

CLASS X (2020-21)
MATHEMATICS STANDARD (041)
SAMPLE PAPER-06

Time : 3 Hours

Maximum Marks : 80

General Instructions :

1. This question paper contains two parts A and B.
2. Both Part A and Part B have internal choices.

**Scan QR Code to
See Video Solutions**

Part-A :

1. It consists of two sections- I and II.
2. Section I has 16 questions. Internal choice is provided in 5 questions.
3. Section II has four case study-based questions. Each case study has 5 case-based sub-parts. An examinee is to attempt any 4 out of 5 sub-parts.

Part-B :

1. Question no. 21 to 26 are very short answer type questions of 2 mark each.
2. Question no. 27 to 33 are short answer type questions of 3 marks each.
3. Question no. 34 to 36 are long answer type questions of 5 marks each.
4. Internal choice is provided in 2 questions of 2 marks, 2 questions of 3 marks and 1 question of 5 marks.

Part - A

Section - I

1. If HCF $(a, b) = 12$ and $a \times b = 1,800$, then find LCM (a, b) .

Ans :

We know that

$$\text{HCF}(a, b) \times \text{LCM}(a, b) = a \times b$$

Substituting the values we have

$$12 \times \text{LCM}(a, b) = 1800$$

or,
$$\text{LCM}(a, b) = \frac{1,800}{12} = 150$$

2. If one of the zeroes of the quadratic polynomial $(k-1)x^2 + kx + 1$ is -3 , then what is the value of k ?

Ans :

If a is zero of quadratic polynomial $f(x)$, then

$$f(a) = 0$$

So,
$$f(-3) = (k-1)(-3)^2 + (-3)k + 1$$

$$0 = (k-1)(9) - 3k + 1$$

$$0 = 9k - 9 - 3k + 1$$

$$0 = 6k - 8$$

$$k = \frac{8}{6} = \frac{4}{3}$$

3. Calculate the zeroes of the polynomial $p(x) = 4x^2 - 12x + 9$.

Ans : [Board Term-1 2010]

$$p(x) = 4x^2 - 12x + 9$$

$$= 4x^2 - 6x - 6x + 9$$

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

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

Substituting $p(x) = 0$, and solving we get $x = \frac{3}{2}, \frac{3}{2}$

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

Hence, zeroes of the polynomial are $\frac{3}{2}, \frac{3}{2}$.

4. Find the positive root of $\sqrt{3x^2 + 6} = 9$.

Ans : [Board Term-2, 2015]

We have
$$\sqrt{3x^2 + 6} = 9$$

$$3x^2 + 6 = 81$$

$$3x^2 = 81 - 6 = 75$$

$$x^2 = \frac{75}{3} = 25$$

Thus
$$x = \pm 5$$

Hence 5 is positive root.

or

If $x = -\frac{1}{2}$, is a solution of the quadratic equation $3x^2 + 2kx - 3 = 0$, find the value of k .

Ans : [Board Term-2, Delhi 2015]

We have
$$3x^2 + 2kx - 3 = 0$$

Substituting $x = -\frac{1}{2}$ in given equation we get

$$3\left(-\frac{1}{2}\right)^2 + 2k\left(-\frac{1}{2}\right) - 3 = 0$$

$$\frac{3}{4} - k - 3 = 0$$

$$k = \frac{3}{4} - 3$$

$$= \frac{3 - 12}{4} = \frac{-9}{4}$$

Hence
$$k = \frac{-9}{4}$$

5. Find the tenth term of the sequence $\sqrt{2}, \sqrt{8}, \sqrt{18}, \dots$

Ans : [Board Term-2 2016]

Let the first term of an AP be a and common difference be d .

Given AP is $\sqrt{2}, \sqrt{8}, \sqrt{18}$ or $\sqrt{2}, 2\sqrt{2}, 3\sqrt{2} \dots$

where, $a = \sqrt{2}, d = \sqrt{2}, n = 10$

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

$$a_{10} = \sqrt{2} + (10 - 1)\sqrt{2}$$

$$= \sqrt{2} + 9\sqrt{2}$$

$$= 10\sqrt{2}$$

Therefore tenth term of the given sequence $\sqrt{200}$.

or

Find the next term of the series $\sqrt{2}, \sqrt{8}, \sqrt{18}, \sqrt{32} \dots$

Ans : [Board Term-2 2012]

Let the first term of an AP be a and common difference d .

Here, $a = \sqrt{2}, a + d = \sqrt{8} = 2\sqrt{2}$

$$d = 2\sqrt{2} - \sqrt{2} = \sqrt{2}$$

$$\text{Next term} = \sqrt{32} + \sqrt{2}$$

$$= 4\sqrt{2} + \sqrt{2}$$

$$= 5\sqrt{2}$$

$$= \sqrt{50}$$



6. Are two triangles with equal corresponding sides always similar?

Ans : [Board Term-1 2015]

Yes, Two triangles having equal corresponding sides are congruent and all congruent Δs have equal angles, hence they are similar too.



7. Find the distance of a point $P(x, y)$ from the origin.

Ans : [Board 2018]

Distance between origin $(0, 0)$ and point $P(x, y)$ is

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$= \sqrt{(x - 0)^2 + (y - 0)^2}$$

$$= \sqrt{x^2 + y^2}$$

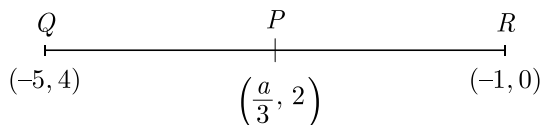


Distance between P and origin is $\sqrt{x^2 + y^2}$.

8. Find the value of a , for which point $P(\frac{a}{3}, 2)$ is the midpoint of the line segment joining the Points $Q(-5, 4)$ and $R(-1, 0)$.

Ans : [Board Term-2 SQP 2016]

As per question, line diagram is shown below.



Since P is mid-point of QR , we have

$$\frac{a}{3} = \frac{-5 + (-1)}{2} = \frac{-6}{2} = -3$$



Thus $a = -9$

9. In a triangle ABC , write $\cos(\frac{B+C}{2})$ in terms of angle A .

Ans : [Board Term-1 2016]

In a triangle $A + B + C = 180^\circ$

$$B + C = 180^\circ - A$$

Thus $\cos(\frac{B+C}{2}) = \cos[\frac{180^\circ - A}{2}]$

$$= \cos[90 - \frac{A}{2}]$$

$$= \sin \frac{A}{2}$$



10. What happens to value of $\cos \theta$ when θ increases from 0° to 90° .

Ans : [Board Term-1 2015]

$\cos \theta$ decreases from 1 to θ .



11. Find the value of $\sin^2 41^\circ + \sin^2 49^\circ$

Ans : [Board Term-1 2012, NCERT]

We have

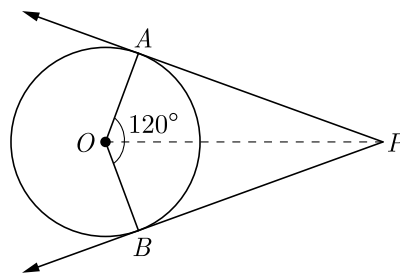
$$\sin^2 41 + \sin^2 49 = \sin^2(90^\circ - 49^\circ) + \sin^2 49^\circ$$

$$= \cos^2 49 + \sin^2 49^\circ$$

$$= 1$$



12. In the figure, PA and PB are tangents to a circle with centre O . If $\angle AOB = 120^\circ$, then find $\angle OPA$.



Ans : [Board Term-2 Delhi 2012, 2014]

Here OA is radius and AP is tangent at A , since radius is always perpendicular to tangent at point of contact, we have

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

Due to symmetry we have

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

Now in right ΔAOP we have

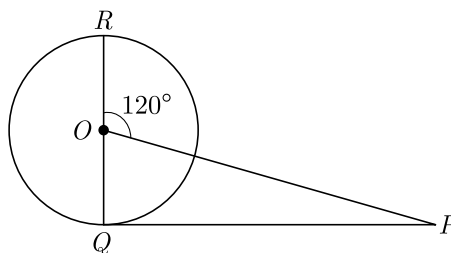
$$\angle APO + \angle OAP + \angle AOP = 180^\circ$$

$$\angle APO + 90^\circ + 60^\circ = 180^\circ$$

$$\angle APO = 180^\circ - 150^\circ = 30^\circ$$

or

PQ is a tangent drawn from an external point P to a circle with centre O , QOR is the diameter of the circle. If $\angle POR = 120^\circ$, What is the measure of $\angle OPQ$?



Ans : [Board Term-2 Foreign 2017]

Since PQ is a tangent to the circle, ΔOQP is right angle triangle

In ΔOQP because of exterior angle,

$$\angle POR = \angle OQP + \angle OPQ$$



Thus $\angle OPQ = \angle POR - \angle OQP$
 $= 120^\circ - 90^\circ = 30^\circ$

13. The radius of a circle is 17.5 cm. find the area of the sector of the circle enclosed by two radii and an arc 44 cm in length.

Ans : [Board 2020 OD Basic]

Given, arc length = 44 cm

Radius of circle, $r = 17.5$ cm

So, area of sector = $\frac{\text{arc length}}{2\pi r} \times \pi r^2$
 $= \frac{\text{arc length} \times r}{2} = \frac{44 \times 17.5}{2}$
 $= 22 \times 17.5 = 385$ sq. cm.



or

Find the area of the sector of a circle of radius 6 cm whose central angle is 30° . (Take $\pi = 3.14$)

Ans : [Board 2020 OD Standard]

Radius, $r = 6$ cm

Central angle, $\theta = 30^\circ$

Area of the sector,

$\frac{\pi r^2 \theta}{360^\circ} = \frac{3.14 \times 6 \times 6 \times 30^\circ}{360^\circ}$
 $= 9.42$ cm²



14. If the radius of the base of a right circular cylinder is halved, keeping the height same, find the ratio of the volume of the reduced cylinder to that of original cylinder.

Ans : [Board Term-2 2012]

$\frac{\text{Volume of reduced cylinder}}{\text{Volume of original cylinder}} = \frac{\pi \times (\frac{r}{2})^2 h}{\pi r^2 h} = \frac{1}{4}$
 $= 1 : 4$



15. What is abscissa of the point of intersection of the “Less than type” and of the “More than type” cumulative frequency curve of a grouped data ?

Ans :

The abscissa of the point of intersection of the “Less than type” and “More than type” cumulative frequency curve of a grouped data is median.



16. A card is drawn at random from a well shuffled pack of 52 cards. Find the probability of getting neither a red card nor a queen.

Ans : [Board Term-2 OD 2016]

There are 26 red cards out of total 52 cards and 2 black queen also.

Total number of cards, $n(S) = 52$

Cards which are neither red nor queen,

$n(E) = 52 - (26 + 2) = 24$

Required probability,

$P(E) = \frac{n(E)}{n(S)} = \frac{24}{52} = \frac{6}{13}$



or

A letter of English alphabet is chosen at random. Determine the probability that the chosen letter is a consonant.

Ans : [Board Term-2 Delhi 2015, 2020 Delhi STD]

In the English language there are 26 alphabets. Consonant are 21. The probability of chosen a consonant

$n(S) = 26$

$n(E) = 21$

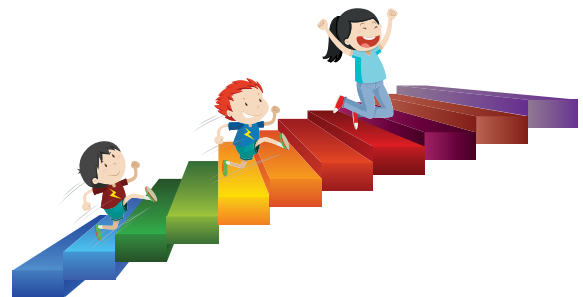
$P(E) = \frac{n(E)}{n(S)} = \frac{21}{26}$



Section II

Case study-based questions are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.

17. Amar, Akbar and Anthony are playing a game. Amar climbs 5 stairs and gets down 2 stairs in one turn. Akbar goes up by 7 stairs and comes down by 2 stairs every time. Anthony goes 10 stairs up and 3 stairs down each time.



Doing this they have to reach to the nearest point of 100th stairs and they will stop once they find it impossible to go forward. They can not cross 100th stair in anyway.

- (i) Who reaches the nearest point?

- (a) Amar
- (b) Akbar
- (c) Anthony
- (d) All together reach to the nearest point.



- (ii) How many times can they meet in between on same stair ?

- (a) 3
- (b) 4
- (c) 5
- (d) No, they cannot meet in between on same stair.

- (iii) Who takes least number of steps to reach near hundred?

- (a) Amar
- (b) Akbar
- (c) Anthony
- (d) All of them take equal number of steps.

- (iv) What is the first stair where any two out of three will meet together?
 - (a) Amar and Akbar will meet for the first time on 15th stair.
 - (b) Akbar and Anthony will meet for the first time on 35th stair.
 - (b) Amar and Anthony will meet for the first time on 21th stair.
 - (d) Amar and Akbar will meet for the first time on 21th stair.
- (v) What is the second stair where any two out of three will meet together?
 - (a) Amar and Akbar will meet on 21th stair.
 - (b) Akbar and Anthony will meet on 35th stair.
 - (c) Amar and Anthony will meet on 21th stair.
 - (d) Amar and Anthony will meet on 35th stair.

Ans :

(i) Amar will reach up to 93th stairs then he will go for 5 stairs up and 2 stairs down hence covering 96 stairs. Since 100th stair is final, so he will not cover more stairs. Akbar will reach up to 95th stair, since 100th stair is final, so he will not cover more stairs. Anthony will reach up to 91th stairs, since 100th stair is final, so she will not cover more stairs. Thus amar reaches the nearest point.

Thus (a) is correct option.

(ii) We find the LCM of 3, 5, and 7.

$$\text{LCM}(3, 5, 7) = 105\text{th stair.}$$

Since, total stairs are 100, they all cannot meet in between on same stair.

Thus (d) is correct option.

(iii) Amar will take $(\frac{100}{3} = 33.33)$ 32 steps to reach to 96th stair, Akbar will take $(\frac{100}{5} = 20)$ 19 steps to reach to 9th stairs and Anthony will take $(\frac{100}{7} = 14.22)$ 13 steps to reach 91th stairs.

Thus (c) is correct option.

(iv) Since $\text{LCM}(3, 5)=15$; $\text{LCM}(5, 7)=35$; $\text{LCM}(3, 7)=21$. Since, 15 is the smallest so Amar and Akbar will meet for the first time on 15th stair.

Thus (a) is correct option.

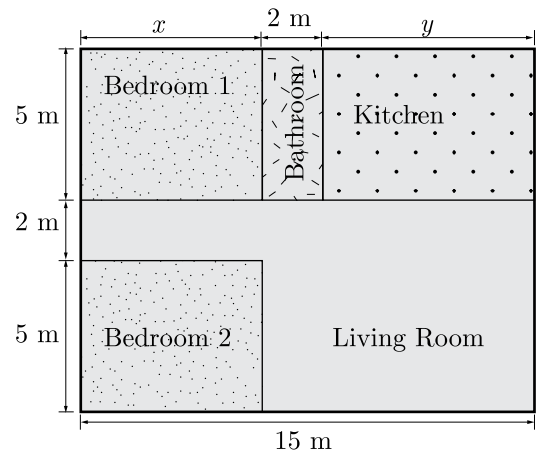
(v) As already calculated in (iii), $\text{LCM}(3, 7) = 21$

Thus (c) is correct option.

18. An architect is a skilled professional who plans and designs buildings and generally plays a key role in their construction. Architects are highly trained in the art and science of building design. Since they bear responsibility for the safety of their buildings' occupants, architects must be professionally licensed.



Varsha is a licensed architect and design very innovative house. She has made a house layout for her client which is given below. In the layout, the design and measurements has been made such that area of two bedrooms and kitchen together is 95 sq. m.



- (i) Which pair of linear equations does describe this situation ?
 - (a) $2x + y = 19$ and $x + y = 13$
 - (b) $x + 2y = 19$ and $2x + y = 13$
 - (c) $2x + y = 38$ and $x + y = 13$
 - (d) $2x + y = 38$ and $2x + y = 13$
- (ii) What is the length of the outer boundary of the layout.
 - (a) 24 m
 - (b) 48 m
 - (c) 27 m
 - (d) 54 m
- (iii) What is the area of bedroom 1 ?
 - (a) 24 m²
 - (b) 30 m²
 - (c) 28 m²
 - (d) 24 m²
- (iv) What is the area of living room in the layout ?
 - (a) 54 m²
 - (b) 48 m²
 - (c) 75 m²
 - (d) 24 m²
- (v) What is the cost of laying tiles in Kitchen at the rate of Rs. 50 per sq. m ?
 - (a) Rs. 1500
 - (b) Rs. 2000
 - (c) Rs. 1750
 - (d) Rs. 3000



Ans :

(i) Area of two bedrooms = $5x + 5x = 10x$ m²

Area of kitchen = $5y$ m²

Thus $10x + 5y = 95 \Rightarrow 2x + y = 19$

Also from figure, we have,

$$x + 2 + y = 15 \Rightarrow x + y = 13$$

Thus (a) is correct option.

(ii) Length of outer boundary

$$= 2(5 + 2 + 5 + 15) = 54 \text{ m}$$

Thus (d) is correct option.

(iii) Solving and $2x + y = 19$ and $x + y = 13$ we get $x = 6$ m and $y = 7$ m.

Area of bedroom = $5 \times 6 = 30$ sq. m

Area of kitchen = $5 \times 7 = 35$ sq. m

Thus (b) is correct option.

(iv) Area of living room

$$= (15 \times 7) - 30 = 105 - 30 = 75 \text{ m}^2$$

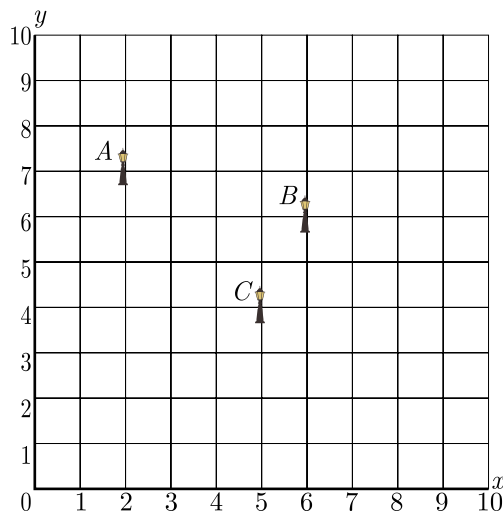
Thus (c) is correct option.

(v) Area of kitchen = $7 \times 5 = 35$ sq m
 Cost of laying tiles in kitchen = Rs. 50 per m^2
 Total cost of laying tiles in kitchen
 = $50 \times 35 = 1750$ Rs
 Thus (c) is correct option.

19. Resident Welfare Association (RWA) of a Gulmohar Society in Delhi have installed three electric poles *A*, *B* and *C* in a society's common park. Despite these three poles, some parts of the park are still in dark. So, RWA decides to have one more electric pole *D* in the park.



The park can be modelled as a coordinate systems given below.



On the basis of the above information, answer any four of the following questions:

- (i) What is the position of the pole *C*?
 - (a) (4, 5)
 - (b) (5, 4)
 - (c) (6, 5)
 - (d) (5, 6)
- (ii) What is the distance of the pole *B* from the corner *O* of the park?
 - (a) $6\sqrt{2}$ units
 - (b) $3\sqrt{2}$ units
 - (c) $6\sqrt{3}$ units
 - (d) $3\sqrt{3}$ units
- (iii) Find the position of the fourth pole *D* so that four points *A*, *B*, *C* and *D* form a parallelogram.
 - (a) (5, 2)
 - (b) (1, 5)
 - (c) (1, 4)
 - (d) (2, 5)
- (iv) What is the distance between poles *A* and *C*?
 - (a) $6\sqrt{2}$ units
 - (b) $3\sqrt{2}$ units
 - (c) $6\sqrt{3}$ units
 - (d) $3\sqrt{3}$ units
- (v) What is the distance between poles *B* and *D*?
 - (a) $2\sqrt{3}$ units
 - (b) $\sqrt{28}$ units
 - (c) $6\sqrt{3}$ units
 - (d) $\sqrt{26}$ units



Ans :

- (i) From the given diagram we can easily get that position of the pole *C* (5, 4). Thus (b) is correct option.
- (ii) Coordinates of *B* are (6, 6).

Distance from origin = $\sqrt{(6-0)^2 + (6-0)^2}$
 = $\sqrt{36 + 36} = 6\sqrt{2}$ units
 Thus (a) is correct option.

(iii) If *ABCD* is a parallelogram, the diagonals bisect each other. Here *AC* and *BD* are diagonals.

$$\text{Mid-point of } AC = \left(\frac{2+5}{2}, \frac{7+4}{2}\right) = (3.5, 5.5)$$

Now, mid-point of diagonal, *BD* will be (3.5, 5.5) also. Let, the coordinates of *D* be (*x*, *y*)

$$\text{Now } \frac{6+x}{2} = 3.5 \text{ and } \frac{6+y}{2} = 5.5$$

$$x = 1 \text{ and } y = 5$$

Thus (b) is correct option.

(iv) Coordinates of *A* are (2, 7) and coordinates of *C* are (5, 4).

Distance between pole *A* and *C*,
 $AC = \sqrt{(5-2)^2 + (4-7)^2}$
 = $\sqrt{9 + 9} = 3\sqrt{2}$ units

Thus (b) is correct option.

(v) Coordinates of *B* are (6, 6) and coordinates of *D* are (1, 5).

Distance between pole *B* and *D*,
 $BD = \sqrt{(6-1)^2 + (6-5)^2}$
 = $\sqrt{5^2 + 1^2}$
 = $\sqrt{25 + 1} = \sqrt{26}$ units

Thus (d) is correct option.

20. When an eagle looks at a rat on the ground, eagle does not attack the rat at its initial position. It takes into account the speed of the rat and the direction in which rat is moving. After analysing the situation (how? it may be God's gift) eagle attacks the rat in such a way that it may successful in catching the rat.



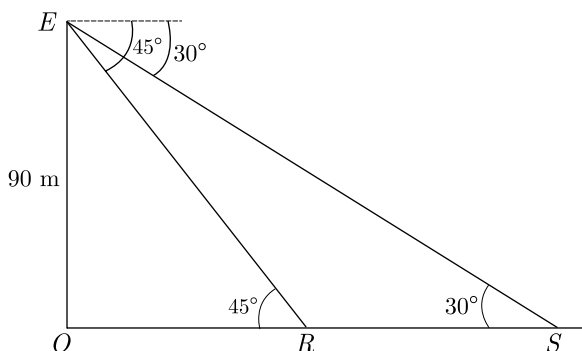
Suppose an eagle sitting on the tree of height 90 m, observe a rat with angle of depression 45° , and moving away from the tree with some speed. Eagle start flying with 30° downward and catch rat in 10 second.

- (i) What is the horizontal distance between tree and initial position of rat ?
 - (a) 60 m
 - (b) 45 m
 - (c) 90 m
 - (d) 120 m
- (ii) What is the distance travelled by rat in 10 seconds?
 - (a) $60(\sqrt{3} - 1)$ m
 - (b) $60(\sqrt{2} - 1)$ m
 - (c) $90(\sqrt{3} - 1)$ m
 - (d) $90(\sqrt{2} - 1)$ m
- (iii) What is the distance travelled by eagle to catch rat?
 - (a) 90 m
 - (b) 180 m
 - (c) 270 m
 - (d) 240 m
- (iv) What is the speed of rat ?
 - (a) 18 m/s
 - (b) $9(\sqrt{3} + 1)$ m/s
 - (c) 64.8 m/s
 - (d) $9(\sqrt{3} - 1)$ m/s
- (v) What is the speed of eagle ?
 - (a) 18 km/h
 - (b) $9(\sqrt{3} + 1)$ km/h
 - (c) $9(\sqrt{3} + 1)$ km/h
 - (d) 64.8 km/h



Ans :

(i) As per information given in question we have made diagram below. Here E is initial position of eagle and R is initial position of rat. Eagle catch rat at S .



$$\frac{OE}{OR} = \tan 45^\circ = 1$$

$$OE = OR = 90 \text{ m}$$

Thus (c) is correct option.

(ii) In triangle $\triangle EOS$, $\angle OES = 90^\circ - 30^\circ = 60^\circ$

$$\frac{OS}{OE} = \tan 60^\circ$$

$$\frac{OS}{90} = \sqrt{3}$$

$$OS = 90\sqrt{3} \text{ m}$$

$$RS = OS - OR$$

$$= 90\sqrt{3} - 90 = 90(\sqrt{3} - 1)$$

Thus (c) is correct option.

(iii) $\frac{EO}{ES} = \cos 60^\circ$

$$\frac{90}{ES} = \frac{1}{2}$$

$$ES = 90 \times 2 = 180 \text{ m}$$

Thus (b) is correct option.

(iv) Speed of rat $s_r = \frac{RS}{t} = \frac{90(\sqrt{3} - 1)}{10}$
 $= 9(\sqrt{3} - 1)$ m/sec

Thus (d) is correct option.

(v) Speed of Eagle,

$$s_e = \frac{ES}{t} = \frac{180}{10} = 18 \text{ m/sec}$$

$$= \frac{18 \times 3600}{1000} \text{ km/h}$$

$$= 64.8 \text{ km/h}$$

Thus (d) is correct option.

Part - B

All questions are compulsory. In case of internal choices, attempt anyone.

21. Find the quadratic polynomial whose sum and product of the zeroes are $\frac{21}{8}$ and $\frac{5}{16}$ respectively.

Ans : [Board Term-1 2012, Set-35]

Sum of zeroes, $\alpha + \beta = \frac{21}{8}$

Product of zeroes $\alpha\beta = \frac{5}{16}$

Now $p(x) = x^2 - (\alpha + \beta)x + \alpha\beta$
 $= x^2 - \frac{21}{8}x + \frac{5}{16}$

or $p(x) = \frac{1}{16}(16x^2 - 42x + 5)$

22. Solve the following pair of linear equations by substitution method:

$$3x + 2y - 7 = 0$$

$$4x + y - 6 = 0$$

Ans : [Board Term-1 2015]

We have $3x + 2y - 7 = 0$... (1)

$$4x + y - 6 = 0$$
 ... (2)

From equation (2), $y = 6 - 4x$... (3)

Putting this value of y in equation (1) we have

$$3x + 2(6 - 4x) - 7 = 0$$

$$3x + 12 - 8x - 7 = 0$$

$$5 - 5x = 0$$

$$5x = 5$$

Thus $x = 1$

Substituting this value of x in (2), we obtain,

$$y = 6 - 4 \times 1 = 2$$

Hence, values of x and y are 1 and 2 respectively.

23. Solve the following quadratic equation for x :

$$4\sqrt{3}x^2 + 5x - 2\sqrt{3} = 0$$

Ans : [Board Term-2, 2013, 2012]

We have $4\sqrt{3}x^2 + 5x - 2\sqrt{3} = 0$

$$4\sqrt{3}x^2 + 8x - 3x - 2\sqrt{3} = 0$$

$$4x(\sqrt{3}x + 2) - \sqrt{3}(\sqrt{3}x + 2) = 0$$

$$(\sqrt{3}x + 2)(4x - \sqrt{3}) = 0$$



Thus $x = -\frac{2}{\sqrt{3}}, \frac{\sqrt{3}}{4}$

or

Solve for $x : x^2 - (\sqrt{3} + 1)x + \sqrt{3} = 0$

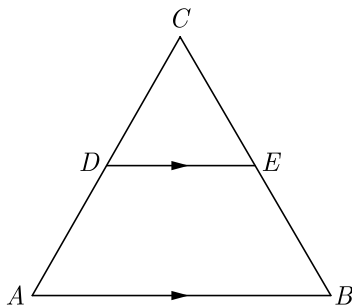
Ans : [Board Term-2 Foreign 2015]

We have

$$\begin{aligned} x^2 - (\sqrt{3} + 1)x + \sqrt{3} &= 0 \\ x^2 - \sqrt{3}x - 1x + \sqrt{3} &= 0 \\ x(x - \sqrt{3}) - 1(x - \sqrt{3}) &= 0 \\ (x - \sqrt{3})(x - 1) &= 0 \end{aligned}$$

Thus $x = \sqrt{3}, x = 1$

24. In the given figure, $\angle A = \angle B$ and $AD = BE$. Show that $DE \parallel AB$.



Ans : [Board Term-1, 2012, set-63]

In $\triangle CAB$, we have

$$\angle A = \angle B \tag{1}$$

By isosceles triangle property we have

$$AC = CB$$

But, we have been given

$$AD = BE \tag{2}$$

Dividing equation (2) by (1) we get,

$$\frac{CD}{AD} = \frac{CE}{BE}$$

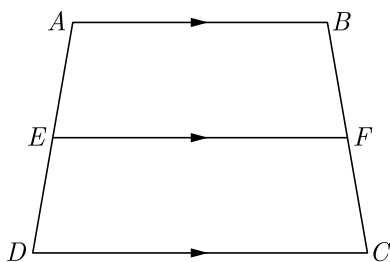
By converse of *BPT*,

$$DE \parallel AB.$$

Hence Proved

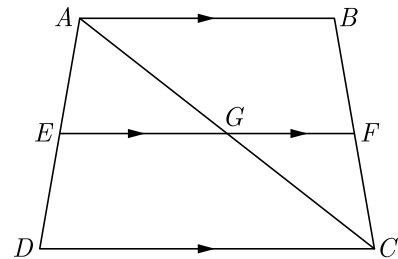
or

In the given figure, if $ABCD$ is a trapezium in which $AB \parallel CD \parallel EF$, then prove that $\frac{AE}{ED} = \frac{BF}{FC}$



Ans : [Board Term-1 2012]

We draw, AC intersecting EF at G as shown below.



In $\triangle CAB$, $GF \parallel AB$, thus by *BPT* we have

$$\frac{AG}{CG} = \frac{BF}{FC} \tag{1}$$

In $\triangle ADC$, $EG \parallel DC$, thus by *BPT* we have

$$\frac{AE}{ED} = \frac{AG}{CG} \tag{2}$$

From equations (1) and (2),

$$\frac{AE}{ED} = \frac{BF}{FC}. \quad \text{Hence Proved.}$$

25. If $\sin A = \frac{\sqrt{3}}{2}$, find the value of $2 \cot^2 A - 1$.

Ans : [Board Term-1 2012]

Using $\cot^2 \theta = -1 + \operatorname{cosec}^2 \theta$ we have

$$\begin{aligned} 2 \cot^2 A - 1 &= 2(\operatorname{cosec}^2 A - 1) - 1 \\ &= \frac{2}{\sin^2 A} - 3 \\ &= \frac{2}{\left(\frac{\sqrt{3}}{2}\right)^2} - 3 \\ &= \frac{8}{3} - 3 = \frac{-1}{3} \end{aligned}$$

Thus $2 \cot^2 A - 1 = \frac{-1}{3}$

26. Given below is the distribution of weekly pocket money received by students of a class. Calculate the pocket money that is received by most of the students.

Pocket Money (in Rs.)	0-20	20-40	40-60	60-80	80-100	100-120	120-140
Number of students.	2	2	3	12	18	5	2

Ans : [Board Term-1 2015]

Class Interval	Frequency
0-20	2
20-40	2
40-60	3
60-80	12
80-100	18
100-120	5
120-140	2
Total	44

Class 80-100 has the maximum frequency 18, therefore this is model class.

We have $l = 80, f_1 = 18, f_2 = 5, f_0 = 12, h = 20$

Mode, $M_o = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) h$
 $= 80 + \left(\frac{18 - 12}{36 - 12 - 5} \right) \times 20$
 $= 80 + \frac{6}{19} \times 20$
 $= 80 + 6.31$
 $= 86.31$



27. Find the values of k for which the quadratic equation $x^2 + 2\sqrt{2k}x + 18 = 0$ has equal roots.

Ans : [Board 2020 SQP Standard]

We have $x^2 + 2\sqrt{2k}x + 18 = 0$

Comparing it by $ax^2 + bx + c$, we get $a = 1$, $b = 2\sqrt{2k}$ and $c = 18$.

Given that, equation $x^2 + 2\sqrt{2k}x + 18 = 0$ has equal roots.

$b^2 - 4ac = 0$
 $(2\sqrt{2k})^2 - 4 \times 1 \times 18 = 0$

$8k^2 - 72 = 0$

$8k^2 = 72$

$k^2 = \frac{72}{8} = 9$

$k = \pm 3$



28. The sum of the first 7 terms of an AP is 63 and that of its next 7 terms is 161. Find the AP.

Ans : [Board 2020 Delhi Standard]

We have $S_7 = 63$

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

$63 = \frac{7}{2} [2a + 6d]$

$9 = a + 3d$... (1)

Now, sum of next 7 terms,

$S_{8-14} = 161$

$S_{8-14} = \frac{7}{2} (a_8 + a_{14})$

$161 = \frac{7}{2} (a + 7d + a + 13d)$

$161 = \frac{7}{2} (2a + 20d)$

$23 = a + 10d$... (2)

Subtracting equation (1) from (2) we have

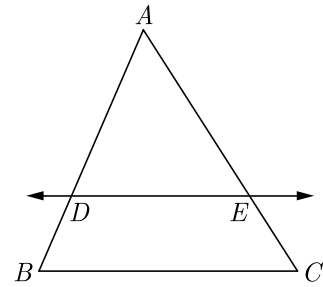
$14 = 7d \Rightarrow d = 2$

Substituting the value of d in (1), we get

$a = 3$

Hence, the AP is 3, 5, 7, 9, ...

29. In Figure, in ΔABC , $DE \parallel BC$ such that $AD = 2.4$ cm, $AB = 3.2$ cm and $AC = 8$ cm, then what is the length of AE ?



Ans : [Board 2020 Delhi Basic]

We have $DE \parallel BC$

By BPT, $\frac{AD}{DB} = \frac{AE}{EC}$

$\frac{2.4}{AB - AD} = \frac{AE}{AC - AE}$

$\frac{2.4}{3.2 - 2.4} = \frac{AE}{8 - AE}$

$\frac{2.4}{0.8} = \frac{AE}{8 - AE}$

$3 = \frac{AE}{8 - AE}$

$\frac{3}{1 + 3} = \frac{AE}{8 - AE + AE}$

$\frac{3}{4} = \frac{AE}{8} \Rightarrow AE = 6$ cm

30. If $\sin \theta + \cos \theta = \sqrt{2}$ prove that $\tan \theta + \cot \theta = 2$

Ans : [Board 2020 OD Standard]

We have $\sin \theta + \cos \theta = \sqrt{2}$

Squaring both the sides, we get

$(\sin \theta + \cos \theta)^2 = (\sqrt{2})^2$

$\sin^2 \theta + \cos^2 \theta + 2 \sin \theta \cos \theta = 2$

$1 + 2 \sin \theta \cos \theta = 2$

$2 \sin \theta \cos \theta = 1$

$\sin \theta \cos \theta = \frac{1}{2}$

... (1)

Now $\tan \theta + \cot \theta = \frac{\sin \theta}{\cos \theta} + \frac{\cos \theta}{\sin \theta}$
 $= \frac{\sin^2 \theta + \cos^2 \theta}{\cos \theta \sin \theta}$
 $= \frac{1}{\sin \theta \cos \theta} = \frac{1}{\frac{1}{2}} = 2 = \text{RHS}$

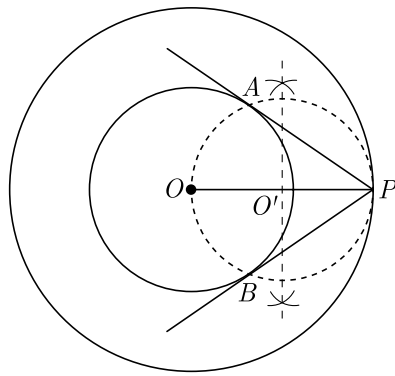
31. Draw two concentric circle of radii 3 cm and 5 cm. Taking a point on the outer circle, construct the pair of tangents to the inner circle.

Ans : [Foreign Set I 2017]

Steps of Construction :

1. Draw a circle with radius 3 cm and centre O .
2. Draw another circle with centre O and radius 5 cm.
3. Take a point P on the circumference of outer circle and join O to P .
4. Taking OP as diameter draw another circle which intersect the smallest circle at A and B .
5. Join A to P and B to P . AP and BP are the required tangents.





32. Find the area of minor segment of a circle of radius 14 cm, when its centre angle is 60°. Also find the area of corresponding major segment. Use $\pi = \frac{22}{7}$.

Ans : [Board Term-2 OD 2015]

Here, $r = 14$ cm, $\theta = 60^\circ$



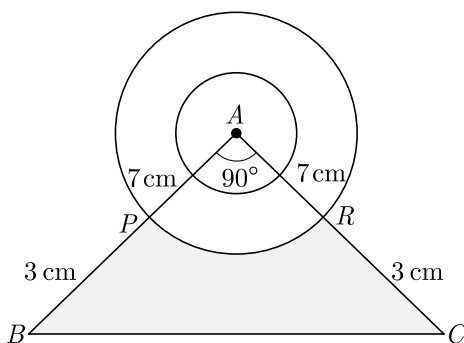
Area of minor segment,

$$\begin{aligned} \pi r^2 \frac{\theta}{360^\circ} - \frac{1}{2} r^2 \sin \theta &= \pi (14)^2 \frac{60^\circ}{360^\circ} - \frac{1}{2} \times (14)^2 \times \frac{\sqrt{3}}{2} \\ &= \frac{22}{7} \times 14 \times 14 \times \frac{60^\circ}{360^\circ} - \frac{1}{2} \times 14 \times 14 \times \frac{\sqrt{3}}{2} \\ &= \left(\frac{308}{3} - 49\sqrt{3} \right) = 17.9 \text{ cm}^2 \text{ approx.} \end{aligned}$$

$$\begin{aligned} \text{Area of major segment} &= \pi r^2 - \left(\frac{308}{3} - 49\sqrt{3} \right) \\ &= \frac{22}{7} \times 14 \times 14 - \frac{308}{3} + 49\sqrt{3} \\ &= \frac{1540}{3} + 49\sqrt{3} = 598.10 \\ &= 598 \text{ cm}^2 \text{ approx.} \end{aligned}$$

or

A momento is made as shown in the figure. Its base $PBCR$ is silver plate from the front side. Find the area which is silver plated. Use $\pi = \frac{22}{7}$.



Ans : [Board Term-2 2015]

From the given figure area of right-angled $\triangle ABC$,

$$\frac{1}{2} AC \times AB = \frac{1}{2} \times 10 \times 10 = 50$$

Area of quadrant APR is the $\frac{1}{4}$ of the circle of radii 7 cm.

Thus area of quadrant APR of the circle of radii 7 cm

$$\frac{1}{4} \pi (7)^2 = \frac{1}{4} \times \frac{22}{7} \times 49 = 38.5 \text{ cm}^2$$

Area of base $PBCR$

$$\begin{aligned} &= \text{Area of } \triangle ABC - \text{Area of quadrant } APR \\ &= 50 - 38.5 = 11.5 \text{ cm}^2 \end{aligned}$$

33. The following table shows the weights (in gms) of a sample of 100 apples, taken from a large consignment :

Weight (in gms)	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130
No. of Apples	8	10	12	16	18	14	12	10

Find the median weight of apples.

Ans : [Board Term-1 2011]

C.I.	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130
f	8	10	12	16	18	14	12	10
$c.f.$	8	18	30	46	64	78	90	100

We have $N = 100$; $\frac{N}{2} = 50$
Cumulative frequency just greater than $\frac{N}{2}$ is 64 and the corresponding class is 90-100. Thus median class is 90-100.

$$\begin{aligned} \text{Median, } M_d &= l + \left(\frac{\frac{N}{2} - F}{f} \right) h \\ &= 90 + \left(\frac{50 - 46}{18} \right) \times 10 \\ &= 90 + \frac{40}{18} = 92.2 \\ &= 92.2 \text{ gm.} \end{aligned}$$



Thus median weight is 92.2.

or

Weekly income of 600 families is given below :

Income (in Rs.)	0-1000	1000-2000	2000-3000	3000-4000	4000-5000	5000-6000
No. of Families	250	190	100	40	15	5

Find the median.

Ans :

We prepare following cumulative frequency table to find median class.

Income	No. of Families	$c.f.$
0-1000	250	250
1000-2000	190	440
2000-3000	100	540
3000-4000	40	580
4000-5000	15	595
5000-6000	5	600
	$N = 600$	

We have $N = 600$; $\frac{N}{2} = 300$

Cumulative frequency just greater than $\frac{N}{2}$ is 440 and the corresponding class is 1000-2000. Thus median class is 1000-2000.

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

$$\begin{aligned} \text{Median} &= 1000 + \left(\frac{300 - 250}{190}\right) \times 1000 \\ &= 1000 + \frac{50}{190} \times 1000 \\ &= 1000 + \frac{5000}{19} \\ &= 1000 + 263.16 \\ &= 1263.16 \end{aligned}$$

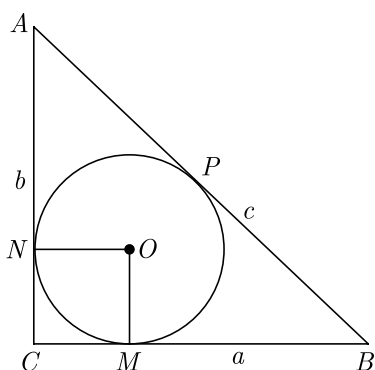
Median = Rs. 1263.16



34. a, b and c are the sides of a right triangle, where c is the hypotenuse. A circle, of radius r , touches the sides of the triangle. Prove that $r = \frac{a + b - c}{2}$.

Ans : [Board Term-2 Delhi 2016]

As per question we draw figure shown below.



Let the circle touches CB at M , CA at N and AB at P .

Now $OM \perp CB$ and $ON \perp CA$ because radius is always perpendicular to tangent

OM and ON are radius of circle, thus

$$OM = ON$$

CM and CN are tangent from C , thus

$$CM = CN$$

Therefore $OMCN$ is a square. Let

Let $OM = r = CM = CN = ON$

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

$$AN = AP, CN = CM \text{ and } BM = BP$$

Now taking $AN = AP$

$$AC - CN = AB - BP$$

$$b - r = c - BM$$

$$b - r = c - (a - r)$$

$$b - r = c - a + r$$

$$2r = a + b - c$$

$$r = \frac{a + b - c}{2} \quad \text{Hence Proved.}$$

35. Water is flowing at the rate of 5 km/hour through a pipe of diameter 14 cm into a rectangular tank of dimensions 50 m \times 44 m. Find the time in which the level of water in the tank will rise by 7 cm.

Ans : [Board Term-2 Delhi Compt. 2017]

Radius of pipe, $r = \frac{14}{2} = 7$ cm

Cross section area of pipe,

$$\pi r^2 = \frac{22}{7} \times \left(\frac{7}{100}\right)^2$$

Speed of water flowing through the pipe

$$= 5 \text{ km/hr} = 15000 \text{ m/hr}$$

In an hour length of water = 5000 m

Volume of water flowing from pipe in 1 hr,

$$\pi r^2 h = \frac{22}{7} \times \left(\frac{7}{100}\right)^2 \times 5000 \text{ m}^3$$

Let t be time taken to fill the tank. Now total volume of water flowing in time t ,

$$\pi r^2 h t = \frac{22}{7} \times \left(\frac{7}{100}\right)^2 \times 5000 t$$

Volume of water flown = Volume of water in tank

$$\pi r^2 h t = l \times b \times y$$

$$\frac{22}{7} \times \left(\frac{7}{100}\right)^2 \times 5000 t = 50 \times 44 \times \frac{7}{100}$$

$$\frac{22}{7} \times \frac{7}{100} \times \frac{7}{100} \times 5000 t = 50 \times 44 \times \frac{7}{100}$$

$$22 \times 50 t = 50 \times 44$$

$$t = \frac{50 \times 44}{22 \times 50} = 2$$

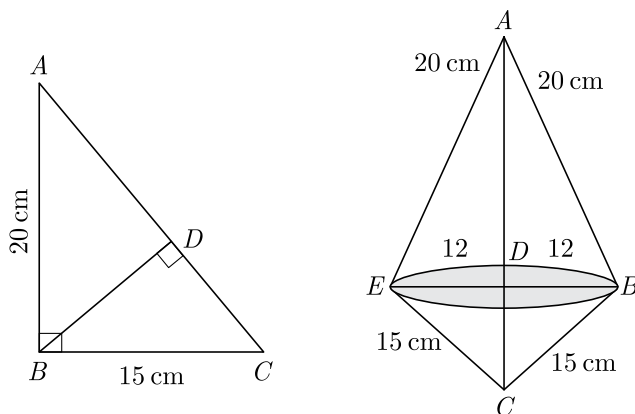
Hence, Time taken to fill the tank is 2 hours.

or

A right triangle whose sides are 15 cm is made to revolve about its hypotenuse. Find the volume and the surface area of the double cone so formed. (Use $\pi = 3.14$)

Ans : [Board Term-2 2012]

As per question the figure is shown below.



We have $AC^2 = 20^2 + 15^2 = 625$

$$AC = 25 \text{ cm}$$

$$\text{area}(\Delta ABC) = \text{area}(\Delta ABC)$$

$$\frac{1}{2} \times AC \times BD = \frac{1}{2} \times BC \times AB$$

$$25 \times BD = 15 \times 20 = 300$$

$$BD = 12 \text{ cm}$$

Volume of double cone,

= Volume of upper cone + Volume of lower cone

$$= \frac{1}{3} \pi (BD)^2 \times AD + \frac{1}{3} \pi (BD)^2 \times CD$$



$$\begin{aligned}
 &= \frac{1}{3}\pi(BD)^2(AD + CD) \\
 &= \frac{1}{3}\pi(BD)^2(AC) \\
 &= \frac{1}{3} \times 3.14 \times (12)^2 \times 25 \\
 &= \frac{1}{3} \times 3.14 \times 144 \times 25 = 3768 \text{ cm}^2
 \end{aligned}$$

Surface area = CSA of upper cone + CSA of lower cone

$$\begin{aligned}
 &= \pi(12)(20) + \pi(12)(15) \\
 &= 12\pi\{20 + 15\} \\
 &= 12 \times 3.14 \times 35 \\
 &= 1318.8 \text{ cm}^2
 \end{aligned}$$

36. The king, queen and jack of clubs are removed from a deck of 52 cards. The remaining cards are mixed together and then a card is drawn at random from it. Find the probability of getting

- (i) a face card,
- (ii) a card of heart,
- (iii) a card of clubs
- (iv) a queen of diamond

Ans : [Board Term-2 Delhi Compt. 2017]

There are $52 - 3 = 49$ cards in deck. Thus we have 49 possible outcomes.

$$n(S) = 49$$

(i) a face card,

Number of face cards, $n(E_1) = 12 - 3 = 9$

$$P(\text{a face card}), \quad P(E_1) = \frac{n(E_1)}{n(S)} = \frac{9}{49}$$

(ii) a card of heart,

No. of card of heart in the deck

$$n(E_2) = 13$$

$$P(\text{a card of heart}), \quad P(E_2) = \frac{n(E_2)}{n(S)} = \frac{13}{49}$$

(iii) a card of clubs

Number of cards of clubs

$$n(E_3) = 13 - 3 = 10$$

$$P(\text{a card of clubs}), \quad P(E_3) = \frac{n(E_3)}{n(S)} = \frac{10}{49}$$

(iv) a queen of diamond.

There is only one queen of diamond.

$$n(E_4) = 1$$

$$P(\text{queen of diamond}), \quad P(E_4) = \frac{n(E_4)}{n(S)} = \frac{1}{49}$$

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