$ m $= 3.7$ m

Here, BC represents the ladder. We need to find its length, *i.e.*, the hypotenuse of the right triangle BDC.

In right ΔBDC, we have

$$\sin 60° = \frac{BD}{BC} \Rightarrow \frac{\sqrt{3}}{2} = \frac{3.7}{BC}$$

$$\therefore \; BC = \frac{3.7 \times 2}{\sqrt{3}} = 4.27 \text{ m (Approx.)}$$

i.e., the length of the ladder should be 4.27 m.

Now, $\dfrac{DC}{BD} = \cot 60° = \dfrac{1}{\sqrt{3}}$

i.e., $DC = \dfrac{3.7}{\sqrt{3}} = 2.14$ m (Approx.)

Therefore, he should place the foot of the ladder at a distance of 2.14 m from the pole.

12. Let the height of a cylinder = h cm and the radius of a cylinder = r cm

Given, $r + h = 37$ cm

Total surface area of cylinder = $2\pi rh + 2\pi r^2$

$\Rightarrow \; 2\pi r(r + h) = 1628 \Rightarrow 2\pi r(37) = 1628$

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$\Rightarrow \quad r = \frac{1628 \times 7}{2 \times 22 \times 37} = 7$

$\therefore \quad r + h = 37 \Rightarrow 7 + h = 37 \quad \Rightarrow \quad h = 30$

Hence, volume of cylinder = $\pi r^2 h$

$= \frac{22}{7} \times 7 \times 7 \times 30 = 4620 \text{ cm}^3$

13. (i) Class-mark = $\frac{\text{lower limit} + \text{upper limit}}{2}$

$\therefore$ Class mark of 15-20 = $\frac{15+20}{2} = \frac{35}{2} = 17.5$

(ii) We have the following table :

Class-interval	**Frequency (f_i)**	**Cumulative frequency (*c.f.*)**
0-5	3	3
5-10	11	14
10-15	38	52
15-20	34	86
20-25	9	95
25-30	5	100
Total	$\Sigma fi = 100$	

Here, $n = 100$

$\Rightarrow \quad \frac{n}{2} = 50$

$\therefore$ Median class = 10-15

14. (i) In quadrilateral $OAPB$, $\angle AOB = 150°$ [Given]

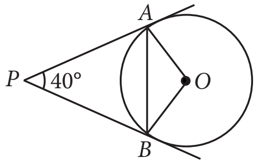
$\angle OAP = \angle OBP = 90°$

$\therefore \quad \angle APB = 360° - 90° - 90° - 150° = 30°$

(ii) We have, $\angle APB = 40°$

Now, $PA = PB$

[Since, the length of tangents drawn from an external point are equal]



In ΔPAB, $\angle PAB = \angle PBA = 70°$

[Angles opposite to equal sides are equal]

Also, $\angle PAB + \angle BAO = 90°$

[Since, radius at the point of contact is perpendicular to tangent]

$\Rightarrow \quad \angle BAO = 90° - 70° = 20°$

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