CBSE Grade X

Mathematics

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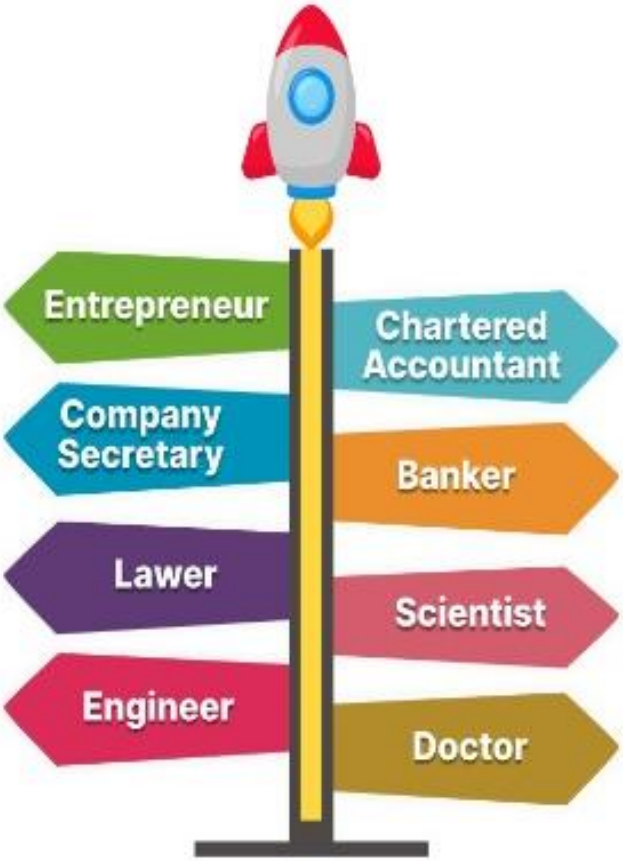

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Sample Paper 1

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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. Solve for x (in terms of a and b) :

$\frac{a}{x-b}+\frac{b}{x-a}=2, x \neq a, b$

OR

Value of the roots of the quadratic equation, $x^2-x-6=0$ are ..... .

2. If the 1^{st} term of a series is 7 and 13^{th} term is 35. Find the sum of 13 terms of the sequence.

3. A circle is inscribed in a ΔABC touching AB, BC and AC at P, Q and R respectively. If $AB=10\,\text{cm}$ $AR=7\,\text{cm}$ and $CR=5\,\text{cm}$, then find the length of BC

4. A solid metallic of dimensions $9\text{m} \times 8\text{m} \times 2$ m is melted and recast into solid cubes of edge 2 m. Find the number of cubes so formed.

5. Write the relationship connecting three measures of central tendencies. Hence find the median of the give data if mode is 24.5 and mean is 29.75.

6. The following distribution shows the marks scored by 140 students in an examination. Calculate the mode of the distribution :

Marks	0-10	10-20	20-30	30-40	40-50
Number of students	20	24	40	36	20

OR

Calculate the median from the following data :

Marks	0-10	10-20	20-30	30-40	40-50
Number of Students	5	15	30	8	2

Section B

7. Solve the following equation: $\frac{1}{x} - \frac{1}{x-2} = 3,\ x \neq 0, 2$

8. The 17^{th} term of an AP is 5 more than twice its 8^{th} term. If 11^{th} term of AP is 43, then find its n^{th} term.

9. A man on the top of a vertical tower observes a car moving at a uniform speed coming directly towards it. If it takes 18 minutes for the angle of depression to change from 30° to 60°, how soon after this will the car reach the tower?

10. Construct a tangent to a circle of radius 4 cm from a point on the concentric circle of radius 6 cm and measure its length. Also to verify the measurement by actual calculation.

OR

raw a circle of radius 2 cm with centre O and take a point P outside the circle such that $OP = 6.5$ cm. From P , draw two tangents to the circle.

Section C

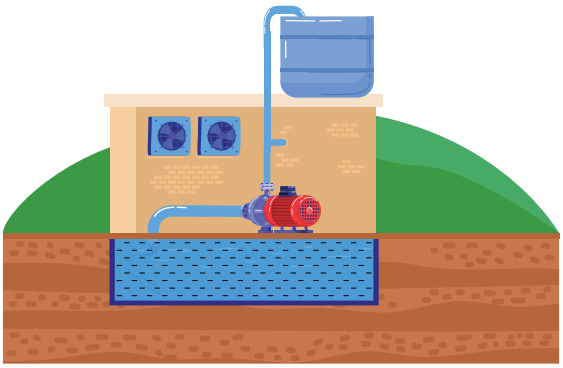
11. The angle of depression of two ships from an aeroplane flying at the height of 7500 m are 30° and 45°. If both the ships are in the same that one ship is exactly behind the other, find the distance between the ships.

12. Prove that tangent drawn at any point of a circle perpendicular to the radius through the point contact.

OR

Prove that tangent drawn at any point of a circle perpendicular to the radius through the point contact.

13. Underground water tank is popular in India. It is usually used for large water tank storage and can be built cheaply using cement-like materials. Underground water tanks are typically chosen by people who want to save space. The water in the underground tank is not affected by extreme weather conditions. The underground tanks maintain cool temperatures in both winter and summer. Electric pump is used to move water from the underground tank to overhead tank.



Ramesh has build recently his house and installed a underground tank and overhead tank. Dimensions of tanks are as follows :
Underground Tank : Base 2 m × 2 m and Height 1.1 m.
Overhead tank : Radius 50 cm and Height 175 cm

(i) What is the capacity of the underground tank ?
(ii) What is the ratio of the capacity of the underground tank to the capacity of the overhead tank?

14. An inspector in an enforcement squad of electricity department visit to a locality of 100 families and record their monthly consumption of electricity, on the basis of family members, electronic items in the house and wastage of electricity, which is summarise in the following table.

Monthly Consumption (in kwh)	Number of families
0-100	2
100-200	5
200-300	x
300-400	12
400-500	17
500-600	20
600-700	y
700-800	9
800-900	7
900-1000	4

Inspector calculated that median of the above data is 525 and after that he lost two data which is given as x and y in table.
Based on the above information, answer the following questions.
(i) What is the value of lost data x ?
(ii) What is the value of lost data y ?

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Sample Paper 1 Solutions

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Mathematics Standard (041)

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SECTION A

1. Solve for x (in terms of a and b) :

$\frac{a}{x-b}+\frac{b}{x-a}=2, x \neq a, b$

Ans :

We have $\frac{a(x-a)+b(x-b)}{(x-b)(x-a)}=2$

$a(x-a)+b(x-b) = 2\left[x^2-(a+b)x+ab\right]$

$ax-a^2+bx-b^2 = 2x^2-2(a+b)x+2ab$

$2x^2-3(a+b)x+(a+b)^2 = 0$

$2x^2-2(a+b)x-(a-b)x+(a+b)^2 = 0$

$\left[2x-(a+b)\right]\left[x-(a+b)\right] = 0$

Thus $x = a+b, \frac{a+b}{2}$

OR

Value of the roots of the quadratic equation, $x^2-x-6=0$ are ..... .

Ans :

$x^2-x-6 = 0$

$x^2-3x+2x-6 = 0$

$x(x-3)+2(x-3) = 0$

$(x-3)(x+2) = 0 \Rightarrow x = 3$ and $x = -2$

2. If the 1^{st} term of a series is 7 and 13^{th} term is 35. Find the sum of 13 terms of the sequence.

Ans :

Let the first term be a, common difference be d, n th term be a_n and sum of n term be S_n.

Here $a=7, a_{13}=35$

$a_n = a+(n-1)d$

$a_{13} = a+12d$

$35 = 7+12d \Rightarrow d = \frac{7}{3}$

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

$S_{13} = \frac{13}{2}\left[2\times 7+12\times\left(\frac{7}{3}\right)\right]$

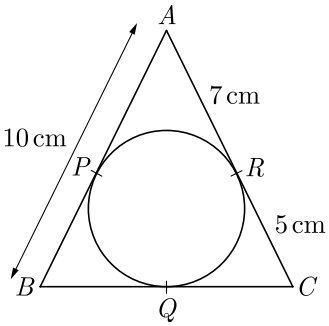
$= \frac{13}{2}[14+28] = \frac{13}{2}\times 42 = 273$

3. A circle is inscribed in a ΔABC touching AB, BC and AC at P, Q and R respectively. If $AB=10$ cm $AR=7$ cm and $CR=5$ cm, then find the length of BC

Ans :

As per given information we have drawn the figure below.

Here a circle is inscribed in a ΔABC touching AB, BC and AC at P, Q and R respectively.



Since, tangents drawn to a circle from an external point are equal,

$AP = AR = 7$ cm

$CQ = CR = 5$ cm

Now, $BP = (AB - AP) = 10 - 7 = 3$ cm

$BP = BQ = 3$ cm

$BC = BQ + QC = 3 + 5 = 8$ cm

4. A solid metallic of dimensions 9m $\times$ 8m $\times$ 2 m is melted and recast into solid cubes of edge 2 m. Find the number of cubes so formed.

Ans :

Volume of cuboid $= 9 \times 8 \times 2$ cm^3

Volume of cube $= 2^3$ cm^3

m160

Let number of recast cubes be n.

Volume of n cubes = Volume of cuboid

$$n2^3 = 9 \times 8 \times 2$$

$$n \times 2 \times 2 \times 2 = 9 \times 8 \times 2$$

$$n = \frac{9 \times 8 \times 2}{2 \times 2 \times 2} = 18$$

Hence, number of cubes recast is 18.

5. Write the relationship connecting three measures of central tendencies. Hence find the median of the give data if mode is 24.5 and mean is 29.75.

Ans :

Mode, $M_o = 24.5$

and mean, $M = 29.75$

The relationship connecting measures of central tendencies is,

n183

$$3M_d = M_o + 2M$$

Thus $3M_d = 24.5 + 2 \times 59.50$

$= 24.5 + 59.50 = 84.0$

Median $M_d = \frac{84}{3} = 28$

6. The following distribution shows the marks scored by 140 students in an examination. Calculate the mode of the distribution :

Marks	0-10	10-20	20-30	30-40	40-50
Number of students	20	24	40	36	20

Ans :

Class 20-30 has the maximum frequency 40, therefore this is model class.

Here, $l = 20, f_1 = 40, f_0 = 24, f_2 = 36, h = 10$

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

n184

$$= 20 + \frac{(40 - 24)}{80 - 24 - 36} \times 10$$

$$= 20 + \frac{16 \times 10}{20} = 28$$

OR

Calculate the median from the following data :

Marks	0-10	10-20	20-30	30-40	40-50
Number of Students	5	15	30	8	2

Ans :

We prepare following cumulative frequency table to find median class.

Marks	No. of students	c.f.
0-10	5	5
10-20	15	20
20-30	30	50
30-40	8	58
40-50	2	60
	$N = 60$	

We have $N = 60$; $\frac{N}{2} = 30$

Cumulative frequency just greater than $\frac{N}{2}$ is 50 and the corresponding class is 20-30. Thus median class is 20-20.

n182

Now $l = 20,\ f = 30,\ F = 20,\ h = 10$

Median, M_d

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

$$= 20 + \left(\frac{30 - 20}{30}\right) \times 10$$

$$= 20 + \frac{100}{30} = 20 + 3.33$$

Thus $Md = 23.33$

Section B

7. Solve the following equation: $\frac{1}{x} - \frac{1}{x-2} = 3,\ x \neq 0, 2$

Ans :

We have $\frac{1}{x} - \frac{1}{x-2} = 3$ $(x \neq 0, 2)$

d188

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

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

$$3x(x-2) = -2$$

$$3x^2 - 6x + 2 = 0$$

Comparing it by $ax^2 + bx + c$, we get $a = 3$, $b = -6$ and $c = 2$.

Now, $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-(-6) \pm \sqrt{(-6)^2 - 4(3)(2)}}{2(3)}$$

$$= \frac{6 \pm \sqrt{36 - 24}}{6} = \frac{6 \pm \sqrt{12}}{6}$$

$$= \frac{6 \pm 2\sqrt{3}}{6}$$

$$= \frac{3 + \sqrt{3}}{3}, \frac{3 - \sqrt{3}}{3}$$

8. The 17^{th} term of an AP is 5 more than twice its 8^{th} term. If 11^{th} term of AP is 43, then find its n^{th} term.

Ans :

Let a be the first term and d be the common difference.

n^{th} term of an AP,

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

Since 17^{th} term of an AP is 5 more than twice of its 8^{th} term, thus

e228

$$a + (17-1)\,d = 5 + 2[a + (8-1)\,d]$$

$$a + 16d = 5 + 2(a + 7d)$$

$$a + 16d = 5 + 2a + 14d$$

$$2d - a = 5 \quad \ldots(1)$$

Since 11^{th} term of AP is 43,

$$a + (11-1)\,d = 43$$

$$a + 10d = 43 \quad \ldots(2)$$

Solving equation (1) and (2), we have

$$a = 3 \text{ and } d = 4$$

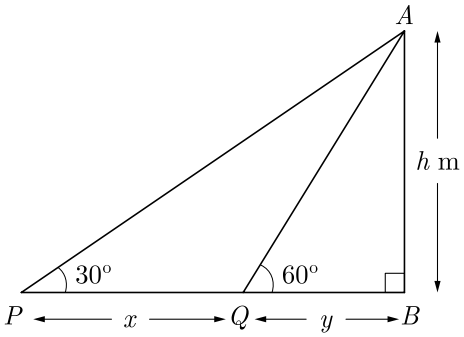
Hence, n^{th} term would be

$$a_n = 3 + (n-1)4 = 4n - 1$$

9. A man on the top of a vertical tower observes a car moving at a uniform speed coming directly towards it. If it takes 18 minutes for the angle of depression to change from 30° to 60°, how soon after this will the car reach the tower?

Ans :

Let h be the height of tower AB. Now as per given in question, we have drawn figure below.



i175

In ΔABQ, $\tan 60^\circ = \frac{AB}{BQ}$

$$\sqrt{3} = \frac{h}{y}$$

$$y = \frac{h}{\sqrt{3}} = \frac{h\sqrt{3}}{3}$$

In ABP, $\tan 30^\circ = \frac{AB}{BP}$

$$\frac{1}{\sqrt{3}} = \frac{h}{x + y}$$

$$x + y = \sqrt{3}\,h$$

$$x = \sqrt{3}\,h - y$$

$$= \sqrt{3}\,h - \frac{\sqrt{3}\,h}{3}$$

$$= \frac{2\sqrt{3}\,h}{3}$$

Thus, speed of car $s = \frac{2\sqrt{3}\,h}{3 \times 18} = \frac{\sqrt{3}\,h}{27}$ m/min

Time for remaining distance,

$$t = \frac{\frac{h\sqrt{3}}{3}}{\frac{h\sqrt{3}}{27}} = 9 \text{ min}$$

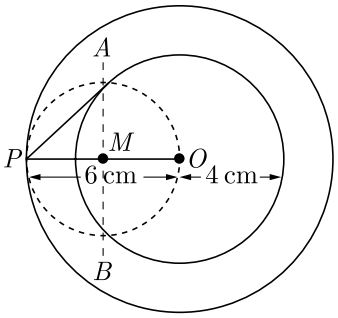
Hence, time taken by car is 9 min.

10. Construct a tangent to a circle of radius 4 cm from a point on the concentric circle of radius 6 cm and measure its length. Also to verify the measurement by actual calculation.

Ans :

Steps of Construction :

1. Draw two concentric circles with centre O and radii 4 cm and 6 cm.
2. Now take any point P on outer circle.
3. Join PO and bisect it and let the midpoint of PO is represented by M.
4. Taking M as centre and OM or MP as radius, draw a circle such that this circle intersects the circle (of radius 4 cm) at A and B.
5. Join AP. PA is the required tangent.
   By measurement, $PA = 4.5$ cm



Justification :

k178

Join OA. As PO is diameter

$$\angle PAO = 90^\circ$$

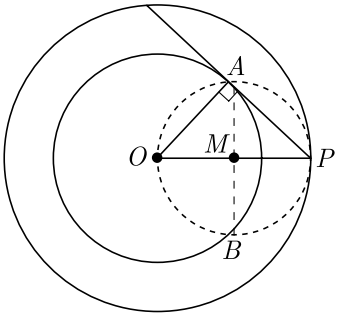
(Angle in a semi-circle)

$$PA \perp OA$$

OA is a radius of the inner circle.

Verification of length of PA. In right ΔPAO,

$$PO = 6\,\text{cm},\ OA = 4\,\text{cm}$$



$$PA = \sqrt{6^2 - 4^2} = \sqrt{36 - 16}$$
$$= \sqrt{20} = 4.47\,\text{cm}$$

Hence, both lengths are approximately equal.

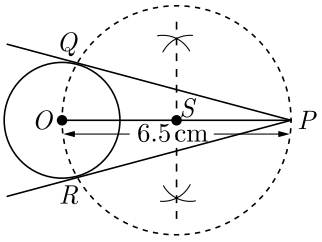
OR

raw a circle of radius 2 cm with centre O and take a point P outside the circle such that $OP = 6.5\,\text{cm}$. From P, draw two tangents to the circle.

Ans :

1. Draw a line segment OP of length 6.5 cm.
2. Draw a circle taking O as centre and radius 2

1. and PR are two tangents.



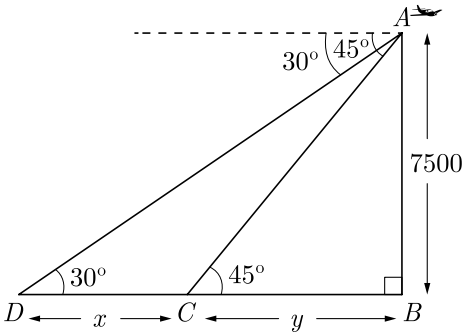
k145

Section C

11. The angle of depression of two ships from an aeroplane flying at the height of 7500 m are 30° and 45°. If both the ships are in the same that one ship is exactly behind the other, find the distance between the ships.

Ans :

Let A, C and D be the position of aeroplane and two ship respectively. Aeroplane is flying at 7500 m height from point B. As per given in question we have drawn figure below.



i208

In right ΔABC we have

$$\frac{AB}{BC} = \tan 45^\circ$$

$$\frac{7500}{y} = 1$$

$$y = 7500 \quad ...(1)$$

$$\frac{7500}{x+y} = \frac{1}{\sqrt{3}}$$

$$x + y = 7500\sqrt{3} \quad ...(2)$$

Substituting the value of y from (1) in (2) we have

$$x + 7500 = 7500\sqrt{3}$$

$$x = 7500\sqrt{3} - 7500$$

$$= 7500(\sqrt{3} - 1)$$

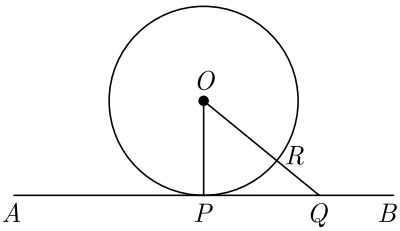
$$= 7500(1.73 - 1)$$
$$= 7500 \times 0.73 = 5475 \text{ m}$$

Hence, the distance between two ships is 5475 m.

12. Prove that tangent drawn at any point of a circle perpendicular to the radius through the point contact.

Ans :

Consider a circle with centre O with tangent AB at point of contact P as shown in figure below



j220

Let Q be point on AB and we join OQ. Suppose it touch the circle at R.

We $OP = OR$ (Radius)

Clearly $OQ > OR$

$OQ > OP$

Same will be the case with all other points on circle. Hence OP is the smallest line that connect AB and smallest line is perpendicular.

Thus $OP \perp AB$

or, $OP \perp PQ$ Hence Proved

OR

Prove that tangent drawn at any point of a circle perpendicular to the radius through the point contact.

Ans :

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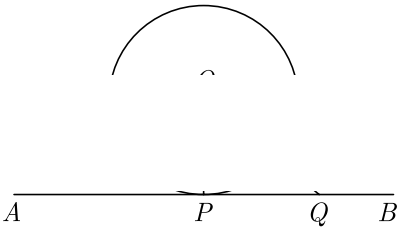

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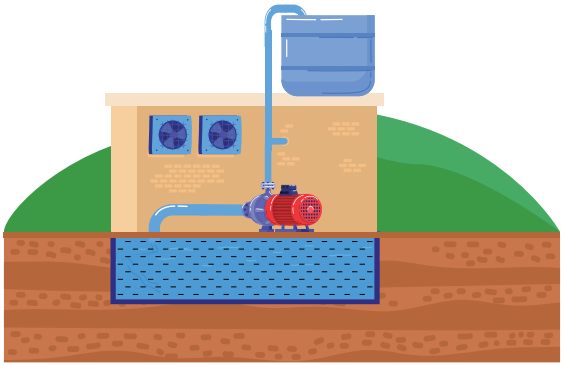

Ramesh has build recently his house and installed a underground tank and overhead tank. Dimensions of tanks are as follows :

Underground Tank : Base 2 m × 2 m and Height 1.1 m.

Overhead tank : Radius 50 cm and Height 175 cm

(i) What is the capacity of the underground tank ?

(ii) What is the ratio of the capacity of the underground tank to the capacity of the overhead tank?

Ans :

(i) Volume of underground tank,

$$4.4 \text{ m}^3 = 4.4 \times 1000 = 4400 \text{ litres}$$

(ii) Radius of overhead is 50 cm i.e. $\frac{1}{2}$ meter and height is 175 cm i.e $1.75 = \frac{7}{4}$ metre.

Thus volume of overhead tank,

$$\pi r^2 h_{cy} = \frac{22}{7} \times \frac{1}{2} \times \frac{1}{2} \times \frac{7}{4} = \frac{11}{8} \text{ m}^3$$

$$\frac{\text{Capacity of sump}}{\text{Capacity of Overhead tank}} = \frac{lbh}{\pi r^2 h_{cy}} = \frac{4.4}{\frac{11}{8}} = 3.2$$

14. An inspector in an enforcement squad of electricity department visit to a locality of 100 families and record their monthly consumption of electricity, on the basis of family members, electronic items in the house and wastage of electricity, which is summarise in the following table.

Monthly Consumption (in kwh)	Number of families
0-100	2
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200-300	x
300-400	12
400-500	17
500-600	20
600-700	y
700-800	9
800-900	7
900-1000	4

Inspector calculated that median of the above data is 525 and after that he lost two data which is given as x and y in table.

Based on the above information, answer the following questions.

(i) What is the value of lost data x ?

(ii) What is the value of lost data y ?

We prepare following cumulative frequency table

Monthly Consumption (in kwh)	Number of families	Cumulative Frequency
0-100	2	2
100-200	5	7
200-300	x	$7+x$
300-400	12	$19+x$
400-500	17	$36+x$
500-600	20	$56+x$
600-700	y	$56+x+y$
700-800	9	$65+x+y$
800-900	7	$72+x+y$
900-1000	4	$76+x+y$
Total	$76+x+y$	

Since total frequency is 100,

$$76+x+y = 100$$
$$x+y = 100-76 = 24$$

Here median is 525, thus median class is 500-600. Also $\frac{N}{2} = \frac{100}{2} = 50$.

Now, $l = 500$, $\frac{N}{2} = 50$, $F = 36+x$, $f = 20$ and $h = 100$.

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

$$525 = 500 + \left(\frac{50-36-x}{20}\right) \times 100$$

$$25 = (14-x) \times 5$$
$$25 = 70 - 5x$$
$$x = \frac{70-25}{5} = 9$$

Now $y = 24 - 9 = 15$

(i) Thus $x = 9$

(ii) $y = 15$

□□□□□□□

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Sample Paper 2

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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

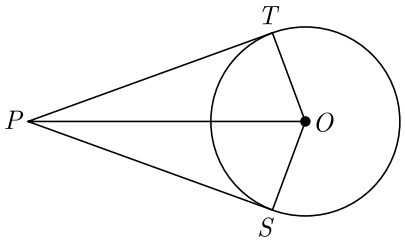
1. If $x = \frac{2}{3}$ and $x = -3$ are roots of the quadratic equation $ax^2 + 7x + b = 0$, find the values of a and b.

OR

Find the nature of roots of the quadratic equation $2x^2 - \sqrt{5}\,x + 1 = 0$.

2. If the n^{th} term of a sequence is $3 - 2n$. Find the sum of fifteen terms.

3. In the given figure, from a point P, two tangents PT and PS are drawn to a circle with centre O such that $\angle SPT = 120^\circ$, Prove that $OP = 2PS$.



4. From a solid cylinder whose height is 2.4 cm and diameter 1.4 cm, a conical cavity of the same height and same diameter is hollowed out. Find the volume of the remaining solid to the nearest cm^3. Use $\pi = \frac{22}{7}$

5. Find the unknown entries a, b, c, d in the following distribution of heights of students in a class :

Height (in cm)	Frequency	Cumulative Frequency
150-155	12	12
155-160	a	25
160-165	10	b
165-170	c	43
170-175	5	48
175-180	2	d

6. Find the mode of the following distribution :

Classes	25-30	30-35	35-40	40-45	45-50	50-55
Frequency	25	34	50	42	38	14

OR

Consider the following distribution :

Marks Obtained	0 or more	10 or more	20 or more	30 or more	40 or more	50 or more
Number of students	63	58	55	51	48	42

(i) Calculate the frequency of the class 30 - 40.
(ii) Calculate the class mark of the class 10 - 25.

Section B

7. Solve for x :

$\frac{x+1}{x-1}+\frac{x-2}{x+2}=4-\frac{2x+3}{x-2}; x \neq 1,-2,2$

8. If 7^{th} term of an AP is $\frac{1}{9}$ and 9^{th} term is $\frac{1}{7}$, find 63^{rd} term.

9. A girl on a ship standing on a wooden platform, which is 50 m above water level, observes the angle of elevation of the top of a hill as 30° and the angle of depression of the base of the hill as 60°. Calculate the distance of the hill from the platform and the height of the hill.

10. Draw a circle of radius 3 cm. Take two points P and Q on one of its extended diameter each at a distance of 7 cm from its centre. Draw tangents to the circle from these two points P and Q.

OR

Draw a line segment AB of length 7 cm. Taking A as centre, draw a circle of radius 3 cm and taking B as centre, draw another circle of radius 2 cm. Construct tangents to each circle from the centre of the other circle.

Section C

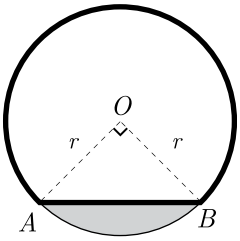
11. The angles of depression of the top and bottom of an 8 m tall building from top of a multi-storeyed building are 30^o and 45^o, respectively. Find the height of multi-storey building and distance between two buildings.

Two tangents PA and PB are drawn from an external point P to a circle with centre O, such that $\angle APB = \angle x$ and $\angle AOB = y$. Prove that opposite angles are supplementary.

13. Atal Tunnel (also known as Rohtang Tunnel) is a highway tunnel built under the Rohtang Pass in the eastern Pir Panjal range of the Himalayas on the Leh-Manali Highway in Himachal Pradesh. At a length of 9.02 km, it is the longest tunnel above 10,000 feet (3,048 m) in the world and is named after former Prime Minister of India, Atal Bihari Vajpayee. The tunnel reduces the travel time and overall distance between Manali and Keylong on

the way to Leh. Moreover, the tunnel bypasses most of the sites that were prone to road blockades, avalanches, and traffic snarls.

Earth is excavated to make a railway tunnel. The tunnel is a cylinder of radius 7 m and length 450 m. A level surface is laid inside the tunnel to carry the railway lines. Figure given below shows the circular cross - section of the tunnel. The level surface is represented by AB, the centre of the circle is O and $\angle AOB = 90^\circ$. The space below AB is filled with rubble (debris from the demolition buildings).



(i) How much volume of earth is removed to make the tunnel ?
(ii) A coating is to be done on the surface of inner curved part of tunnel. What is the area of tunnel to be being coated ?

14. Life insurance is a contract between an insurance policy holder and an insurer or assurer, where the insurer promises to pay a designated beneficiary a sum of money upon the death of an insured person (often the policy holder). Depending on the contract, other events such as terminal illness or critical illness can also trigger payment. The policy holder typically pays a premium, either regularly or as one lump sum.

SBI life insurance agent found the following data for distribution of ages of 100 policy holders. Calculate the median age, if policies are given only to persons having age 18 years onwards but less than 60 years.

Age (in years)	Number of policy holders
Below 20	2
Below 25	6
Below 30	24
Below 35	45
Below 40	78
Below 45	89
Below 50	92
Below 55	98
Below 60	100

(i) What is the median value of age ?
(ii) What is the mode value of age ?

****

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Sample Paper 2 Solutions

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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. If $x=\frac{2}{3}$ and $x=-3$ are roots of the quadratic equation $ax^2+7x+b=0$, find the values of a and b.

Ans :

We have $ax^2+7x+b=0$ (1)

Substituting $x=\frac{2}{3}$ in above equation we obtain

$$\frac{4}{9}a+\frac{14}{3}+b=0$$

$$4a+42+9b=0$$

d170

$$4a+9b=-42 \quad (2)$$

and substituting $x=-3$ in (1) we obtain

$$9a-21+b=0$$

$$9a+b=21 \quad (3)$$

Solving (2) and (3), we get $a=3$ and $b=-6$

OR

Find the nature of roots of the quadratic equation $2x^2-\sqrt{5}\,x+1=0$.

Ans :

We have $2x^2-\sqrt{5x}+1=0$

Comparing with $ax^2+bx+c=0$ we get $a=2$, $b=-\sqrt{5}$ and $c=1$,

Now $b^2-4ac=\left(-\sqrt{5}\right)^2-4\times(2)\times(1)$

$=5-8=-3<0$

Since, discriminant is negative, therefore quadratic equation $2x^2-\sqrt{5}\,x+1=0$ has no real roots i.e., imaginary roots.

d132

2. If the n^{th} term of a sequence is $3-2n$. Find the sum of fifteen terms.

Ans :

Let the first term be a, common difference be d, n th term be a_n and sum of n term be S_n

Here, $a_n=3-2n$

Taking $n=1$, $a_1=3-2=1$

15th term, $a_{15}=3-2\times15=3-30=-27$

Now $S_n=\frac{n}{2}(a_1+a_n)$

$$S_{15}=\frac{15}{2}(a_1+a_{15})$$

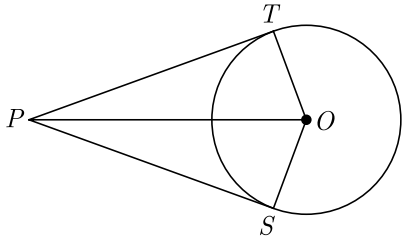
$$=\frac{15}{2}[1+(-27)]$$

$$=\frac{15}{2}[-26]$$

$$=15\times(-13)=-195$$

e206

3. In the given figure, from a point P, two tangents PT and PS are drawn to a circle with centre O such that $\angle SPT=120^\circ$, Prove that $OP=2PS$.



Ans :

We have $\angle SPT=120^\circ$

As OP bisects $\angle SPT$,

$$\angle OPS=\frac{120^\circ}{2}=60^\circ$$

j178

Since radius is always perpendicular to tangent,

$$\angle PTO = 90^\circ$$

Now in right triangle POS, we have

$$\cos 60^\circ = \frac{PS}{OP}$$

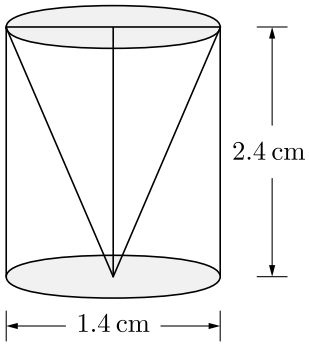
$$\frac{1}{2} = \frac{PS}{OP}$$

$$OP = 2PS \qquad \text{Hence proved.}$$

4. From a solid cylinder whose height is 2.4 cm and diameter 1.4 cm, a conical cavity of the same height and same diameter is hollowed out. Find the volume of the remaining solid to the nearest cm³. Use $\pi = \frac{22}{7}$

Ans :

As per question the figure is shown below.



m161

Volume of remaining solid is difference of volume of cylinder and volume of cone.

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

$$= \frac{2}{3} \times \frac{22}{7} \times (0.7)^2 \times 2.4$$

$$= 44 \times 0.1 \times 0.7 \times 0.8$$

$$= 4.4 \times .56 = 2.464 \text{ cm}^3.$$

5. Find the unknown entries a, b, c, d in the following distribution of heights of students in a class :

Height (in cm)	Frequency	Cumulative Frequency
150-155	12	12
155-160	a	25
160-165	10	b
165-170	c	43
170-175	5	48
175-180	2	d

Ans :

From the table,

$$12 + a = 25 \Rightarrow a = 25 - 12 = 13$$

$$25 + 10 = b \Rightarrow b = 35,$$

$$b + c = 43 \Rightarrow$$

$$c = 43 - b = 13 - 35 = 8$$

$$\text{and } 48 + 2 = d \Rightarrow d = 50$$

n185

6. Find the mode of the following distribution :

Classes	25 - 30	30 - 35	35 - 40	40 - 45	45 - 50	50 - 55
Frequency	25	34	50	42	38	14

Ans :

Class 35-40 has the maximum frequency 50, therefore this is model class.

Now $l = 35$, $f_1 = 50$, $f_2 = 42$, $f_0 = 34$, $h = 5$

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

$$= 35 + \frac{50 - 34}{100 - 34 - 42} \times 5$$

$$= 35 + \frac{16 \times 5}{24} = 38.33$$

n186

OR

Consider the following distribution :

Marks Obtained	0 or more	10 or more	20 or more	30 or more	40 or more	50 or more
Number of students	63	58	55	51	48	42

(i) Calculate the frequency of the class 30 - 40.
(ii) Calculate the class mark of the class 10 - 25.

Ans :

Class Interval	c.f.	f
0-10	63	5
10-20	58	3
20-30	55	4
30-40	51	3
40-50	48	6
50-60	42	42

n162

(i) Frequency of the class 30 - 40 is 3.

(ii) Class mark of the class $:10 - 25 = \frac{10 + 25}{2}$

$$= \frac{35}{2} = 17.5$$

Section B

7. Solve for x :

$\frac{x+1}{x-1} + \frac{x-2}{x+2} = 4 - \frac{2x+3}{x-2}; x \neq 1, -2, 2$

Ans :

We have $\frac{x+1}{x-1} + \frac{x-2}{x+2} = 4 - \frac{2x+3}{x-2}$

$$\frac{x^2+3x+2+x^2-3x+2}{x^2+x-2} = \frac{4x-8-2x-3}{x-2}$$

$$\frac{2x^2+4}{x^2+x-2} = \frac{2x-11}{x-2}$$

$$(2x^2+4)(x-2) = (2x-11)(x^2+x-2)$$

$$5x^2+19x-30 = 0$$

$$(5x-6)(x+5) = 0$$

$$x = -5, \frac{6}{5}$$

d191

8. If 7^{th} term of an AP is $\frac{1}{9}$ and 9^{th} term is $\frac{1}{7}$, find 63^{rd} term.

Ans :

Let the first term be a, common difference be d and nth term be a_n.

We have $a_7 = \frac{1}{9} \Rightarrow a+6d = \frac{1}{9}$ (1)

$$a_9 = \frac{1}{7} \Rightarrow a+8d = \frac{1}{7} \quad (2)$$

Subtracting equation (1) from (2) we get

$$2d = \frac{1}{7} - \frac{1}{9} = \frac{2}{63} \Rightarrow d = \frac{1}{63}$$

e232

Substituting the value of d in (2) we get

$$a + 8 \times \frac{1}{63} = \frac{1}{7}$$

$$a = \frac{1}{7} - \frac{8}{63} = \frac{9-8}{63} = \frac{1}{63}$$

$$a_{63} = a + 62 \times \frac{1}{63} = \frac{1}{63} + \frac{62}{63}$$

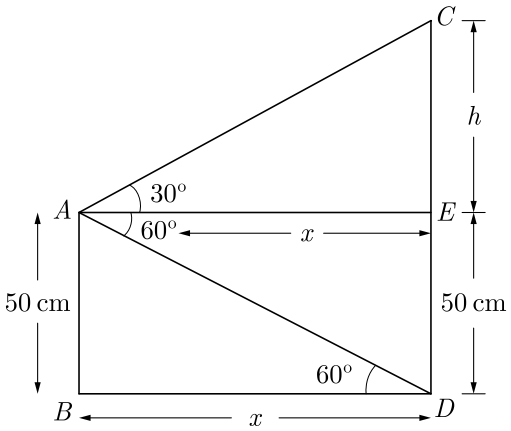
$$= \frac{63}{63} = 1$$

Hence, $a_{63} = 1$.

9. A girl on a ship standing on a wooden platform, which is 50 m above water level, observes the angle of elevation of the top of a hill as 30° and the angle of depression of the base of the hill as 60°. Calculate the distance of the hill from the platform and the height of the hill.

Ans :

Let AB be the wooden platform of height 50 m. As per question we have shown the figure below. Here total height of hill is CD and h is the height of hill above platform.



Now, $CD = CE + ED$

$= (h+50)$ m

$BD = AE = x$

i176

In ΔABD, $\tan 60^\circ = \frac{AB}{BD}$

$$\sqrt{3} = \frac{50}{x}$$

$$x = \frac{50}{\sqrt{3}} = \frac{50\sqrt{3}}{3} \text{ m}$$

In ΔCEA, $\tan 30^\circ = \frac{CE}{AE}$

$$\frac{1}{\sqrt{3}} = \frac{h}{x}$$

$$h = \frac{x}{\sqrt{3}} = \frac{50\sqrt{3}}{3} \times \frac{1}{\sqrt{3}} = \frac{50}{3} \text{ m}$$

Now, $CD = h + 50$

$$= \frac{3}{3} \text{ m} = 66.66 \text{ m}$$

So, distance between hill and platform is $\frac{50\sqrt{3}}{3}$ m and height of hill is 66.66 m.

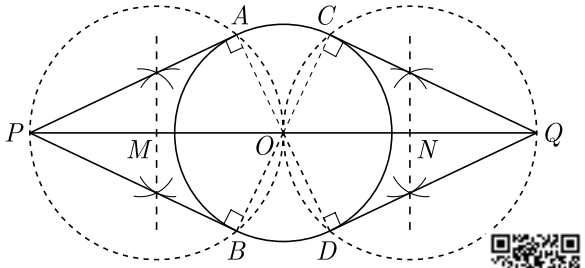
10. Draw a circle of radius 3 cm. Take two points P and Q on one of its extended diameter each at a distance of 7 cm from its centre. Draw tangents to

the circle from these two points P and Q.

Ans :

Steps of Construction :

1. Draw a circle of radius 4 cm with centre O and draw a diameter.
2. Extend its diameter on both sides and cut $OP = OQ = 9\,\text{cm}$.
3. Bisect PO such that M be its mid-point.
4. Taking M as centre and MO as radius, draw a circle. Let it intersect the given circle at A and B .
5. Join PA and PB.
   Thus, PA and PB are the two required tangents from P.
6. Now bisect OQ such that N is its mid-point.
7. Taking N as centre and NO as radius, draw a circle. Let it intersect the given circle at C and D.
8. Join QC and QD.
   Thus, QC and QD are the required tangents from Q.



k179

Justification :

Join OA to get,

$$\angle OAP = 90^\circ$$

(Angle in a semi-circle)

Since $PA \perp OA$, thus PA is a tangent.

Similarly, $PB \perp OA$ PB is a tangent.

Now, join OC to get,

$$\angle QCO = 90^\circ \quad \text{(Angle in a semi-circle)}$$

Since $QC \perp OC$, thus QC is a tangent.

Similarly, $QD \perp OC$, thus QD is a tangent.

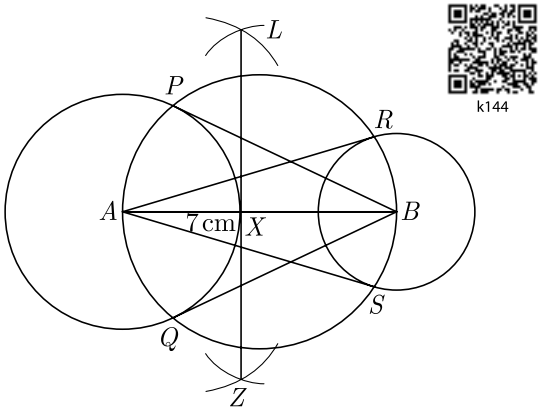
OR

Draw a line segment AB of length 7 cm. Taking A as centre, draw a circle of radius 3 cm and taking B as centre, draw another circle of radius 2 cm. Construct tangents to each circle from the centre of the other circle.

Ans :

Steps of construction :

1. Draw a line segment AB of length 7 cm.
2. Draw a circle with A as centre and radius 3 cm.
3. Draw another circle with B as centre and radius 2 cm.



k144

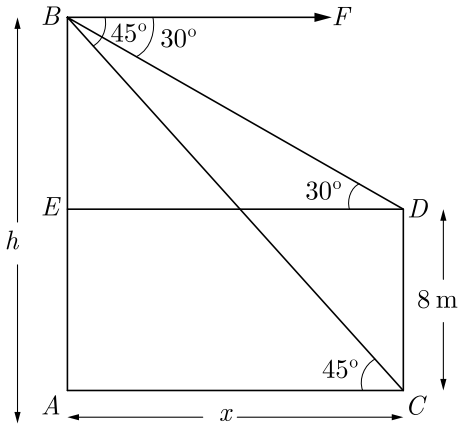
4. Draw another circle taking AB as diameter circle, which intersects first two circles at P and Q, R and S.
5. Join B to P, B to Q A to R and A to S.
   Hence, BP, BQ, AR and AS are the required tangents.

Section C

11. The angles of depression of the top and bottom of an 8 m tall building from top of a multi-storeyed building are 30° and 45°, respectively. Find the height of multi-storey building and distance between two buildings.

Ans :

As per given in question we have drawn figure below.



Here $AE = CD = 8$ m

$BE = AB - AE = (h - 8)$

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and $AC = DE = x$

Also, $\angle FBD = \angle BDE = 30^\circ$

$\angle FBC = \angle BCA = 45^\circ$

i210

In right angled ΔCAB we have

$$\tan 45^\circ = \frac{AB}{AC}$$

$$1 = \frac{h}{x} \Rightarrow x = h \quad ...(1)$$

In right angled ΔEDB

$$\tan 30^\circ = \frac{BE}{ED}$$

$$\frac{1}{\sqrt{3}} = \frac{h-8}{x}$$

$$x = \sqrt{3}(h-8) \quad ...(2)$$

From (1) and (2), we get

$$h = \sqrt{3}h - 8\sqrt{3}$$

$$8\sqrt{3} = \sqrt{3}h - h$$

$$h = \frac{8\sqrt{3}}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1}$$

$$= 4\sqrt{3}(\sqrt{3}+1) = (12+4\sqrt{3}) \text{ m}$$

Since, $x = h$, $x = (12+4\sqrt{3})$

Distance $= (12+4\sqrt{3})$ m

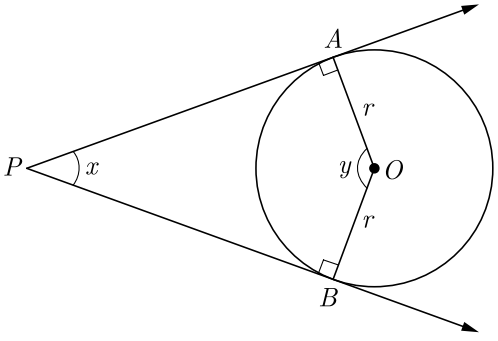
$= 4(3+\sqrt{3})$ m

Hence the height of multi storey building is $4(3+\sqrt{3})$ m.

12. Two tangents PA and PB are drawn from an external point P to a circle with centre O, such that $\angle APB = \angle x$ and $\angle AOB = y$. Prove that opposite angles are supplementary.

Ans :

As per question we draw figure shown below.



Now $OA \perp AP$ and $OB \perp BP$ because tangent drawn at any point of a circle is perpendicular to the radius through the point contact.

Thus $\angle A = \angle B = 90^\circ$

Since, $AOBP$ is a quadrilateral,

j221

$$\angle A + \angle B + x + y = 360^\circ$$

$$90^\circ + 90^\circ + x + y = 360^\circ$$

$$180 + x + y = 360^\circ$$

$$x + y = 180^\circ$$

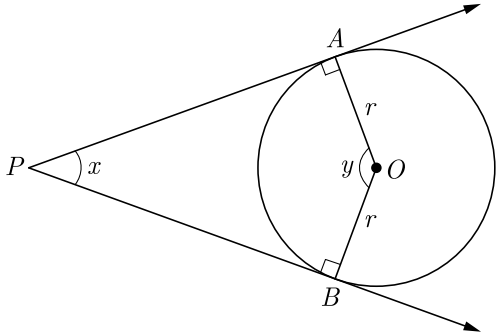
Therefore opposite angle are supplementary.

OR

Two tangents PA and PB are drawn from an external point P to a circle with centre O, such that $\angle APB = \angle x$ and $\angle AOB = y$. Prove that opposite angles are supplementary.

Ans :

As per question we draw figure shown below.



Now $OA \perp AP$ and $OB \perp BP$ because tangent drawn at any point of a circle is perpendicular to the radius through the point contact.

Thus $\angle A = \angle B = 90^\circ$

Since, $AOBP$ is a quadrilateral,

j221

$$\angle A + \angle B + x + y = 360^\circ$$

$$90^\circ + 90^\circ + x + y = 360^\circ$$

$$180 + x + y = 360^\circ$$

$$x + y = 180^\circ$$

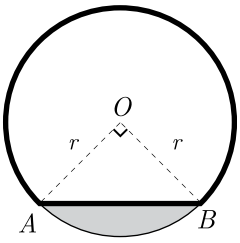
Therefore opposite angle are supplementary.

13. Atal Tunnel (also known as Rohtang Tunnel) is a highway tunnel built under the Rohtang Pass in the eastern Pir Panjal range of the Himalayas on the Leh-Manali Highway in Himachal Pradesh. At a length of 9.02 km, it is the longest tunnel above 10,000 feet (3,048 m) in the world and is named after former Prime Minister of India, Atal Bihari Vajpayee. The tunnel reduces the travel time and overall distance between Manali and Keylong on the way to Leh. Moreover, the tunnel bypasses most of the sites that were prone to road blockades,

avalanches, and traffic snarls.

Earth is excavated to make a railway tunnel. The tunnel is a cylinder of radius 7 m and length 450 m. A level surface is laid inside the tunnel to carry the railway lines. Figure given below shows the circular cross - section of the tunnel. The level surface is represented by AB, the centre of the circle is O and $\angle AOB = 90^\circ$. The space below AB is filled with rubble (debris from the demolition building)

m280



(i) How much volume of earth is removed to make the tunnel ?

(ii) A coating is to be done on the surface of inner curved part of tunnel. What is the area of tunnel to be being coated ?

Ans :

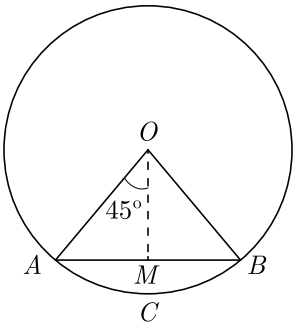
(i) Cross-section area of tunnel to be excavated $= \pi r^2$

Volume of earth to be removed,

$$\pi r^2 l = \frac{22}{7} \times 7 \times 7 \times 450$$

$$= 69300 \text{ m}^3$$

(ii) The geometry of cross-section is shown below.



Triangle OAB is isosceles triangle having right angle at O.

Length of curved part of cross-section,

$$= \frac{2\pi r(360^\circ - 90^\circ)}{360^\circ}$$

$$= \frac{2 \times \frac{22}{7} \times 7(360^\circ - 90^\circ)}{360^\circ}$$

$$= \frac{2 \times 22 \times 270^\circ}{360^\circ} = 33 \text{ m}$$

Total curved surface area of tunnel

= Length of curved part of cross-section $\times$ Length of tunnel

$$= 33 \times 450 = 14850 \text{ m}^2$$

14. Life insurance is a contract between an insurance policy holder and an insurer or assurer, where the insurer promises to pay a designated beneficiary a sum of money upon the death of an insured person (often the policy holder). Depending on the contract, other events such as terminal illness or critical illness can also trigger payment. The policy holder typically pays a premium, either regularly or as one lump sum.

SBI life insurance agent found the following data for distribution of ages of 100 policy holders. Calculate the median age, if policies are given only to persons having age 18 years onwards but less than 60 years.

Age (in years)	Number of policy holders
Below 20	2

Below 25	6
Below 30	24
Below 35	45
Below 40	78
Below 45	89
Below 50	92
Below 55	98
Below 60	100

(i) What is the median value of age ?
(ii) What is the mode value of age ?

n303

Ans :

The given table is cumulative frequency distribution. We write the frequency distribution as given below:

Class interval	Cumulative Frequency	Frequency
15-20	2	$2-0=2$
20-25	6	$6-2=4$
25-30	24	$24-6=18$
30-35	45	$45-24=21$
35-40	78	$78-45=33$
40-45	89	$89-78=11$
45-50	92	$92-89=3$
50-55	98	$98-92=6$
55-60	100	$100-98=2$

We have, $\sum f_i = N = 100$

(i) Cumulative frequency just greater than $\frac{N}{2}=\frac{100}{2}=50$ is 78 and the corresponding class is 35-40. Thus median class is 35-40.
Now, $l = 35$, $\frac{N}{2}=50$, $F=45$, $f=33$ and $h=5$

$$\text{Median, } M_d = l+\left(\frac{\frac{N}{2}-F}{f}\right)h$$
$$= 35+\left[\frac{50-45}{33}\right]\times 5$$
$$= 35+\frac{20}{11}$$
$$= 35+1.82 = 36.82 \text{ years}$$

Thus, the median age 35.76 years.

(ii) Now $l = 35$, $f_1 = 33$, $f_2 = 11$, $f_0 = 21$, $h = 5$

$$\text{Mode, } M_o = l+\left(\frac{f_1-f_0}{2f_1-f_0-f_2}\right)h$$
$$= 35+\frac{33-21}{66-21-11}\times 5$$
$$= 35+\frac{12}{33}\times 5$$

□□□□□□□

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Sample Paper 3

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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

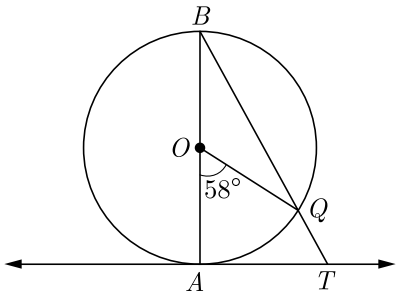
1. Solve for x : $\sqrt{6x+7}-(2x-7)=0$

OR

For what values of k, the equation $9x^2+6kx+4=0$ has equal roots?

2. The n^{th} term of an AP is given by $(-4n+15)$. Find the sum of first 20 terms of this AP.

3. In given figure, AB is the diameter of a circle with centre O and AT is a tangent. If $\angle AOQ=58^\circ$, find $\angle ATQ$.



4. A 5 m wide cloth is used to make a conical tent of base diameter 14 m and height 24 m. Find the cost of cloth used at the rate of Rs.25 per meter.

5. Find x and y from the following cumulative frequency distribution :

Classes	Frequency	c.f.
0-8	15	15
8-16	x	28
16-24	15	43
24-32	18	y
32-40	09	70

6. The frequency distribution of agricultural holdings in a village below :

Area of land (in hectare)	1-3	3-5	5-7	7-9	9-11	11-13
Number of families	20	45	80	55	40	12

Find the modal agricultural holding of the village.

OR

Find median of the data, using an empirical relation when it is given that Mode = 12.4 and Mean = 10.5.

Section B

7. Solve the following quadratic equation for x :

$x^2+\left(\frac{a}{a+b}+\frac{a+b}{a}\right)x+1=0$

8. The sum of first n terms of three arithmetic progressions are S_1, S_2 and S_3 respectively. The first term of each AP is 1 and common differences are 1, 2 and 3 respectively. Prove that $S_1+S_3=2S_2$.

9. The angles of depression of the top and bottom of a building 50 meters high as observed from the top of a tower are 30° and 60° respectively. Find the height of the tower, and also the horizontal distance between the building and the tower.

10. Draw a pair of tangents to a circle of radius 5 cm which are inclined to each other at an angle of 60°.

OR

Construct a tangent to a circle of radius 4 cm from a point on the concentric circle of radius 6 cm.

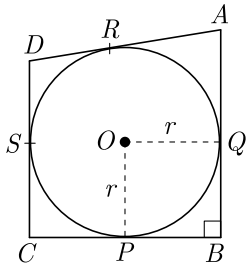
Section C

11. The angle of elevation of a cloud from a point 120 m above a lake is 30° and the angle of depression of its reflection in the lake is 60°. Find the height of the cloud.

12. In figure, PQ is a chord of a circle O and PT is a tangent. If $\angle QPT=60^\circ$, find $\angle PRQ$.

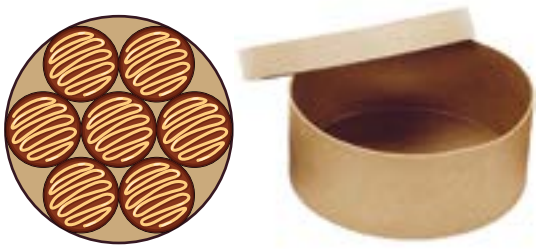
OR

In figure, a circle with centre O is inscribed in a quadrilateral $ABCD$ such that, it touches the sides BC, AB, AD and CD at points P, Q, R and S respectively. If $AB=29$ cm, $AD=23$ cm, $\angle B=90^\circ$ and $DS=5$ cm, then find the radius of the circle (in cm).



13. A bakery is an establishment that produces and sells flour-based food baked in an oven such as bread, cookies, cakes, pastries, and pies. Some retail bakeries are also categorized as cafés, serving coffee and tea to customers who wish to consume the baked goods on the premises.

Tania runs a bakery shop and her bakery is very famous for tasty biscuits. The amount of mixture required to make one biscuit is 18 cu cm. Before it is cooked, the mixture is rolled into a sphere. After the biscuit is cooked, the biscuit becomes a cylinder of radius 3 cm and height 0.7 cm. The increase in volume is due to air being trapped in the biscuit. Biscuits are packed in a cylindrical card box of height 14 cm. The arrangement of biscuits is shown below.



(i) What is the volume of the biscuits after it is cooked ? What is the volume of air trapped, while cooking the biscuit ?

(ii) How much space is vacant in box after biscuits are packed ?

14. The Kendriya Vidyalaya Sangathan is a system of premier central government schools in India that are instituted under the aegis of the Ministry of Education (MHRD), Government of India. As of October 2020, it has a total of 1239 schools. It is one of the world's largest chains of schools. The system came into being in 1963 under the name 'Central Schools'. Later, the name was changed to Kendriya Vidyalaya. Its schools are all affiliated to the Central Board of Secondary Education (CBSE). The objective of KVS is to cater to the educational needs of the children of transferable Central Government employees including Defence and Para-Military personnel by providing a common programme of education.

Commissioner of Regional office Jaipur prepare a table of the marks obtained of 100 students which is given below

Marks obtained	0-20	20-40	40-60	60-80	80-100
Number of students	15	18	21	29	p

He was told that mean marks of a student is 53.

(i) What is the value of model marks ?

(ii) What is the value of median marks ?

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Sample Paper 3 Solutions

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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. Solve for x : $\sqrt{6x+7}-(2x-7)=0$

Ans :

We have $\sqrt{6x+7}-(2x-7)=0$

or, $\sqrt{6x+7}=(2x-7)$

Squaring both sides we get

$$\begin{aligned} 6x+7 &= (2x-7)^2 \\ 6x+7 &= 4x^2-28x+49 \\ 4x^2-34x+42 &= 0 \\ 2x^2-17x+21 &= 0 \\ 2x^2-14x-3x+21 &= 0 \\ 2x(x-7)-3(x-7) &= 0 \\ (x-7)(2x-3) &= 0 \end{aligned}$$

d171

Thus $x=7$ and $x=\frac{2}{3}$.

OR

For what values of k, the equation $9x^2+6kx+4=0$ has equal roots?

Ans :

We have, $9x^2+6kx+4=0$

For equal roots, $D=0$,

$$\begin{aligned} b^2-4ac &= 0 \\ (6k)^2-4(a)(4) &= 0 \\ 36k^2-144 &= 0 \\ 36k^2 &= 144 \\ k^2 &= 4 \\ k &= \pm 2 \end{aligned}$$

d120

2. The n^{th} term of an AP is given by $(-4n+15)$. Find the sum of first 20 terms of this AP.

Ans :

Let the first term be a, common difference be d, n th term be a_n and sum of n term be S_n.

We have $a_n=-4n+15$

$$\begin{aligned} a_1 &= -4\times 1+15=11 \\ a_2 &= -4\times 2+15=7 \\ a_3 &= -4\times 3+15=3 \\ d &= a_2-a_1=7-11=-4 \end{aligned}$$

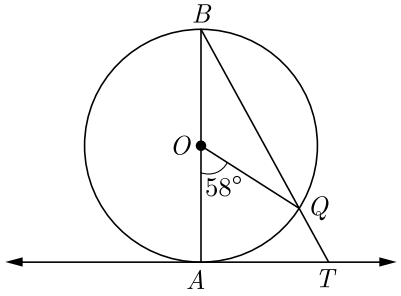
e208

Now, we have $a=11$, $d=-4$

$$\begin{aligned} S_n &= \frac{n}{2}[2a+(n-1)d] \\ S_{20} &= \frac{20}{2}[2\times 11+(20-1)\times(-4)] \\ &= 10[22-76]=10\times(-54)=-540 \end{aligned}$$

Thus $S_{20}=-540$.

3. In given figure, AB is the diameter of a circle with centre O and AT is a tangent. If $\angle AOQ=58^\circ$, find $\angle ATQ$.



j180

Ans :

We have $\angle AOQ=58^\circ$

Since angle $\angle ABQ$ and $\angle AOQ$ are the angle on the circumference of the circle by the same arc,

$$\angle ABQ = \frac{1}{2}\angle AOQ$$

$$= \frac{1}{2} \times 58^\circ = 29^\circ$$

Here OA is perpendicular to TA because OA is radius and TA is tangent at A.

Thus $\angle BAT = 90^\circ$

$\angle ABQ = \angle ABT$

Now in ΔBAT,

$$\angle ATB = 90^\circ - \angle ABT$$

$$= 90^\circ - 29^\circ = 61^\circ$$

Thus $\angle ATQ = \angle ATB = 61^\circ$

4. A 5 m wide cloth is used to make a conical tent of base diameter 14 m and height 24 m. Find the cost of cloth used at the rate of Rs.25 per meter.

Ans :

We have radius $r = 7$ m and height $h = 24$ m

Slant height of tent,

$$l = \sqrt{r^2 + h^2} = \sqrt{7^2 + 24^2}$$

$$= \sqrt{625} = 25 \text{ m.}$$

m164

Curved surface area of cone,

$$\pi rl = \frac{22}{7} \times 7 \times 25 = 550 \text{ m}^2$$

Curves surface area of tent will be required area of cloth. Let x meter of cloth is required

$$5x = 550 \text{ or, } x = \frac{550}{5} = 110 \text{ m.}$$

Thus 110 m of cloth is required.

$$\text{Cost of cloth} = 25 \times 110 = Rs.2750.$$

5. Find x and y from the following cumulative frequency distribution :

Classes	Frequency	c.f.
0-8	15	15
8-16	x	28
16-24	15	43
24-32	18	y
32-40	09	70

Ans :

From the cumulative frequency distribution

$$15 + x = 28 \Rightarrow x = 28 - 15 =$$

and $43 + 18 = y \Rightarrow y = 61$

n187

Hence, $x = 13$ and $y = 61$

6. The frequency distribution of agricultural holdings in a village below :

Area of land (in hectare)	1-3	3-5	5-7	7-9	9-11	11-13
Number of families	20	45	80	55	40	12

Find the modal agricultural holding of the village.

Ans :

Class 5-7 has the maximum frequency 80, therefore this is model class.

Here $l = 5, f_1 = 80, f_0 = 45, h = 2, f_2 = 55$

n188

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

$$= 5 + \frac{80 - 45}{160 - 45 - 55} \times 2$$

$$= 5 + \frac{35 \times 2}{60}$$

$$= 6.17$$

OR

Find median of the data, using an empirical relation when it is given that Mode = 12.4 and Mean = 10.5 .

Ans :

Mode, $M_o = 12.4$

Mean, $M = 10.5$

Median, M_d

n161

$$= \frac{1}{3}M + \frac{2}{3}M_o$$

$$= \frac{1}{3}(12.4) + \frac{2}{3}(10.5) = \frac{12.4}{3} + \frac{21}{3}$$

$$= \frac{12.4 + 21}{3} = \frac{33.4}{3} = 11.13$$

Section B

7. Solve the following quadratic equation for x :

$$x^2 + \left(\frac{a}{a+b} + \frac{a+b}{a}\right)x + 1 = 0$$

Ans :

We have $x^2 + \left(\frac{a}{a+b} + \frac{a+b}{a}\right)x + 1 = 0$

$$x^2 + \frac{a}{a+b}x + \frac{a+b}{a}x + 1 = 0$$

d193

$$x\Big(x+\frac{a}{a+b}\Big)+\frac{a+b}{a}\Big(x+\frac{a}{a+b}\Big)=0$$

$$\Big(x+\frac{a}{a+b}\Big)\Big(x+\frac{a+b}{a}\Big)=0$$

Thus $x = \frac{-a}{a+b}, \frac{-(a+b)}{a}$

8. The sum of first n terms of three arithmetic progressions are S_1, S_2 and S_3 respectively. The first term of each AP is 1 and common differences are 1, 2 and 3 respectively. Prove that $S_1 + S_3 = 2S_2$.

Ans :

Let the first term be a, common difference be d, n th term be a_n and sum of n term be S_n.

We have $S_1 = 1+2+3+\ldots..n$

$S_2 = 1+3+5+\ldots..$ up to n terms

$S_3 = 1+4+7+\ldots..$ upto n terms

Now $S_n = \frac{n(n+1)}{2}$

$S_2 = \frac{n}{2}[2+(n-1)2] = \frac{n}{2}[2n] = n^2$

and $S_3 = \frac{n}{2}[2+(n-1)3] = \frac{n(3n-1)}{2}$

Now, $S_1 + S_3 = \frac{n(n+1)}{2} + \frac{n(3n-1)}{2}$

$= \frac{n[n+1+3n-1]}{2} = \frac{n[4n]}{2}$

$= 2n^2 = 2s_2$ Hence Proved

9. The angles of depression of the top and bottom of a building 50 meters high as observed from the top of a tower are 30° and 60° respectively. Find the height of the tower, and also the horizontal distance between the building and the tower.

Ans :

Let AB be the building of height 50 m and CD be tower of height h. Angle of depressions of top and

Now, $DE = AB = 50$ m

$CE = CD - DE = (h-50)$ m

Again, we have

$\angle CAE = 30^\circ$ and $\angle CBD = 60^\circ$

In $\Delta AEC, \tan 30^\circ = \frac{CE}{AE}$

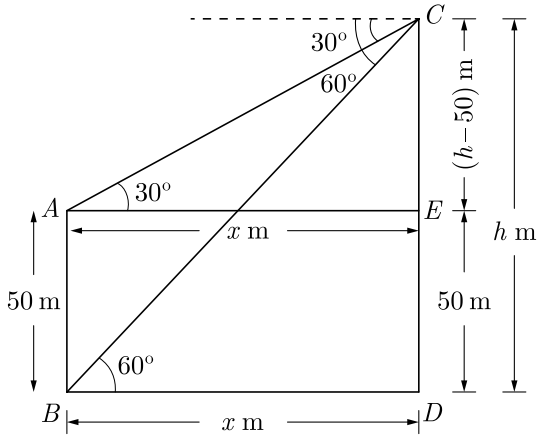
$\frac{1}{\sqrt{3}} = \frac{h-50}{x}$

$x = \sqrt{3}(h-50)$ ...(1)

In $\Delta BDC, \tan 60^\circ = \frac{CD}{BD}$

$\sqrt{3} = \frac{h}{x}$

$x = \frac{h}{\sqrt{3}}$ ...(2)



From equation (1) and equation (2), we have

$\sqrt{3}(h-50) = \frac{h}{\sqrt{3}}$

$3(h-50) = h$

$3h - 150 = h$

$2h = 150 \Rightarrow h = 75$

Substituting $h = 75$ in equation (2), we get

$x = \frac{h}{\sqrt{3}} = \frac{75}{\sqrt{3}} = 25\sqrt{3}$

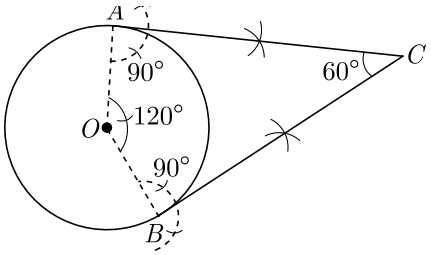
$= 25 \times 1.73 = 43.2$ m

Hence, height of the tower is 75 m and distance between the building and the tower is 43.2 m.

10. Draw a pair of tangents to a circle of radius 5 cm which are inclined to each other at an angle of 60°.

Ans :

Steps of Construction :



3. Draw a perpendicular on OA at A.
4. Draw another perpendicular on OB at B.
5. Let the two perpendiculars meet at C.
   Thus, CA and CB are the two required tangents to the given circle which are inclined to each other at 60°.

Justification :

In a quadrilateral $OACB$, using angle sum property, we

k180

$$\begin{aligned} 120^\circ + 90^\circ + 90^\circ + \angle ACB &= 360^\circ \\ 300^\circ + \angle ACB &= 360^\circ \\ \angle ACB &= 360^\circ - 300^\circ \\ &= 60^\circ. \end{aligned}$$

OR

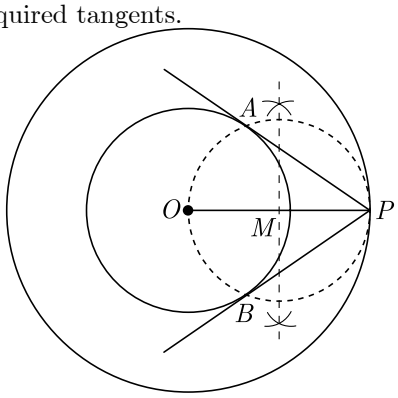
Construct a tangent to a circle of radius 4 cm from a point on the concentric circle of radius 6 cm.

Ans :

Steps of Construction :

1. Draw a circle with centre O and radius 4 cm.
2. Draw another circle with centre O and radius 6 cm.
3. Take a point P on outer circle and join OP.
4. Draw perpendicular bisector of OP which intersect OP at M.
5. Draw a circle with centre M which intersects inner circle at points A and B.
6. Join AP and BP. Thus AP and BP are required tangents.

k138

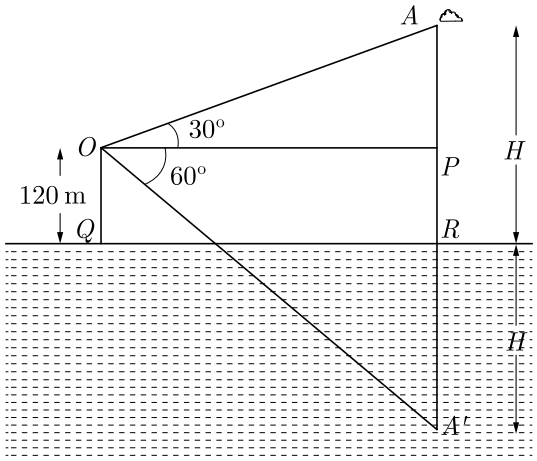


Section C

11. The angle of elevation of a cloud from a point 120 m above a lake is 30° and the angle of depression of its reflection in the lake is 60°. Find the height of the cloud.

Ans :

As per given in question we have drawn figure below.



Here A is cloud and A' is refection of cloud

i213

In right ΔAOP we have

$$\begin{aligned} \tan 30^\circ &= \frac{PA}{OP} \\ \frac{1}{\sqrt{3}} &= \frac{H-120}{OP} \\ OP &= (H-120)\sqrt{3} \qquad ...(1) \end{aligned}$$

In right $\Delta OPA'$ we have

$$\begin{aligned} \tan 60^\circ &= \frac{PA'}{OP} \\ \sqrt{3} &= \frac{H+120}{OP} \\ OP &= \frac{H+120}{\sqrt{3}} \qquad ...(2) \end{aligned}$$

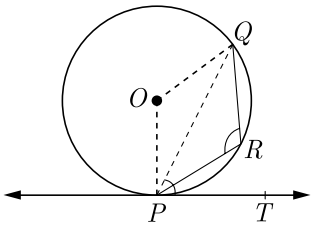
From (1) and (2), we get

$$\begin{aligned} \frac{H+120}{\sqrt{3}} &= \sqrt{3}(H-120) \\ H+120 &= 3(H-120) \\ H+120 &= 3H-360 \\ 2H &= 480 \Rightarrow H = 240 \end{aligned}$$

Thus height of cloud is 240 m.

12. In figure, PQ is a chord of a circle O and PT is a tangent. If $\angle QPT = 60^\circ$, find $\angle PRQ$.

Ans :



j222

We have $\angle QPT = 60^\circ$

Here $\angle OPT = 90^\circ$ because of tangent at radius.

Now $\angle OPQ = \angle OQP$

$= \angle OPT - \angle QTP$

$= 90^\circ - 60^\circ = 30^\circ$

$\angle POQ = 180^\circ - (\angle OPQ + \angle OQP)$

$= 180^\circ - (30^\circ + 30^\circ)$

$= 180^\circ - 60^\circ = 120^\circ$

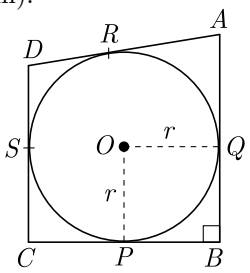
NowReflex $\angle POQ = 360^\circ - 120^\circ = 240^\circ$

$\angle PRQ = \frac{1}{2}$ Reflex $\angle POQ$

$= \frac{1}{2} \times 240^\circ = 120^\circ$

OR

In figure, a circle with centre O is inscribed in a quadrilateral $ABCD$ such that, it touches the sides BC, AB, AD and CD at points P, Q, R and S respectively. If $AB = 29$ cm, $AD = 23$ cm, $\angle B = 90^\circ$ and $DS = 5$ cm, then find the radius of the circle (in cm).



j218

Ans :

Since length of tangents from an external point to a circle are equal,

$DR = DS = 5$ cm

$AR = AQ$

$BQ = BP$

Now $AR = AD - DR$

$= 23 - 5 = 18$ cm

$AQ = AR = 18$ cm

$QB = AB - AQ = 29 - 18 = 11$ cm

$PB = QB = 11$

Now $\angle OQB = \angle OPB = 90^\circ$ because radius is always perpendicular to tangent.

Thus $OP = OQ = PB = BQ$

So, $POQB$ is a square. Hence, $r = OP = PB = 11$ cm

13. A bakery is an establishment that produces and sells flour-based food baked in an oven such as bread, cookies, cakes, pastries, and pies. Some retail bakeries are also categorized as cafés, serving coffee and tea to customers who wish to consume the baked goods on the premises.

Tania runs a bakery shop and her bakery is very famous for tasty biscuits. The amount of mixture required to make one biscuit is 18 cu cm. Before it is cooked, the mixture is rolled into a sphere. After the biscuit is cooked, the biscuit becomes a cylinder of radius 3 cm and height 0.7 cm. The increase in volume is due to air being trapped in the biscuit. Biscuits are packed in a cylindrical card box of height 14 cm. The arrangement of biscuits is shown below.

(i) What is the volume of the biscuits after it is cooked ? What is the volume of air trapped, while cooking the biscuit ?

(ii) How much space is vacant in box after biscuits are packed ?

Ans :

(i) Volume of the biscuit,

$= \pi r^2 h = \frac{22}{7} \times 3^2 \times 0.7 = 19.8$ cu cm

Volume of air trap

= Volume of biscuit − Volume of sphere

$= 19.8 - 18 = 1.8$ cu cm

(ii) From figure it is clear that radius of box is 3

times of biscuit radius i.e. $3 \times 3 = 9$.

$$\text{Volume of box} = \pi R^2 H$$
$$= \frac{22}{7} \times 9 \times 9 \times 14$$
$$= 22 \times 9 \times 9 \times 2$$
$$= 3564\,\text{cm}^3$$

m281

$$\text{Volume of biscuits} = \pi r^2 h \times 140$$
$$= 19.8 \times 140$$
$$= 2772\,\text{cm}^3$$
$$\text{Vacant volume} = 3564 - 2772 = 792\,\text{cm}^3$$

14. The Kendriya Vidyalaya Sangathan is a system of premier central government schools in India that are instituted under the aegis of the Ministry of Education (MHRD), Government of India. As of October 2020, it has a total of 1239 schools. It is one of the world's largest chains of schools. The system came into being in 1963 under the name 'Central Schools'. Later, the name was changed to Kendriya Vidyalaya. Its schools are all affiliated to the Central Board of Secondary Education (CBSE). The objective of KVS is to cater to the educational needs of the children of transferable Central Government employees including Defence and Para-Military personnel by providing a common programme of education.

Commissioner of Regional office Jaipur prepare a table of the marks obtained of 100 students which is given below

Marks obtained	0-20	20-40	40-60	60-80	80-100
Number of students	15	18	21	29	p

He was told that mean marks of a student is 53.

(i) What is the value of model marks ?

(ii) What is the value of median marks ?

n304

Ans :

(i) Here, $l = 60$, $f_1 = 29$, $f_0 = 21$, $f_2 = 17$ and $h = 20$

$$\text{Mode, } M_o = l + h\left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right)$$
$$= 60 + \frac{29 - 21}{2 \times 29 - 21 - 17} \times 20$$
$$= 60 + \frac{8}{58 - 38} \times 20 = 60 + 8 = 68$$

(ii) Now $3M_d = M_o + 2M = 68 + 2 \times 53$

$$M_d = \frac{174}{3} = 58$$

Hence median is 58.

□□□□□□□

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Sample Paper 4

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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 value of k for which the roots of the quadratic equation $2x^2 + kx + 8 = 0$ will have the equal roots ?

OR

Find the roots of the equation $x^2 + 7x + 10 = 0$

2. Which term of the AP $3, 12, 21, 30, ...$ will be 90 more than its 50^{th} term.

3. Prove that the lengths of two tangents drawn from an external point to a circle are equal.

4. Find the number of plates, 1.5 cm in diameter and 0.2 cm thick, that can be fitted completely inside a right circular of height 10 cm and diameter 4.5 cm.

5. Write the median class of the following distribution :

Classes	0- 10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	4	4	8	10	12	8	4

6. The following are the ages of 300 patients getting medical treatment in a hospital on a particular day :

Age (in years)	10-20	20-30	30-40	40-50	50-60	60-70
Number of students	60	42	55	70	53	20

Form the ''less than type'' cumulative frequency distribution table.

OR

Find the mean of the data using an empirical formula when it is given that mode is 50.5 and median in 45.5.

Section B

7. Solve the following quadratic equation for x :

$9x^2 - 9(a+b)x + 2a^2 + 5ab + 2b^2 = 0$

8. The 14^{th} term of an AP is twice its 8^{th} term. If the 6^{th} term is -8, then find the sum of its first 20 terms.

9. The person standing on the bank of river observes that the angle of elevation of the top of a tree standing on opposite bank is 60°. When he moves 30 m away from the bank, he finds the angle of elevation to be 30°. Find the height of tree and width of the river.

10. Draw a line segment AB of length 8 cm. Taking A as centre, draw a circle of radius 4 cm and taking B as centre, draw another circle of radius 3 cm. Construct tangents to each circle from the centre of the other circle.

OR

Draw a circle of radius 3.5 cm. From a point P, 6 cm from its centre, draw two tangents to the circle.

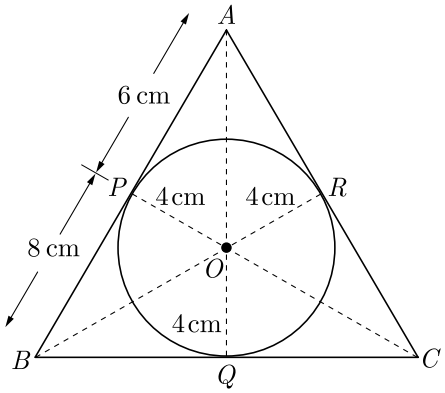
Section C

11. From the top of a tower of height 50 m, the angles of depression of the top and bottom of a pole are 30° and 45° respectively. Find :

(i) How far the pole is from the bottom of the tower,

(ii) The height of the pole. (Use $\sqrt{3} = 1.732$)

12. In Figure the radius of incircle of $\Delta\, ABC$ of area $84\,\text{cm}^2$ and the lengths of the segments AP and BP into which side AB is divided by the point of contact are 6 cm and 8 cm Find the lengths of the sides AC and BC.



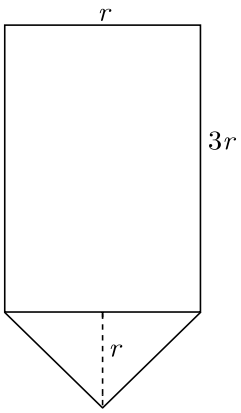
OR

Prove that opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.

13. The advantages of cone bottom tanks are found in nearly every industry, especially where getting every last drop from the tank is important. This type of tank has excellent geometry for draining, especially with high solids content slurries as these cone tanks provide a better full-drain solution. The conical tank eliminates many of the problems that flat base tanks have as the base of the tank is sloped towards the centre giving the greatest possible

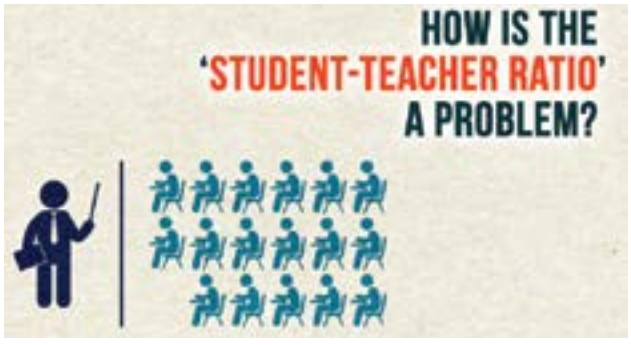
full-drain system in vertical tank design.

Rajesh has been given the task of designing a conical bottom tank for his client. Height of conical part is equal to its radius. Length of cylindrical part is the 3 times of its radius. Tank is closed from top. The cross section of conical tank is given below.



(i) If radius of cylindrical part is taken as 3 meter, what is the volume of above conical tank ?
(ii) What is the area of metal sheet used to make this conical tank ? Assume that tank is covered from top.

14. Student-teacher ratio expresses the relationship between the number of students enrolled in a school and the number teachers employed by the school. Student-teacher ratio is important for a number of reasons. It can be used as a tool to measure teacher workload as well as the allocation of resources. A low student-teacher ratio indicates the burden on a single teacher of teaching multiple students as well as the lack of time that each student gets.



A survey was conducted in the 100 secondary school of Rajasthan and following frequency distribution table was prepared

Students per teacher	Number of School
20-25	5
25-30	15
30-35	25
35-40	30
40-45	15
45-50	10

(i) What is the median value of students per teacher?
(ii) What is the model value of students per teacher ?

****

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Sample Paper 4 Solutions

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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 value of k for which the roots of the quadratic equation $2x^2+kx+8=0$ will have the equal roots ?

Ans :

We have $2x^2+kx+8=0$

Comparing with $ax^2+bx+c=0$ we get

$a=2, b=k$, and $c=8$

For equal roots, $D=0$

$$\begin{aligned} b^2-4ac &= 0 \\ k^2-4\times 2\times 8 &= 0 \\ k^2 &= 64 \\ k &= \pm\sqrt{64} \end{aligned}$$

Thus $k=\pm 8$

OR

Find the roots of the equation $x^2+7x+10=0$

Ans :

We have,

$$\begin{aligned} x^2+7x+10 &= 0 \\ x^2+5x+2x+10 &= 0 \\ x(x+5)+2(x+5) &= 0 \\ (x+5)(x+2) &= 0 \\ x &= -5-2 \end{aligned}$$

So, roots of given equation are -5 and -2.

2. Which term of the AP $3, 12, 21, 30, \ldots..$ will be 90 more than its 50^{th} term.

Ans :

Let the first term be a, common difference be d and nth term be a_n.

We have $a=3, d=9$

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

$a_{50} = 3+49\times 9 = 444$

Now, $a_n - a_{50} = 90$

$$\begin{aligned} 3+(n-1)9-444 &= 90 \\ (n-1)9 &= 90+441 \\ (n-1) &= \frac{531}{9}=49 \\ n &= 49+1=50 \end{aligned}$$

3. Prove that the lengths of two tangents drawn from an external point to a circle are equal.

Ans :

Consider a circle of radius r and centre at O as shown in figure below. Here we have drawn two tangent from P at A and B. We have to prove that

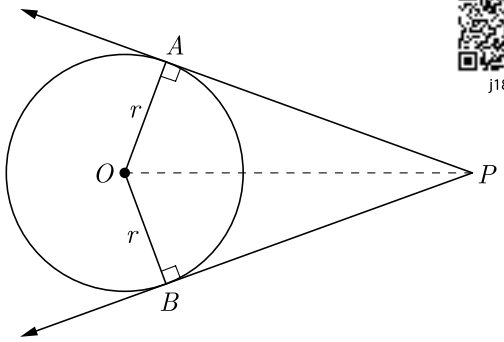
$AP = PB$

We join OA, OB and OP. In ΔPAO and ΔPBO, OP is common and $OA=OB$ radius of same circle. Since radius is always perpendicular to tangent, at point of contact,

$\angle OAP = \angle OBP = 90^\circ$

Thus $\Delta PAO \cong \Delta PBO.$

and hence, $AP = BP$

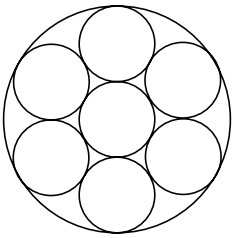


Thus length of 2 tangents drawn from an external point to a circle are equal.

4. Find the number of plates, 1.5 cm in diameter and 0.2 cm thick, that can be fitted completely inside a right circular of height 10 cm and diameter 4.5 cm.

Ans :

As per question we can arrange circular plate in right circular as follows. Here smaller circle is plate of 1.5 cm diameter and large circle is cylinder of 4.5 cm diameter.



m165

From figure it may be easily seen that 6 plate will be fitted in cylinder in one layer.
Height of six plate is 0.2 cm. Total height of cylinder is 10 cm. Thus layer of plate in cylinder is $\frac{10}{0.2} = 50$ layer. Thus total plate $50 \times 6 = 300$.

5. Write the median class of the following distribution :

Classes	0 - 10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	4	4	8	10	12	8	4

Ans :

We prepare following cumulative frequency table to find median class.

Classes	Frequency	Less than c.f.
0-10	4	4
10-20	4	8
20-30	8	16
30-40	10	26
40-50	12	38
50-60	8	46
60-70	4	50
	$N = 50$	

n189

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

Cumulative frequency just greater than $\frac{N}{2}$ is 26 and the corresponding class is 30-40. Thus median class is 20-20.

6. The following are the ages of 300 patients getting medical treatment in a hospital on a particular day :

Age (in years)	10-20	20-30	30-40	40-50	50-60	60-70
Number of students	60	42	55	70	53	20

Form the ''less than type'' cumulative frequency distribution table.

Ans :

Age	Number of Patients
Less then 20	60
Less then 30	102
Less then 40	157
Less then 50	227
Less then 60	280
Less then 70	300

n190

OR

Find the mean of the data using an empirical formula when it is given that mode is 50.5 and median in 45.5.

Ans :

Mode, $M = 50.5$

Median, $M_d = 45.5$

Now $3M_d = M_o + 2M$

$3 \times 45.5 = 50.5 + 2M$

Mean, $M = \frac{136.5 - 50.5}{2} = 43$

n163

Hence mean is 43.

Section B

7. Solve the following quadratic equation for x :

$9x^2 - 9(a+b)x + 2a^2 + 5ab + 2b^2 = 0$

Ans :

We have $9x^2 - 9(a+b)x + 2a^2 + 5ab + 2b^2 = 0$

Now $2a^2 + 5ab + 2b^2 = 2a^2 + 4ab + ab + 2b^2$

$= 2a[a+2b] + b[a+2b]$

$= (a+2b)(2a+b)$

Hence the equation becomes

$9x^2 - 9(a+b)x + (a+2b)(2a+b) = 0$

$$9x^2 - 3[3a+3b]x + (a+2b)(2a+b) = 0$$
$$9x^2 - 3\big[(a+2b)+(2a+b)\big]x + (a+2b)(2a+b) = 0$$
$$9x^2 - 3(a+2b)x - 3(2a+b)x + (a+2b)(2a+b) = 0$$
$$3x\big[3x-(a+2b)\big] - (2a+b)\big[3x-(a+2b)\big] = 0$$
$$\big[3x-(a+2b)\big]\big[3x-(2a+b)\big] = 0$$
$$3x-(2a+b) = 0$$
$$x = \frac{a+2b}{3}$$

d208

$$3x-(2a+b) = 0$$
$$x = \frac{2a+b}{3}$$

Hence, roots are $\frac{a+2b}{3}$ and $\frac{2a+b}{3}$.

8. The 14^{th} term of an AP is twice its 8^{th} term. If the 6^{th} term is -8, then find the sum of its first 20 terms.

Ans :

Let the first term be a, common difference be d, n th term be a_n and sum of n term be S_n.
Here, $a_{14} = 2a_8$ and $a_6 = -8$

e244

Now $a+13d = 2(a+7d)$
$a+13d = 2a+14d$
$a = -d$ ...(1)
and $a_6 = -8$
$a+5d = -8$ ...(2)

Solving (1) and (2), we get

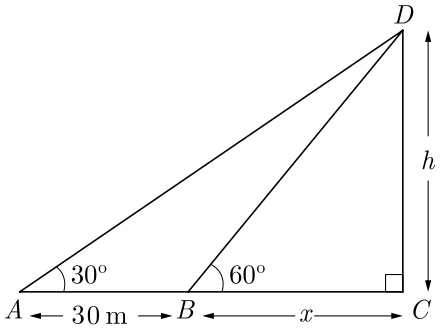
$a = 2, d = -2$

Now $S_{20} = \frac{20}{2}[2\times 2+(20-1)(-2)]$
$= 10[4+19\times(-2)]$
$= 10(4-38)$
$= 10\times(-34) = -340$

9. The person standing on the bank of river observes that the angle of elevation of the top of a tree standing on opposite bank is 60°. When he moves 30 m away from the bank, he finds the angle of elevation to be 30°. Find the height of tree and width of the river.

Ans :

Let CD be the tree of height h. Let A be the position of person after moving 30 m away from point B on bank of river. Let $BC = x$ be the width of the river.
As per given in question we have drawn figure below.



In right $\Delta DBC, \frac{h}{x} = \tan 60^\circ$

$h = \sqrt{3}\,x$ ...(1)

In right ΔADC,

$$\frac{h}{x+30} = \tan 30^\circ = \frac{1}{\sqrt{3}}$$

i182

$\sqrt{3}\,h = x+30$ ...(2)

Substituting the value of h from eq. (1) in eq. (2), we get

$3x = x+30$
$x = 15$ m ...(3)

Thus $h = \sqrt{3}\times 15 = 15\sqrt{3}$
$= 15\times 1.732 = 25.98$ m

Hence, height of tree is 25.98 m and width of river is 15 m.

10. Draw a line segment AB of length 8 cm. Taking A as centre, draw a circle of radius 4 cm and taking B as centre, draw another circle of radius 3 cm. Construct tangents to each circle from the centre of the other circle.

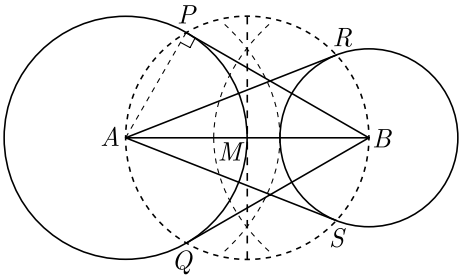
Ans :

k181

Steps of Construction :

1. Draw a line segment $AB = 8$ cm.
2. Draw a circle with centre A and radius 4 cm, draw another circle with centre B and radius 3 cm.
3. Bisect the line segment AB. Let its mid-point be M.
4. With centre as M and MA (or MB) as radius, draw a circle such that it intersects the two circles at points P, Q, R and S.
5. Join BP and BQ.
   Thus, BP and BQ are the required two tangents from B to the circle with centre A.

6. Join RA and SA.
Thus, RA and SA are the required two tangents from A to the circle with centre B.



Justification :
Let us join A and P.

$\angle APB = 90^\circ$ (Angle in a semi-circle)

$BP \perp AP$

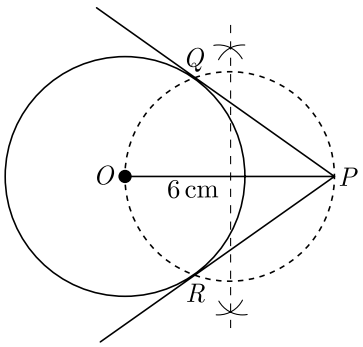
But AP is a radius of the circle with centre A. Thus BP has to be a tangent to the circle with centre A. Similarly, BQ has to be tangent to the circle with centre A.
Also, AR and AS are tangents to the circle with centre B.

OR

Draw a circle of radius 3.5 cm. From a point P, 6 cm from its centre, draw two tangents to the circle.

Ans :

Step of construction :
1. Draw a line segment OP of length 6 cm.
2. From the point O, draw a circle of radius $= 3.5$ cm.
3. Draw a perpendicular bisector of OP. Let M be the mid point of OP.
4. Taking M as centre and OM as radius draw a circle.
5. This circle intersects the given circle at Q and R.
6. Join PQ and PR, which are tangents to the circles.



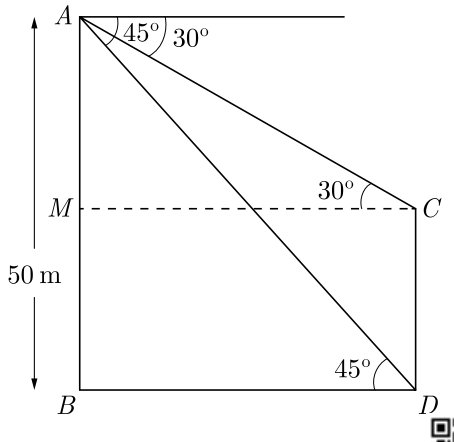
k136

Section C

11. From the top of a tower of height 50 m, the angles of depression of the top and bottom of a pole are 30° and 45° respectively. Find :
(i) How far the pole is from the bottom of the tower,
(ii) The height of the pole. (Use $\sqrt{3} = 1.732$)

Ans :

Let AB be the tower of height 50 m and CD be the pole of height h. From the top of a tower of height 50 m, the angles of depression of the top and bottom of a pole are 30° and 45° respectively. As per given in question we have drawn figure below.



i218

In right ΔABD we have,

$$\tan 45^\circ = \frac{AB}{BD} = 1$$

$$1 = \frac{50}{x} \Rightarrow x = 50 \text{ m}$$

(i) Thus distance of pole from bottom of tower is 50 m.

Now in ΔAMC we have

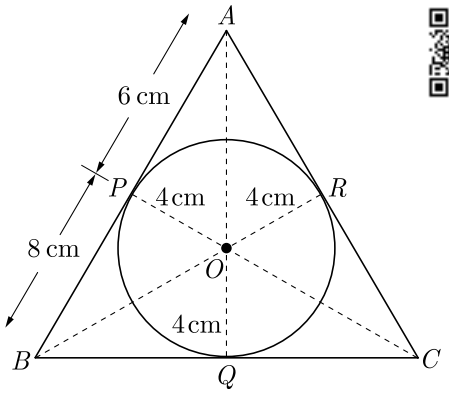
$$\tan 30^\circ = \frac{AM}{MC} = \frac{AM}{x}$$

$$AM = \frac{50}{\sqrt{3}} \text{ or } 28.87 \text{ m.}$$

(ii) Height pole $h = CD = BM$
$= 50 - 28.87 = 21.13$ m.

12. In Figure the radius of incircle of ΔABC of area $84\,\text{cm}^2$ and the lengths of the segments AP and BP into which side AB is divided by the point of contact are 6 cm and 8 cm Find the lengths of the

sides AC and BC.



j223

Ans :

Since length of tangents from an external point to a circle are equal,

At A, $AP = AR = 6$ cm (1)

At B, $,BP = BQ = 8$ cm (2)

At C, $CR = CQ = x$ (3)

Perimeter of ΔABC,

$$p = AP + PB + BQ + QC + CR + RA$$
$$= 6 + 8 + 8 + x + x + 6 = 28 + 2x$$

Now area $\Delta ABC = \frac{1}{2}rp$

Here $r = 4$ is the radius of circle. Substituting all values we have

$$84 = \tfrac{1}{2} \times 4 \times (28 + 2x)$$
$$84 = 56 + 4x$$
$$21 = 14 + x \Rightarrow x = 7$$

Thus $AC = AR + RC = 6 + 7 = 13$ cm

$BC = BQ + QC = 8 + 7 = 15$ cm

OR

Prove that opposite sides of a quadrilateral circumscribing a circle subtend supplementary angles at the centre of the circle.

Ans :

A circle centre O is inscribed in a quadrilateral $ABCD$ as shown in figure given below.

Since OE and OF are radius of circle,

$$OE = OF$$

Tangent drawn at any point of a circle is perpendicular to the radius through the point contact.

Thus $\angle OEA = \angle OFA = 90^\circ$

Now in ΔAEO and ΔAFO,

$OE = OF$

$\angle OEA = \angle OFA = 90^\circ$

$OA = OA$ (Common side)

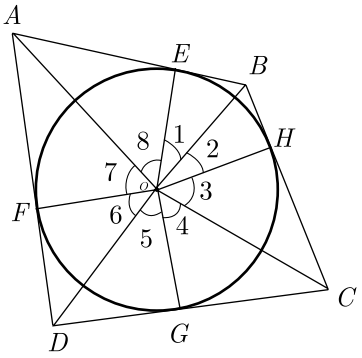
Thus $\Delta AEO \cong \Delta AFO$ (SAS congruency)

$\angle 7 = \angle 8$

Similarly, $\angle 1 = \angle 2$

$\angle 3 = \angle 4$

$\angle 5 = \angle 6$



j219

Since angle around a point is 360°,

$\angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 + \angle 6 + \angle 7 + \angle 8 = 360^\circ$

$2\angle 1 + 2\angle 8 + 2\angle 4 + 2\angle 5 = 360^\circ$

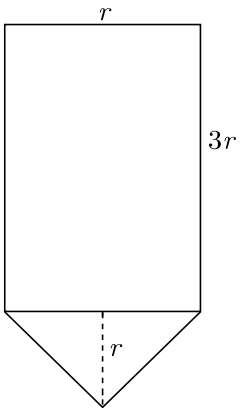
$\angle 1 + \angle 8 + \angle 4 + \angle 5 = 180^\circ$

$(\angle 1 + \angle 8) + (\angle 4 + \angle 5) = 180^\circ$

$\angle AOB + \angle COD = 180^\circ$ Hence Proved.

13. The advantages of cone bottom tanks are found in nearly every industry, especially where getting every last drop from the tank is important. This type of tank has excellent geometry for draining, especially with high solids content slurries as these cone tanks provide a better full-drain solution. The conical tank eliminates many of the problems that flat base tanks have as the base of the tank is sloped towards the centre giving the greatest possible full-drain system in vertical tank design.

Rajesh has been given the task of designing a conical bottom tank for his client. Height of conical part is equal to its radius. Length of cylindrical part is the 3 times of its radius. Tank is closed from top. The cross section of conical tank is given below.



(i) If radius of cylindrical part is taken as 3 meter, what is the volume of above conical tank ?

(ii) What is the area of metal sheet used to make this conical tank ? Assume that tank is covered from top.

Ans :

(i) Length of cylindrical part is three times of radius of conical part and height of conical part is equal to its radius.
If we assume r be the common radius of cylindrical part and conical part, height of conical part will be r and length of cylindrical part will be $3r$.

Volume of conical tank= Volume of cylindrical part + Volume of conical part

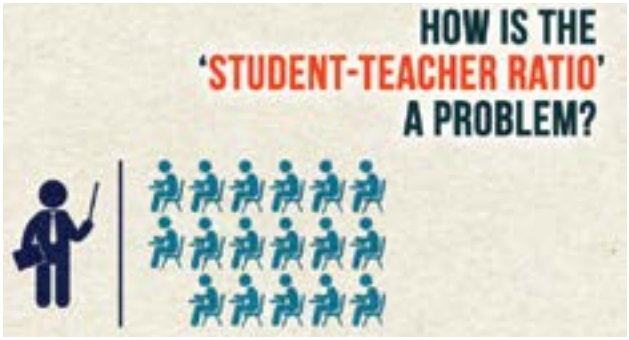
$$= \pi r^2 l + \frac{1}{3}\pi r^2 h$$
$$= \pi r^2 \cdot 3r + \frac{1}{3}\pi r^2 \cdot r$$
$$= 3\pi r^3 + \frac{1}{3}\pi r^3 = \frac{10}{3}\pi r^3$$
$$= \frac{10}{3}\pi (3)^3 = 90\,\pi \text{ m}^3$$

m283

(ii) Surface area of tank = SA of top +CSA of cylinder +CSA of cone

$$= \pi r^2 + 2\pi rl + \pi r\sqrt{h^2 + r^2}$$
$$= \pi r^2 + 2\pi r \cdot 3r + \pi r\sqrt{r^2 + r^2}$$
$$= \pi r^2 + 6\pi r^2 + \sqrt{2}\,\pi r^2$$
$$= (1 + 6 + \sqrt{2})\,\pi r^2$$
$$= (7 + \sqrt{2})\,\pi (3)^2$$
$$= 9(7 + \sqrt{2})\,\pi \text{ m}^2$$

14. Student-teacher ratio expresses the relationship between the number of students enrolled in a school and the number teachers employed by the school. Student-teacher ratio is important for a number of reasons. It can be used as a tool to measure teacher workload as well as the allocation of resources. A low student-teacher ratio indicates the burden on a single teacher of teaching multiple students as well as the lack of time that each student gets.



A survey was conducted in the 100 secondary school of Rajasthan and following frequency distribution table was prepared

Students per teacher	Number of School
20-25	5
25-30	15
30-35	25
35-40	30
40-45	15
45-50	10

(i) What is the median value of students per teacher?

(ii) What is the model value of students per teacher ?

Ans :

(i) Median, $M_d = l + \left(\frac{\frac{N}{2} - F}{f}\right)h$
$= 35 + \frac{50 - 45}{30} \times 5$
$= 35 + \frac{5}{6} = \frac{215}{6} = 35.83$

n305

(ii) Here, $l = 35$, $f_1 = 30$, $f_0 = 25$, $f_2 = 15$ and $h = 5$

Mode, $M_o = l + h\left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right)$
$= 35 + \frac{30 - 25}{60 - 25 - 15} \times 5$
$= 35 + \frac{5}{20} \times 5$
$= 35 + 1.25 = 36.25$

□□□□□□□

Sample Paper 5

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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

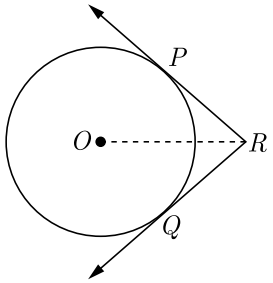
1. Find k so that the quadratic equation $(k+1)x^2 - 2(k+1)x + 1 = 0$ has equal roots.

OR

If one root of the quadratic equation $3x^2 + px + 4 = 0$is $\frac{2}{3}$, then find the value of p and the other root of the equation.

2. Find how many integers between 200 and 500 are divisible by 8.

3. In figure, two tangents RQ and RP are drawn from an external point R to the circle with centre O. If $\angle PRQ = 120^\circ$, then prove that $OR = PR + RQ$.



4. A solid metallic cylinder of radius 3.5 cm and height 14 cm melted and recast into a number of small solid metallic ball, each of radius $\frac{7}{12}$ cm. Find the number of balls so formed.

5. Find the mean of the following data :

Class	Frequency
0.5-5.5	13
5.5-10.5	16
10.5-15.5	22
15.5-20.5	18
20.5-25.5	11

6. Find the mean number of plants per house from the following data :

Number of plants	0-2	2-4	4-6	6-8	8-10	10-12	12-14
Number of houses	1	2	1	5	6	2	3

OR

Consider the following frequency distribution of the heights of 60 students of a class

Height (in cm)	150-155	155-160	160-165	165-170	170-175	175-180
Number of students	15	13	10	8	9	5

What is the upper limit of the median class in the given data?

Section B

7. If the ratio of the sums of first n terms of two AP's is $(7n+1):(4n+27)$, find the ratio of their m^{th} terms.

8. Two poles of equal heights are standing opposite to each other on either side of the road which is 80 m wide. From a point P between them on the road, the angle of elevation of the top of a pole is 60° and the angle of depression from the top of the other pole of point P is 30°. Find the heights of the poles and the distance of the point P from the poles.

9. Let ABC be a right triangle in which $AB = 6\,\text{cm}$, $BC = 8\,\text{cm}$ and $\angle B = 90^\circ$. BD is the perpendicular from B on AC. The circle through B, C, D is drawn. Construct the tangents from A to this circle.

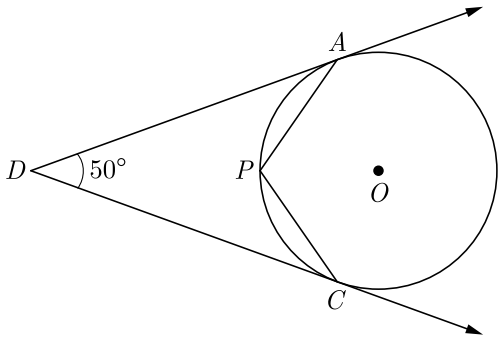
10. A metallic cylinder has radius 3 cm and height 5 cm. To reduce its weights, a conical hole is drilled in the cylinder. The conical hole has a radius of $\frac{3}{2}$ cm and its depth $\frac{8}{9}$ cm. Calculate the ratio of the volume of metal left in the cylinder to the volume of metal taken out in conical shape.

OR

A hollow cylindrical pipe is made up of copper. It is 21 dm long. The outer and inner diameters of the pipe are 10 cm and 6 cm respectively. Find the volume of copper used in making the pipe.

Section C

11. In the given figure, O is the centre of the circle. Determine $\angle APC$, if DA and DC are tangents and $\angle ADC = 50^\circ$.



12. The median of the following data is 525. Find the values of x and y, if total frequency is 100 :

Class	Frequency
0-100	2
100-200	5
200-300	x
300-400	12
400-500	17
500-600	20
600-700	y
700-800	9
800-900	7
900-1000	4

OR

A survey regarding the heights in (cm) of 51 girls of class X of a school was conducted and the following data was obtained. Find the median height and the mean using the formulae.

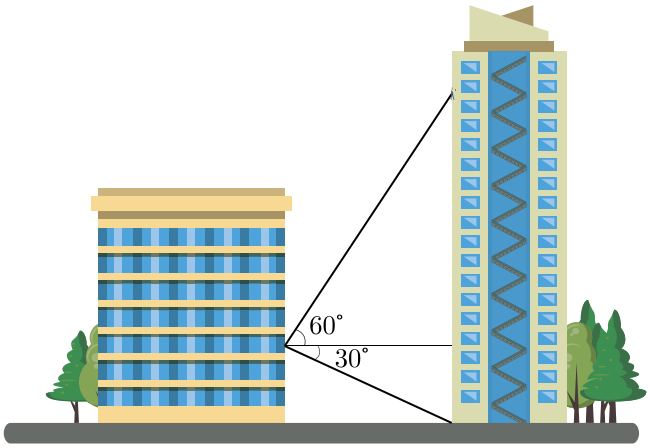
Height (in cm)	**Number of Girls**
Less than 140	4
Less than 145	11
Less than 150	29
Less than 155	40
Less than 160	46
Less than 165	51

13. A tour bus in Jaipur serves 400 customers a day. The charge is Rs 50 per person. The owner of the bus service estimates that the company would lose 10 passengers a day for each Rs 5 fare increase.

(i) How much should the fare be in order to maximize the income for the company?

(ii) What is the maximum income the company can expect to make?

14. From his hotel room window on the fourth floor, Ranjan notices some window washers high above him on the hotel across the street.



Curious as to their height above ground, he quickly estimates the buildings are 60 m apart, the angle of elevation to the workers is about 60°, and the angle of depression to the base of the hotel is about 30°.

(i) How high above ground is the window of Ranjan's hotel room?

(ii) How high above ground are the workers?

****

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Sample Paper 5 Solutions

Class – X Exam 2021-22 (TERM – II)

Mathematics Standard (041)

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 k so that the quadratic equation $(k+1)x^2 - 2(k+1)x + 1 = 0$ has equal roots.

Ans :

We have $(k+1)x^2 - 2(k+1)x + 1 = 0$

Comparing with $Ax^2 + Bx + C = 0$ we get $A = (k+1), B = -2(k+1), C = 1$

If roots are equal, then $D = 0$, i.e.

$$\begin{aligned} B^2 &= 4AC \\ 4(k+1)^2 &= 4(k+1) \\ k^2 + 2k + 1 &= k + 1 \\ k^2 + k &= 0 \\ k(k+1) &= 0 \\ k &= 0, -1 \end{aligned}$$

Since $k = -1$ does not satisfy the equation, thus $k = 0$

OR

If one root of the quadratic equation $3x^2 + px + 4 = 0$ is $\frac{2}{3}$, then find the value of p and the other root of the equation.

Ans :

Given, quadratic equation is $3x^2 + px + 4 = 0$.

Since $\frac{2}{3}$ is one root of the given quadratic equation,

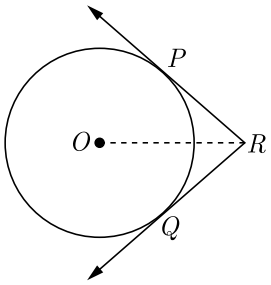
$$\begin{aligned} 3\left(\frac{2}{3}\right)^2 + p\left(\frac{2}{3}\right) + 4 &= 0 \\ \frac{4}{3} + \frac{2p}{3} + 4 &= 0 \\ \frac{4 + 2p + 12}{3} &= 0 \\ 2p + 16 &= 0 \\ p &= -8 \end{aligned}$$

Substituting $p = -8$ in given equation, we get

$$\begin{aligned} 3x^2 - 8x + 4 &= 0 \\ 3x^2 - 6x - 2x + 4 &= 0 \\ 3x(x-2) - 2(x-2) &= 0 \\ (x-2)(3x-2) &= 0 \Rightarrow x = 2, \frac{2}{3} \end{aligned}$$

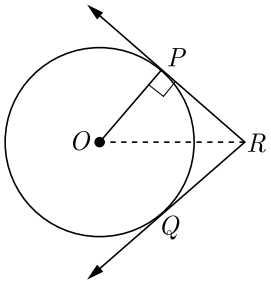
Hence, other root is 2.

2. In figure, two tangents RQ and RP are drawn from an external point R to the circle with centre O. If $\angle PRQ = 120^\circ$, then prove that $OR = PR + RQ$.



Ans :

We redraw the given figure by joining O to P as shown below.



$\angle PRO = \frac{1}{2}\angle PRQ$

$$= \frac{120^\circ}{2} = 60^\circ$$

Here ΔOPR is right angle triangle, thus

$$\angle POR = 90^\circ - \angle PRO = 90^\circ - 60^\circ = 30^\circ$$

Now $$\frac{PR}{OR} = \sin 30^\circ = \frac{1}{2}$$

$$OR = 2PR = PR + PR$$

Since $PR = QR$,

$$OR = PR + QR \qquad \text{Hence Proved}$$

3. Find how many integers between 200 and 500 are divisible by 8.

Ans :

Number divisible by 8 are 208, 2016, 224, ... 496. It is an AP

Let the first term be a, common difference be d and nth term be a_n.

We have $a = 208, d = 8$ and $a_n = 496$

e214

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

$$208 + (n-1)d = 496$$

$$(n-1)8 = 496 - 208$$

$$n - 1 = \frac{288}{8} = 36$$

$$n = 36 + 1 = 37$$

Hence, required numbers divisible by 8 is 37.

4. A solid metallic cylinder of radius 3.5 cm and height 14 cm melted and recast into a number of small solid metallic ball, each of radius $\frac{7}{12}$ cm. Find the number of balls so formed.

Ans :

Let the number of recasted balls be N.

Radius of cylinder $R = 3.5$ cm

Height of cylinder $h = 14$cm

Radius of recasted ball $r = \frac{7}{12}$

$$\text{Volume of balls} = \text{Volume of cylinder}$$

$$n\frac{4}{3}\pi r^3 = \pi R^2 h$$

$$n \times \frac{4}{3} \times \frac{7}{12} \times \frac{7}{12} \times \frac{7}{12} = 3.5 \times 3.5 \times 14$$

$$n = \frac{3.5 \times 3.5 \times 14 \times 3 \times 12 \times 12 \times 12}{4 \times 7 \times 7 \times 7}$$

$$= 0.5 \times 0.5 \times 2 \times 3 \times 3 \times 12 \times 12$$

$$= 648$$

m166

Hence, number of recasted balls is 648.

5. Find the mean of the following data :

Class	Frequency
0.5-5.5	13
5.5-10.5	16
10.5-15.5	22
15.5-20.5	18
20.5-25.5	11

n191

Ans :

We prepare following table to find mean.

Class	$x_i = \frac{l_1 + l_2}{2}$	f_i	$f_i x_i$
0.5-5.5	3	13	39
5.5-10.5	8	16	128
10.5-15.5	13	22	286
15.5-20.5	18	18	324
20.5-25.5	23	11	253
	Total	$\sum f_i = 80$	1,030

Mean $$\overline{x} = \frac{\sum x_i f_i}{\sum f_i} = \frac{1,030}{80} = 12.9$$

6. Find the mean number of plants per house from the following data :

Number of plants	0-2	2-4	4-6	6-8	8-10	10-12	12-14
Number of houses	1	2	1	5	6	2	3

Ans :

We prepare following table to find mean.

Class	$x_i = \frac{l_1 + l_2}{2}$	f_i	$f_i x_i$
0-2	1	1	1
2-4	3	2	6
4-6	5	1	5
6-8	7	5	35
8-10	9	6	54
10-12	11	2	22
12-14	13	3	39
	Total	20	162

n192

Mean $$M = \frac{\sum f_i x_i}{\sum f_i} = \frac{162}{20} = 8.1$$

Mean number of plants per house is 8.1.

OR

Consider the following frequency distribution of the heights of 60 students of a class

Height (in cm)	150-155	155-160	160-165	165-170	170-175	175-180
Number of students	15	13	10	8	9	5

What is the upper limit of the median class in the given data?

Ans :

We prepare the following cumulative table

Height x (in cm)	Number of Students (f)	cf
150-155	15	15
155-160	13	28
160-165	10	38
165-170	08	46
170-175	09	55
175-180	08	63
	$N = 63$	

n133

We have, $N = 63; \frac{N}{2} = \frac{63}{2} = 31.5$

The cumulative frequency just greater than $\frac{N}{2}$ is 38 and the corresponding class is 160-165. Thus upper limit is 165.

Section B

Ans :

$$\frac{S_n}{S'_n} = \frac{\quad}{4n+27}$$

$$\frac{\frac{n}{2}\left[2a+(n-1)d\right]}{\frac{n}{2}\left[2A+(n-1)D\right]} = \frac{7n+1}{4n+27}$$

$$\frac{2a+(n-1)d}{2A+(n-1)D} = \frac{7n+1}{4n+27}$$

$$\frac{a+(\frac{n-1}{2})d}{A+(\frac{n-1}{2})D} = \frac{7n+1}{4n+27}$$

e245

Substituting $\frac{n-1}{2} = m-1$ or $n = 2m-1$ we get

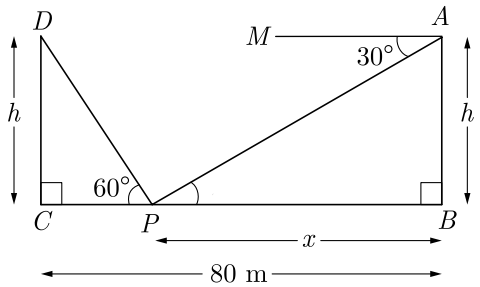
$$\frac{a+(m-1)d}{A+(m-1)D} = \frac{7(2m-1)+1}{4(2m-1)+27} = \frac{14m-6}{8m+23}$$

Hence, $\frac{a_m}{A_m} = \frac{14m-6}{8m+23}$

8. Two poles of equal heights are standing opposite to each other on either side of the road which is 80 m wide. From a point P between them on the road, the angle of elevation of the top of a pole is 60° and the angle of depression from the top of the other pole of point P is 30°. Find the heights of the poles and the distance of the point P from the poles.

Ans :

Let the distance between pole AB and point P be x. As per given in question we have drawn figure below.



Here distance between pole CD and P is $80-x$.

In right angle triangle ΔABP, $\angle APB = 30^\circ$

$$\tan 30^\circ = \frac{h}{x}$$

$$h = \frac{x}{\sqrt{3}} \quad ...(1)$$

In angle triangle ΔCDP,

$$\sqrt{3}$$

$$x = 80 \times 3 - x \times 3$$

$$4x = 240$$

$$x = \frac{240}{4} = 60 \text{ m}$$

Substituting this value of x in (1) we have

$$h = \frac{60}{\sqrt{3}} = 20\sqrt{3} = 34.64 \text{ m}$$

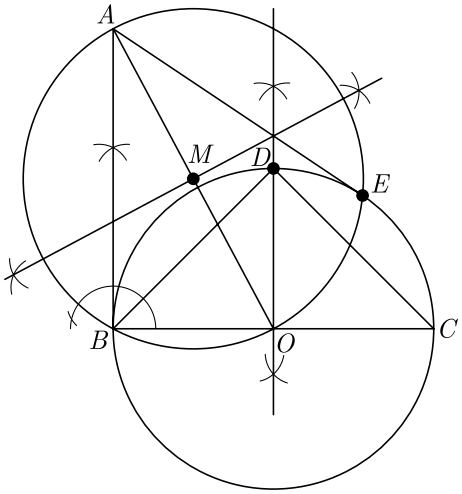
Hence, height of the pole AB and CD is 34.64 m
Distance of point P from pole AB is 20 m.
Distance of point P from pole CD is 60 m.

9. Let ABC be a right triangle in which $AB = 6\,\text{cm}$, $BC = 8\,\text{cm}$ and $\angle B = 90^\circ$. BD is the perpendicular from B on AC. The circle through B, C, D is drawn. Construct the tangents from A to this circle.

Ans :

Steps of Construction :

1. Draw a triangle ΔABC such that $AB = 6\,\text{cm}$, $BC = 8\,\text{cm}$ and $\angle B = 90^\circ$.
2. Draw $BD \perp AC$. Now bisect BC and let its mid-point be O.
   So, O is centre of the circle passing through B, C and D.



3. Join AO.
4. Bisect AO. Let M be the mid-point of AO.
5. Taking M as centre and MA as radius, draw a circle intersecting the given circle at B and E.
6. Join AB and AE. Thus, AB and AE are the required two tangents to the given circle from A.

Justification :
If we join OE, then

$$\angle AEO = 90^\circ$$

(Angle in a semi circle)

$$AE \perp OE$$

But OE is a radius of the given circle. Thus AE has to be a tangent to the circle. Similarly, AB is also a tangent to the given circle.

10. A metallic cylinder has radius 3 cm and height 5 cm. To reduce its weights, a conical hole is drilled in the cylinder. The conical hole has a radius of $\frac{3}{2}$ cm and its depth $\frac{8}{9}$ cm. Calculate the ratio of the volume of metal left in the cylinder to the volume of metal taken out in conical shape.

Ans :

Volume of cylinder,

$$\pi r^2 h = \pi(3)^2 \times 5 = 45\pi \text{ cm}^3$$

Volume of conical hole,

$$\frac{1}{3}\pi r^2 h = \frac{1}{3}\pi\left(\frac{3}{2}\right)^2 \times \frac{8}{9} = \frac{2}{3}\pi \text{ cm}^3$$

Metal left in cylinder $= 45\pi - \frac{2}{3}\pi = \frac{133\pi}{3}$

$$\frac{\text{Volume of metal left}}{\text{Volume of metal taken out}} = \frac{\frac{133}{3}\pi}{\frac{2}{3}\pi} = 133 : 2.$$

Hence required ratio is 133 : 2

OR

A hollow cylindrical pipe is made up of copper. It is 21 dm long. The outer and inner diameters of the pipe are 10 cm and 6 cm respectively. Find the volume of copper used in making the pipe.

Ans :

Volume of copper used in making the pipe is equal to the difference of volume of external cylinder and volume of internal cylinder.
Height of cylindrical pipe,

$$h = 21 \text{ dm} = 210 \text{ cm}$$

External Radius, $R = \frac{10}{2} = 5$ cm

Internal Radius, $r = \frac{6}{2} = 3$ cm

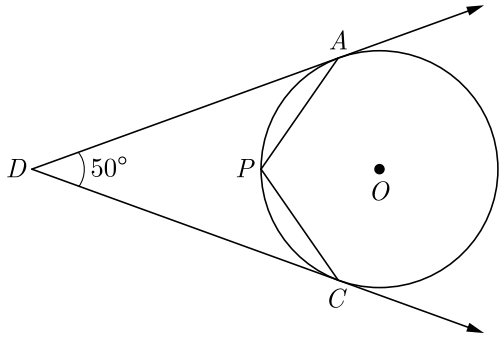
Volume of copper used in making the pipe

$$= (\text{Volume of External Cylinder}) - (\text{Volume of Internal Cylinder})$$
$$= \pi R^2 h - \pi r^2 h$$
$$= \pi h(R^2 - h^2)$$
$$= \frac{22}{7} \times 210 \times (5^2 - 3^2)$$
$$= \frac{22}{7} \times 210 \times (25 - 9)$$
$$= \frac{22}{7} \times 210 \times 16$$
$$= 10560 \text{ cm}^3.$$

Section C

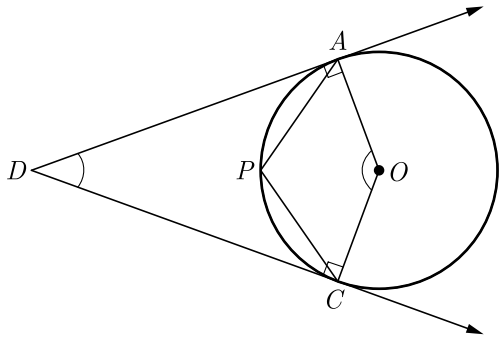
11. In the given figure, O is the centre of the circle.

Determine $\angle APC$, if DA and DC are tangents and $\angle ADC = 50^\circ$.



Ans :

We redraw the given figure by joining A and C to O as shown below.



Since DA and DC are tangents from point D to the circle with centre O, and radius is always perpendicular to tangent, thus

$$\angle DAO = \angle DCO = 90^\circ$$

and

$$\angle ADC + \angle DAO + \angle DCO + \angle AOC = 360^\circ$$
$$50^\circ + 90^\circ + 90^\circ + \angle AOC = 360^\circ$$
$$230^\circ + \angle AOC = 360^\circ$$
$$\angle AOC = 360^\circ - 230^\circ = 130^\circ$$

Now Reflex $\angle AOC = 360^\circ - 130^\circ = 230^\circ$

$$\angle APC = \frac{1}{2} \text{ reflex } \angle AOC$$
$$= \frac{1}{2} \times 230^\circ = 115^\circ$$

12. The median of the following data is 525. Find the values of x and y, if total frequency is 100 :

Class	Frequency
0-100	2
100-200	5
200-300	x
300-400	12
400-500	17
500-600	20
600-700	y
700-800	9
800-900	7
900-1000	4

Ans :

We prepare cumulative frequency table as given below.

Class Interval	Frequency (f)	Cum. freq. *c.f.*
0-100	2	2
100-200	5	7
200-300	x	$7 + x$
300-400	12	$19 + x$
400-500	17	$36 + x$
500-600	20	$56 + x$
600-700	y	$56 + x + y$
700-800	9	$65 + x + y$
800-900	7	$72 + x + y$
900-1000	4	$76 + x + y$
	$N = 100$	

From table we have

$$76 + x + y = 100$$
$$x + y = 100 - 76 = 24 \quad ...(1)$$

Here median is 525 which lies between class $500 - 600$. Thus median class is 500-600.

Median, M_d

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

$$525 = 500 + \left[\frac{\frac{100}{2} - (36 + x)}{20}\right] \times 100$$
$$25 = (50 - 36 - x)5$$
$$14 - x = \frac{25}{5} = 5$$
$$x = 14 - 5 = 9$$

Substituting the value of x is equation (1), we get

$$y = 24 - 9 = 15$$

Hence, $x = 9$ and $y = 15$

OR

A survey regarding the heights in (cm) of 51 girls of class X of a school was conducted and the following data was obtained. Find the median height and the mean using the formulae.

Height (in cm)	**Number of Girls**
Less than 140	4
Less than 145	11
Less than 150	29
Less than 155	40
Less than 160	46
Less than 165	51

Ans :

To calculate the median height, we need to convert the given data in the form of intervals and their corresponding frequencies.

n244

Given distribution is of less type and 140, 145, 150, 165 gives the upper limits of the corresponding class interval So, the classes should be below 140, 140-145, 145-150, 160-165.

Now, the frequency of class interval below 140 is 4, since then are 4 boys with height less than 140. For the frequency of class interval 140-145 subtract the number of boys having height less than 140 from the number of boys having height less than 145.

Thus, the frequency of class interval 140-145 is $11 - 4 = 7$ Similarly, we can calculate the frequencies of other class intervals and get the following table

Class interval	Frequency	Cumulative Frequency
Below 140	4	4
140-145	$11 - 4 = 7$	11
145-150	$29 - 11 = 18$	29
150-155	$40 - 29 = 11$	40
155-160	$46 - 40 = 6$	46
160-165	$51 - 46 = 5$	51

Here, $N = 51$

$$\frac{N}{2} = \frac{51}{2} = 25.5$$

Since, the cumulative frequency just greater than 25.5 is 29 and the corresponding class is 145-150. Thus 145-150 is median class,

Now, $l = 145,\ f = 18,\ F = 11$ and $h = 5$

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

$$= 145 + \left\{\frac{25.5 - 11}{18}\right\} \times 5$$

$$= 145 + \frac{72.5}{18}$$

$$= 145 + 4.03 = 149.03$$

For Mean we prepare following table.

Height (in cm)	f_i	x_i	$f_i x_i$
Below 140	4	137.5	550
140-145	7	142.5	997.5
145-150	18	147.5	2655
150-155	11	152.5	1617.5
155-160	6	157.5	945
160-165	5	162.5	812.5
	$N = \sum f_i = 51$		$\sum f_i x_i = 7637.5$

Now Mean $M = \frac{\sum f_i x_i}{N} = \frac{7637.5}{51} = 149.75$

13. A tour bus in Jaipur serves 400 customers a day. The charge is Rs 50 per person. The owner of the bus service estimates that the company would lose 10 passengers a day for each Rs 5 fare increase.

(i) How much should the fare be in order to maximize the income for the company?

(ii) What is the maximum income the company can expect to make?

Ans :

(i) Let x represent the number of Rs 5 fare increases. Then $50 + 5x$ is the price per passenger and $400 - 10x$ is the number of passengers.

The income is the number of passengers

multiplied by the price per ticket. Let $I(x)$ represent income as a function of x

d324

Now $I(x) = (400-10x)(50+5x)$

$= 10(40-x)(5)(10+x)$

$= 50(40-x)(10+x)$

$= 50(400+40x-10x-x^2)$

$= 50(400+30x-x^2)$

$= -50(x^2-30x-400)$

$= -50(x^2-30x+15^2-15^2-400)$

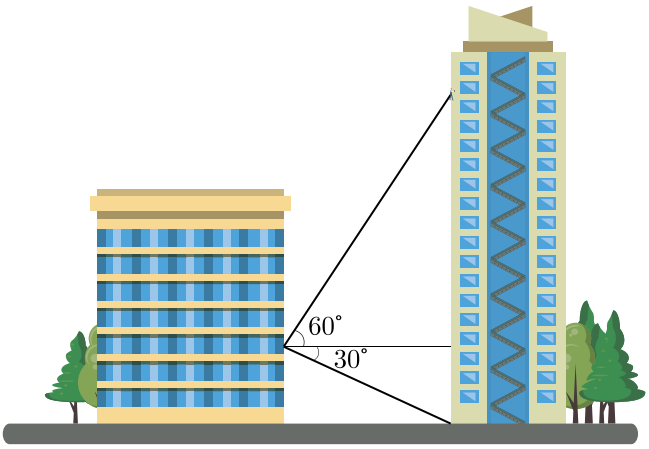
$= -50(x^2-30x+15^2-625)$

$= -50(x^2-30x+15^2)+50\times625$

$= -50(x-15)^2+31250$

(ii) From above equation it is clear that $I(x)$ is maximum at $x=15$ and this maximum value is 31250. This means the company should make 15 fare increases of Rs 5 to maximize its income. Thus, the ticket price should be $50+5\times15=125$ Rs.

14. From his hotel room window on the fourth floor, Ranjan notices some window washers high above him on the hotel across the street.



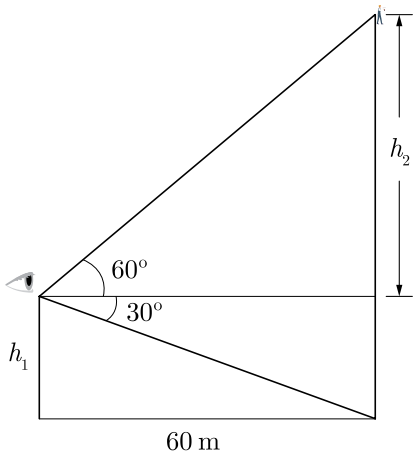
Curious as to their height above ground, he quickly estimates the buildings are 60 m apart, the angle of elevation to the workers is about $60°$, and the angle of depression to the base of the hotel is about $30°$.

(i) How high above ground is the window of Ranjan's hotel room?

(ii) How high above ground are the workers?

Ans :

Let h_1 be the height of Ranjan window from ground and h_2 be height of window washers from Ranjan. We draw a diagram of the situation as shown below.



i225

Here $\tan 30° = \frac{h_1}{60}$

$\frac{1}{\sqrt{3}} = \frac{h_1}{60}$

$h_1 = \frac{60}{\sqrt{3}} = 20\sqrt{3}$

$= 20\times1.732 = 34.64$ m

Now $\tan 60° = \frac{h_2}{60}$

$\sqrt{3} = \frac{h_2}{60}$

$h_2 = 60\sqrt{3}$

$= 60\times1.732 = 103.92$ m

Height of workers from ground,

$h_1+h_2 = 34.64+103.92$

$= 138.56$ m

(i) Window of Ranjan hotel is 34.64 meter above ground.

(ii) Workers are 138.64 meter above the ground.

□□□□□□□

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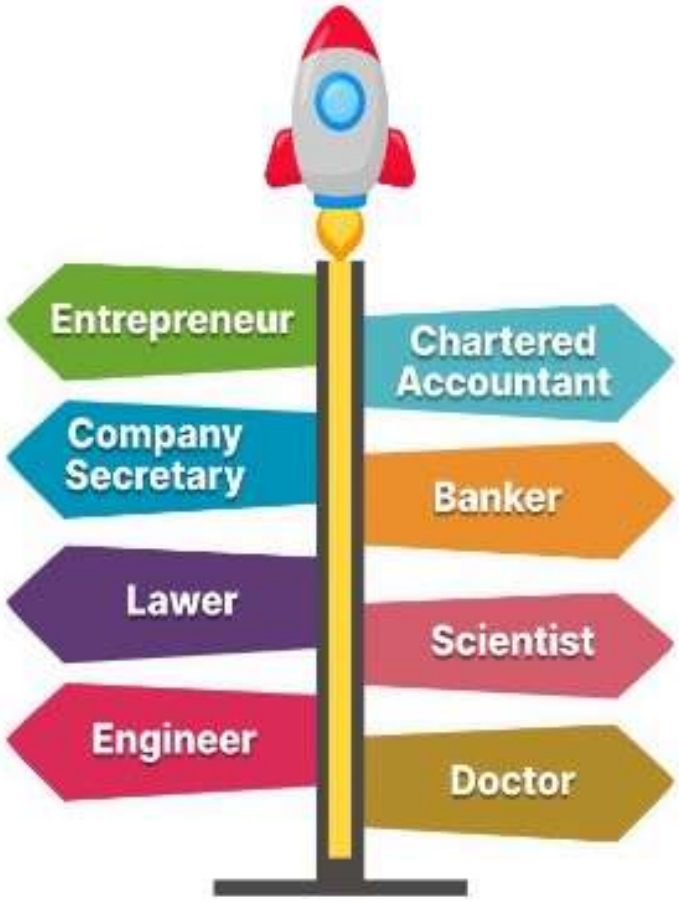

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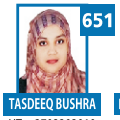

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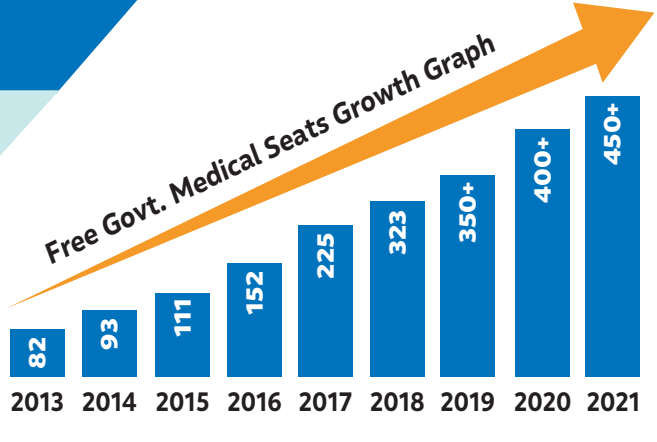
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