Sample Question Paper - 1
Class – X Session -2021-22
TERM 1
Subject- Mathematics (Standard) 041

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 40**

General Instructions:

1. The question paper contains three parts A, B and C.
2. Section A consists of 20 questions of 1 mark each. Attempt any 16 questions.
3. Section B consists of 20 questions of 1 mark each. Attempt any 16 questions.
4. Section C consists of 10 questions based on two Case Studies. Attempt any 8 questions.
5. There is no negative marking.

Section A

Attempt any 16 questions

1. The decimal expansion of the number $\frac{441}{2^2 \times 5^3 \times 7^2}$ has **[1]**

   a) None of these
   b) non-terminating and non-repeating decimal
   c) terminating decimal
   d) non-terminating repeating decimal

2. The pair of equations 2x + 3y = 5 and 4x + 6y = 15 has **[1]**

   a) infinitely many solutions
   b) exactly two solutions
   c) no solution
   d) a unique solution

3. What should be subtracted to the polynomial x^2 - 16x + 30, so that 15 is the zero of the resulting polynomial? **[1]**

   a) 15
   b) 14
   c) 16
   d) 30

4. The solution of $\frac{a^2}{x} - \frac{b^2}{y} = 0$ and $\frac{a^2b}{x} + \frac{b^2a}{y} = a + b$ where x, y $\neq$ 0 is **[1]**

   a) x = -a^2 and y = -b^2
   b) x = a^2 and y = -b^2
   c) x = a^2 and y = b^2
   d) x = -a^2 and y = b^2

5. If $sin\theta - cos\theta = 0$, then the value of $\sin^4\theta + \cos^4\theta$ is **[1]**

   a) 1
   b) $\frac{3}{4}$
   c) $\frac{1}{4}$
   d) $\frac{1}{2}$

6. (2+ $\sqrt{5}$) is **[1]**

   a) an irrational number
   b) not real number
   c) a rational number
   d) an integer

7. If α, β are the zeros of the polynomial $p(x) = 4x^2 + 3x + 7$, then $\frac{1}{\alpha} + \frac{1}{\beta}$ is equal to **[1]**

a) $\frac{3}{7}$
b) $-\frac{3}{7}$
c) $-\frac{7}{3}$
d) $\frac{7}{3}$

8. If A (2, 2), B (-4, - 4) and C (5, -8) are the vertices of a triangle, then the length of the median through vertex C is **[1]**

a) $\sqrt{113}$
b) $\sqrt{65}$
c) $\sqrt{85}$
d) $\sqrt{117}$

9. The number of zeroes of a cubic polynomial is **[1]**

a) 3
b) 2
c) 4
d) 1

10. The sum and product of the zeroes of the polynomial $f(x) = 4x^2 - 27x + 3k^2$ are equal, then the value of k is **[1]**

a) ± 3
b) 0
c) ± 1
d) ± 2

11. A die is thrown once. The probability of getting a prime number is **[1]**

a) $\frac{1}{3}$
b) $\frac{1}{6}$
c) $\frac{1}{2}$
d) $\frac{2}{3}$

12. If HCF (26,169) = 13, then LCM (26,169) = **[1]**

a) 13
b) 26
c) 52
d) 338

13. The distance of a point from the y-axis is called **[1]**

a) origin
b) None of these
c) abscissa
d) ordinate

14. Points (1, 0) and (-1, 0) lies on **[1]**

a) line x + y = 0
b) y-axis
c) x-axis
d) line x - y = 0

15. If one zero of the quadratic polynomial $kx^2 + 3x + k$ is 2 then the value of k is **[1]**

a) $\frac{-5}{6}$
b) $\frac{-6}{5}$
c) $\frac{5}{6}$
d) $\frac{6}{5}$

16. $9\sec^2A - 9\tan^2A$ = **[1]**

a) 8
b) 9
c) 0
d) 1

17. The solution of $\frac{x}{a} + \frac{y}{b} = 2$ and $ax - by = a^2 - b^2$ is **[1]**

a) x = a and y = b
b) $x = a^2$ and $y = b^2$

c) $x = -a^2$ and $y = -b^2$ | d) x = -a and y = -b

18. Two numbers 'a' and 'b' are selected successively without replacement in that order from the integers 1 to 10. The probability that $\frac{a}{b}$ is an integer, is [1]

a) $\frac{17}{45}$ | b) $\frac{8}{45}$
c) $\frac{1}{5}$ | d) $\frac{17}{90}$

19. The sum of a rational and an irrational number is [1]

a) Can be Rational or Irrational | b) Irrational
c) Always Rational | d) Rational

20. If A(5, 3), B(11, -5) and P(12, y) are the vertices of a right triangle right angled at P, then y = [1]

a) -1, 4 | b) 2, 4
c) -2, 4 | d) 2, -4

Section B

Attempt any 16 questions

21. In a cyclic quadrilateral ABCD, if $\angle$A = $(2x - 1)^o$, $\angle$B = $(y + 5)^o$, $\angle$C = $(2y + 15)^o$ and $\angle$D = $(4x - 7)^o$, then the value of $\angle C$ is [1]

a) 55^o | b) 125^o
c) 65^o | d) 115^o

22. A quadratic polynomial whose zeros are $\frac{3}{5}$ and $\frac{-1}{2}$, is [1]

a) $10x^2 - x + 3$ | b) $10x^2 + x - 3$
c) $10x^2 - x -3$ | d) $10x^2 + x + 3$

23. If $a = 2^3 \times 3, b = 2 \times 3 \times 5, c = 3^n \times 5$ and LCM (a, b, c) $= 2^3 \times 3^2 \times 5$, then n = [1]

a) 1 | b) 4
c) 3 | d) 2

24. $\cos^4A - \sin^4A$ is equal to [1]

a) $2 \sin^2 A - 1$ | b) $2 \sin^2 A + 1$
c) $2 \cos^2 A + 1$ | d) $2 \cos^2 A - 1$

25. The sum of the digits of a two digit number is 9. Nine times this number is twice the number obtained by reversing the digits, then the number is [1]

a) 72 | b) 27
c) 18 | d) 81

26. If α and β are the zeroes of the polynomial $x^2 - 6x + 8$, then the value of $\alpha^3 + \beta^3$ is [1]

a) 76 | b) 72
c) 74 | d) 80

27. Two poles of height 13 m and 7 m respectively stand vertically on a plane ground at a distance [1]

of 8 m from each other. The distance between their tops is

a) 11 m
b) 10 m
c) 9 m
d) 12 m

28. The ratio in which the point (1, 3) divides the line segment joining the points (-1, 7) and (4, -3) is **[1]**

a) 2 : 3
b) 7: 2
c) 3 : 2
d) 2 : 7

29. If $\tan\theta = \frac{1}{\sqrt{7}}$ then $\frac{cosec^2\theta - \sec^2\theta}{cosec^2\theta + \sec^2\theta} =$ **[1]**

a) $\frac{1}{12}$
b) $\frac{3}{7}$
c) $\frac{3}{4}$
d) $\frac{5}{7}$

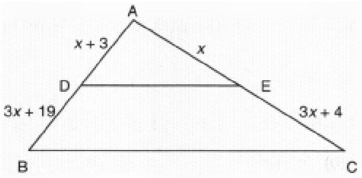
30. If x = α and y = β is the solution of the equations x - y = 2 and x + y = 4, then **[1]**

a) α = 1 and β = 3
b) α = 3 and β = -1
c) α = 3 and β = 1
d) α = -3 and β = 1

31. The exponent of 2 in the prime factorisation of 144, is **[1]**

a) 4
b) 5
c) 6
d) 3

32. In the given figure value of x for which DE || BC is **[1]**



a) 3
b) 2
c) 4
d) 1

33. If sinA + $\sin^2$ A = 1, then the value of the expression ($\cos^2$A + $\cos^4$A) is **[1]**

a) $\frac{1}{2}$
b) 1
c) 3
d) 2

34. If the point R(x, y) divides the join of P(x_1, y_1) and Q(x_2, y_2) internally in the given ratio m_1 : m_2, then the coordinates of the point R are **[1]**

a) $\left(\frac{m_2x_1 - m_1x_2}{m_1+m_2}, \frac{m_2y_1 - m_1y_2}{m_1+m_2}\right)$
b) $\left(\frac{m_2x_1 - m_1x_2}{m_1-m_2}, \frac{m_2y_1 - m_1y_2}{m_1-m_2}\right)$
c) $\left(\frac{m_2x_1 + m_1x_2}{m_1+m_2}, \frac{m_2y_1 + m_1y_2}{m_1+m_2}\right)$
d) None of these

35. A child's game has 8 triangles of which 5 are blue and rest are red and 10 squares of which 6 are blue and the rest are red. One piece is lost at random. The probability that it is a square of blue colour is **[1]**

a) $\frac{4}{9}$
b) $\frac{6}{10}$
c) $\frac{1}{3}$
d) $\frac{2}{3}$

36. A system of linear equations is said to be consistent, if it has **[1]**

a) two solutions
b) one or many solutions
c) no solution
d) exactly one solution

37. $(1 + \sqrt{2}) + (1 - \sqrt{2})$ is **[1]**

a) a rational number
b) a non-terminating decimal
c) None of these
d) an irrational number

38. The value of (tan1° tan2° tan3° ... tan89°) is **[1]**

a) 0
b) $\frac{1}{2}$
c) 1
d) 2

39. If two different dice are rolled together, the probability of getting an even number **[1]**

a) $\frac{1}{2}$
b) $\frac{1}{4}$
c) $\frac{1}{36}$
d) $\frac{1}{6}$

40. If the endpoints of a diameter of a circle are (-4, -3) and (2, 7), then the coordinates of the centre are **[1]**

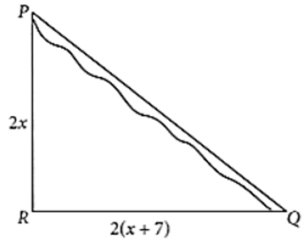
a) (1, -2)
b) (0, 0)
c) (2, -1)
d) (-1, 2)

Section C

Attempt any 8 questions

Question No. 41 to 45 are based on the given text. Read the text carefully and answer the questions:

Minister of a state went to city Q from city P. There is a route via city R such that PR ⊥ RQ. PR = 2x km and RQ = 2(x + 7) km. He noticed that there is a proposal to construct a 26 km highway which directly connects the two cities P and Q.



41. Which concept can be used to get the value of x? **[1]**

a) Converse of thales theorem
b) Pythagoras theorem
c) Thales theorem
d) Converse of Pythagoras theorem

42. The value of x is **[1]**

a) 5
b) 6
c) 4
d) 8

43. The value of PR is **[1]**

a) 20 km
b) 25 km

c) 10 km | d) 15 km

44. The value of RQ is **[1]**

a) 20 km | b) 12 km

c) 24 km | d) 16 km

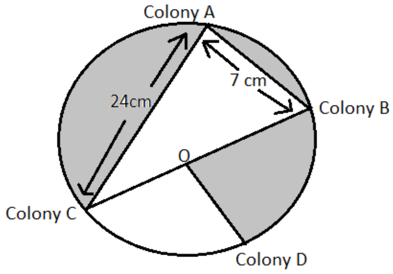
45. How much distance will be saved in reaching city Q after the construction of highway? **[1]**

a) 4 km | b) 9 km

c) 8 km | d) 10 km

Question No. 46 to 50 are based on the given text. Read the text carefully and answer the questions:

To find the polluted region in different areas of Dwarka (a part of Delhi represented by the circle given below) a survey was conducted by the students of class X. It was found that the shaded region is the polluted region, where O is the centre of the circle.



46. Find the radius of the circle. **[1]**

a) 13.5 cm | b) 12.5 cm

c) 15 cm | d) 16.5 cm

47. Find the area of the circle. **[1]**

a) 495.6 cm^2 | b) 491.07 cm^2

c) 481.7 cm^2 | d) 490 cm^2

48. If D lies at the middle of arc BC, then area of region COD is **[1]**

a) 121 cm^2 | b) 126 cm^2

c) 122.76 cm^2 | d) 129.8 cm^2

49. Area of the $\triangle BAC$ is **[1]**

a) 81 cm^2 | b) 79 cm^2

c) 84 cm^2 | d) 77 cm^2

50. Find the area of the polluted region. **[1]**

a) 280.31 cm^2 | b) 240.31 cm^2

c) 285.31 cm^2 | d) 284.31 cm^2

Solution

Section A

1. **(c)** terminating decimal

   Explanation: To check if the number is terminating: we will find the lowest form of the number.

   $\frac{441}{2^2 \times 5^7 \times 7^2}$

   Here 441 = 49 $\times$ 9 = $7^2 \times 3^2$

   $\frac{7^2 \times 3^2}{2^2 \times 5^7 \times 7^2} = \frac{3^2}{2^2 \times 5^7}$

   Here denominator = $2^2 \times 5^7$

   Here the denominator is of the form $2^m 5^n$

   m = 2, n = 7

   Hence, the number has a terminal decimal representation.

2. **(c)** no solution

   Explanation: Here, $\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}, \frac{b_1}{b_2} = \frac{3}{6} = \frac{1}{2}$ and $\frac{c_1}{c_2} = \frac{-5}{-15} = \frac{1}{3}$

   $\therefore \frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

   So, the given system has no solution.

3. **(a)** 15

   Explanation:

   We know that, if x = α is zero of a polynomial then x - α is a factor of f(x)

   Since 15 is zero of the polynomial f(x) = x^2 - 16x + 30, therefore (x − 15) is a factor of f(x)

   Now, we divide f(x) = x^2 - 16x + 30 by (x - 15) we get

   $$\begin{array}{r|l} & x-1 \\ x-15 & +x^2-16x+30 \\ & \pm x^2 \mp 15x \\ & -1x+30 \\ & \pm 1x \pm 15 \\ & 15 \end{array}$$

   Thus we should subtract the remainder 15 from x^2 - 16x + 30.

4. **(c)** x = a^2 and y = b^2

   Explanation: First equation:

   $\frac{a^2}{x} - \frac{b^2}{y}$ = 0

   or $\frac{a^2}{x} = \frac{b^2}{y}$

   Second Equation:

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

   $\Rightarrow \left(\frac{b^2}{y}\right) \times b + \frac{b^2 a}{y}$ = a + b

   $\Rightarrow \left(\frac{b^2}{y}\right) \times (b + a)$ = a + b

   $\Rightarrow \frac{b^2}{y} = \frac{a+b}{a+b}$ = 1

   $\Rightarrow$ y = b^2

   $\frac{a^2}{x} = \frac{b^2}{y}$

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

   $\Rightarrow$ x = a^2

   Hence x = a^2 and y = b^2

5. **(d)** $\frac{1}{2}$

Explanation: Given: $\sin\theta - \cos\theta = 0$

$\Rightarrow \sin\theta = \cos\theta$

$\Rightarrow \sin\theta = \sin(90^\circ - \theta)$

$\Rightarrow \theta = 90^\circ - \theta \Rightarrow \theta = 45^\circ$

$\therefore \sin^4\theta + \cos^4\theta$ = $\sin^4 45^\circ + \cos^4 45^\circ$

= $\left(\frac{1}{\sqrt{2}}\right)^4 + \left(\frac{1}{\sqrt{2}}\right)^4$

= $\frac{1}{4} + \frac{1}{4}$

= $\frac{1}{2}$

6. **(a)** an irrational number

Explanation: The sum of a rational and an irrational number is an irrational number hence it is an irrational number.

7. **(b)** $-\frac{3}{7}$

Explanation: Since α and β are the zeros of the quadratic polynomial $p(x) = 4x^2 + 3x + 7$

$\alpha + \beta = \frac{-\text{ Coefficient of } x}{\text{Coefficient of } x^2} = \frac{-3}{4}$

$\alpha\beta = \frac{\text{Constant term}}{\text{coefficient of } x^2} = \frac{7}{4}$

Now, $\frac{1}{\alpha} + \frac{1}{\beta} = \frac{\beta+\alpha}{\alpha\beta} = \frac{\frac{-3}{4}}{\frac{7}{4}} = \frac{-3}{4} \times \frac{4}{7} = \frac{-3}{7}$

Thus, the value of $\frac{1}{a} + \frac{1}{\beta}$ is $\frac{-3}{7}$.

8. **(c)** $\sqrt{85}$

Explanation: Let mid point of A(2, 2), B(-4, -4) be whose coordinates will be

$= \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right) = \left(\frac{2-4}{2}, \frac{2-4}{2}\right)$

or $\left(\frac{-2}{2}, \frac{-2}{2}\right) = (-1, -1)$

$\therefore$ Length of median CD

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

$= \sqrt{(5+1)^2 + (-8+1)^2}$

$= \sqrt{(6)^2 + (-7)^2} = \sqrt{36 + 49}$

$= \sqrt{85}$ units

9. **(a)** 3

Explanation: The number of zeroes of a cubic polynomial is at most 3 because the highest power of the variable in cubic polynomial is 3, i.e. $ax^3 + bx^2 + cx + d$

10. **(a)** ± 3

Explanation: Let α, β are the zeroes of the given polynomial.

Given: $\alpha + \beta = \alpha\beta$

$\Rightarrow \frac{-b}{a} = \frac{c}{a}$

$\Rightarrow$ -b = -c

$\Rightarrow$ -(-27) = $3k^2$

$\Rightarrow$ $k^2 = 9$

$\Rightarrow$ k = ± 3

11. **(c)** $\frac{1}{2}$

Explanation: Prime number on a die are 2, 3, 5

$\therefore$ Probability of getting a prime number on the face of the die $= \frac{3}{6} = \frac{1}{2}$

12. **(d)** 338

Explanation: HCF (26, 169) = 13

We have to find the value for LCM (26, 169)

We know that the product of numbers is equal to the product of their HCF and LCM.

Therefore,
13(LCM) = 26(169)
$\text{LCM} = \frac{26(169)}{13}$
LCM = 338

13. **(c)** abscissa
Explanation: The distance of a point from the y-axis is the x (horizontal) coordinate of the point and is called abscissa.

14. **(c)** x-axis
Explanation: Since the ordinates of given points are 0. Therefore, points lie on x-axis.

15. **(b)** $\frac{-6}{5}$
Explanation: x = 2 satisfies $kx^2 + 3x + k = 0$
$\therefore$ 4k + 6 + k = 0 $\Rightarrow 5k = -6 \Rightarrow k = \frac{-6}{5}$

16. **(b)** 9
Explanation: 9 $\sec^2A$ - 9 $\tan^2A$
= 9($\sec^2A$ - $\tan^2A$)
= 9(1) = 9

17. **(a)** x = a and y = b
Explanation: Given
$\frac{x}{a} + \frac{y}{b}$ = 2 ... (i)
ax - by = $a^2 - b^2$ ... (ii)
Eq (i) can be written as bx + ay = 2ab ... (iii)
multiply equation (ii) by a and equation (iii) by b and adding
$a^2x + b^2x = a^3 - ab^2 + 2ab^2 = a(a^2 + b^2)$
x = a
multiply equation (ii) by b and equation (iii) by a and Subtract
$-b^2y - a^2y = ba^2 - b^3 - 2ba^2$
$-y(b^2 + a^2) = -b(b^2 + a^2)$
y = b

18. **(d)** $\frac{17}{90}$
Explanation: a and b are two number to be selected from the integers = 1 to 10 without replacement of a and b
i.e., 1 to 10 = 10
and 2 to 10 = 9
No. of ways = 10 $\times$ 9 = 90
Probability of $\frac{a}{b}$ where it is an integer
$\therefore$ Possible event will be
= (2, 2), (3, 3), (4, 2), (4, 4), (5, 5), (6, 2), (6, 6), (7, 7), (8, 2), (8, 8), (9, 3), (9, 9), (10, 2), (10, 5)
(10, 10), = 17
$P(E) = \frac{m}{n} = \frac{17}{90}$

19. **(b)** Irrational
Explanation: Let rational number + irrational number = rational number
And we know " rational number can be expressed in the form of PQ, where p, q are any integers,
So, we can express our assumption As :
PQ + x = ab (Here x is a irrational number)
x = ab - PQ
So,
x is a rational number, but that contradicts our starting assumption.
Hence rational number + irrational number = irrational number

20. **(d)** 2, -4

Explanation: A(5, 3), B(11, -5) and P(12, y) are the vertices of a right triangle, right-angled at P

$\therefore$ $AB^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$ [BY P.G.T]

$= (11 - 5)^2 + (-5 - 3)^2 = (6)^2 + (-8)^2$

= 36 + 64 = 100

Similarly $BP^2 = (12 - 11)^2 + (y + 5)^2 = (1)^2 + y^2 + 10y + 25$

$= y^2 + 10y + 26$

and $AP^2 = (12 - 5)^2 + (y - 3)^2 = (7)^2 + (y - 3)^2$

$= 49 + y^2 - 6y + 8 = y^2 - 6y + 58$

$\because \triangle ABP$ is a right triangle

$\therefore AB^2 = BP^2 + AP^2$

$100 = y^2 + 10y + 26 + y^2 - 6y + 58$

$100 = 2y^2 + 4y + 84$

$\Rightarrow 2y^2 + 4y + 84 - 100 = 0 \Rightarrow 2y^2 + 4y - 16 = 0$

$\Rightarrow y^2 + 2y - 8 = 0$ (Dividing by 2)

$\Rightarrow y^2 + 4y - 2y - 8 = 0 \left\{\begin{array}{l} \because -8 = 4 \times (-2) \\ 2 = 4 - 2 \end{array}\right\}$

$\Rightarrow y(y + 4) -2(y + 4) = 0$

$\Rightarrow (y + 4) (y - 2) = 0$

Either y + 4 = 0, then y = -4

or y - 2 = 0, then y = 2

y = 2, -4

Section B

21. **(d)** 115^o

Explanation: Since the sum of the opposite angles of a cyclic quadrilateral is 180^o

$\therefore \angle A + \angle C = 180^o$

$\Rightarrow 2x - 1 + 2y + 15 = 180^o$

$\Rightarrow x + y = 83^o$ ... (i)

And $\angle B + \angle D = 180^o$

$\Rightarrow y + 5 + 4x - 7 = 180^o$

$\Rightarrow 4x + y = 182^o$ ... (ii)

Subtracting eq. (ii) from eq. (i),

we get $-3x = -99^o$

$\Rightarrow x = 33^o$

Putting the value of x in eq. (i),

we get $33^o + y = 83^o$

$\Rightarrow y = 50^o$

$\therefore \angle C = (2y + 15)^o = (2 \times 50 + 15)^o = 115^o$

22. **(c)** $10x^2 - x - 3$

Explanation: $\alpha + \beta = \left(\frac{3}{5} - \frac{1}{2}\right) = \frac{1}{10}, \alpha\beta = \frac{3}{5} \times \left(\frac{-1}{2}\right) = \frac{-3}{10}$

Required olynomial is $x^2 - \frac{1}{10}x - \frac{3}{10}$, i.e., $10x^2 - x - 3$

23. **(d)** 2

Explanation: LCM (a, b, c) $= 2^3 \times 3^2 \times 5$ .... (I)

we have to find the value of n

Also we have

$a = 2^3 \times 3$

$b = 2 \times 3 \times 5$
$c = 3^n \times 5$
We know that the while evaluating LCM, we take greater exponent of the prime numbers in the factorisation of the number.
Therefore, by applying this rule and taking $n \geq 1$ we get the LCM as
LCM (a, b, c) = $2^3 \times 3^n \times 5$ ..... (II)
On comparing (I) and (II) sides, we get:
$2^3 \times 3^2 \times 5 = 2^3 \times 3^n \times 5$
n = 2

24. **(d)** 2 $\cos^2$ A - 1

Explanation: We have, $\cos^4$ A - $\sin^4$ A = ($\cos^2$ A + $\sin^2$ A) ($\cos^2$ A - $\sin^2$ A)
= 1 ($\cos^2$ A - $\sin^2$ A) = $\cos^2$ A - (1 - $\cos^2$ A)
= $\cos^2$ A - 1 + $\cos^2$ A
= 2 $\cos^2$ A - 1

25. **(c)** 18

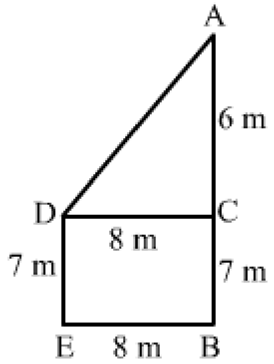
Explanation: Let unit digit = x , Tens digit = y , therefore original no will be 10y + x
Sum of digits are 9 So that x + y = 9 ... (i)
nine times this number is twice the number obtained by reversing the order of the digits 9(10y + x) = 2(10x + y)
90y + 9x = 20 x + 2y
88y - 11x = 0
Divide by 11 we get 8y - x = 0 ... (ii)
Adding equations (i) and (ii), we get
9y = 9
y = $\frac{9}{9}$ = 1
Putting this value in equation 1 we get
x + y = 9
x + 1 = 9
x = 8
Therefore the number is 10(1) + 8 = 18

26. **(b)** 72

Explanation: Here a = 1, b = -6, c = 8
Since $\alpha^3 + \beta^3 = (\alpha + \beta)\left[\alpha^2 + \beta^2 - \alpha\beta\right] = (\alpha + \beta)\left[(\alpha + \beta)^2 - 2\alpha\beta - \alpha\beta\right]$
= $(\alpha + \beta)\left[(\alpha + \beta)^2 - 3\alpha\beta\right]$
= $\left(\frac{-b}{a}\right)\left[\left(\frac{-b}{a}\right)^2 - 3 \times \frac{c}{a}\right]$
= $\left(\frac{-b}{a}\right)\left[\frac{b^2}{a^2} - \frac{3c}{a}\right]$
= $\left(\frac{-b}{a}\right)\left[\frac{b^2 - 3ac}{a^2}\right]$
= $\frac{-b^3 + 3abc}{a^3}$
Putting the values of a,b and c, we get = $\frac{-(-6)^3 + 3 \times 1 \times (-6) \times 8}{(1)^3}$ = $\frac{216 - 144}{1}$ = 72

27. **(b)** 10 m

Explanation:



Let AB and DE be the two poles.
According to the question:
AB = 13 m
DE = 7 m
Distance between their bottoms = BE = 8 m
Draw a perpendicular DC to AB from D, meeting AB at C. We get:
DC = 8m, AC = 6 m
Applying Pythagoras theorem in right-angled triangle ACD, we have:

$AD^2 = DC^2 + AC^2 = 8^2 + 6^2 = 64 + 36 = 100$

$AD = \sqrt{100} = 10\text{m}$

28. **(a)** 2 : 3

Explanation: Given: (x, y) = (1, 3), (x_1, y_1) = (-6, 10), (x_2, y_2) = (3, -8)

Let $m_1 : m_2 = k : 1$

$\therefore x = \frac{m_1 x_2 + m_2 x_1}{m_1 + m_2}$

$1 = \frac{k \times 4 + 1 \times (1)}{k+1}$

k + 1 = 4k - 1

$\Rightarrow k = \frac{2}{3}$

Therefore, the required ratio is 2 : 3

29. **(c)** $\frac{3}{4}$

Explanation: $\tan\theta = \frac{1}{\sqrt{7}} = \frac{\text{Perpendicular}}{\text{Base}}$

By Pythagoras Theorem,

$(\text{Hyp.})^2 = (\text{Base})^2 + (\text{Perp.})^2$

$= (1)^2 + (\sqrt{7})^2 = 1 + 7 = 8$

$\therefore \text{ Hyp. } = \sqrt{8} = 2\sqrt{2}$

$\text{Now, cosec } \theta = \frac{\text{Hypotenuse}}{\text{Perpendicular}} = \frac{2\sqrt{2}}{1}$

$\sec\theta = \frac{\text{Hypotenuse}}{\text{Base}} = \frac{2\sqrt{2}}{\sqrt{7}}$

Now, $\frac{cosec^2\theta - \sec^2\theta}{cosec^2\theta + \sec^2\theta} = \frac{\left(\frac{2\sqrt{2}}{1}\right)^2 - \left(\frac{2\sqrt{2}}{\sqrt{7}}\right)^2}{\left(\frac{2\sqrt{2}}{1}\right)^2 + \left(\frac{2\sqrt{2}}{\sqrt{7}}\right)^2}$

$= \frac{8 - \frac{8}{7}}{8 + \frac{8}{7}}$

$= \frac{\frac{56-8}{7}}{\frac{56+8}{7}} = \frac{\frac{48}{7}}{\frac{64}{7}}$

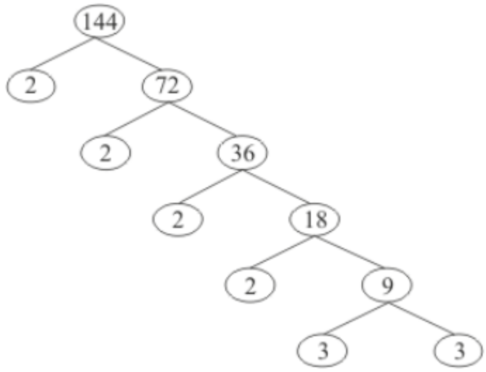
$= \frac{48}{7} \times \frac{7}{64} = \frac{3}{4}$

30. **(c)** $\alpha = 3$ and $\beta = 1$

Explanation: Given: x - y = 2 ... (i) ... (i)
And x + y = 4 ... (ii)

Adding eq. (i) and (ii) for the elimination of y, we get
2x = 6
$\Rightarrow$ x = 3
Putting the value of x in eq. (i), we get
3 - y = 2
$\Rightarrow$ y = 1
$\therefore$ x = α = 3 and y = β = 1

31. **(a)** 4
Explanation:
Using the factor tree for prime factorisation, we have:



Therefore, 144 = $2 \times 2 \times 2 \times 2 \times 3 \times 3$
$\Rightarrow 144 = 2^4 \times 3^2$
Thus, the exponent of 2 in 144 is 4.

32. **(b)** 2
Explanation: In $\triangle$ABC, DE || BC
$\therefore \frac{AD}{DB} = \frac{AE}{EC}$
$\Rightarrow \frac{x+3}{3x+19} = \frac{x}{3x+4}$
$\Rightarrow$ (x + 3) (3x + 4) = x (3x + 19)
$\Rightarrow 3x^2 + 4x + 9x + 12 = 3x^2 + 19x$
$\Rightarrow 3x^2 + 13x + 12 = 3x^2 + 19x$
$\Rightarrow 12 = 3x^2 + 19x - 3x^2 - 13x$
$\Rightarrow 12 = 6x \Rightarrow x = \frac{12}{6} = 2$
$\therefore$ x = 2

33. **(b)** 1
Explanation: Given that, $\sin A + \sin^2 A = 1$
$\Rightarrow \sin A = 1 - \sin^2 A$
$\Rightarrow \sin A = \cos^2 A$
$\Rightarrow \sin^2 A = \cos^4 A$
$\Rightarrow 1 - \cos^2 A = \cos^4 A$
$\Rightarrow \cos^2 A + \cos^4 A = 1$

34. **(c)** $\left(\frac{m_2x_1+m_1x_2}{m_1+m_2}, \frac{m_2y_1+m_1y_2}{m_1+m_2}\right)$
Explanation: If the point R(x, y) divides the join of P(x_1, y_2) and Q(x_2, y_2) internally in the given ratio $m_1 : m_2$,
then the coordinates of the point R are $\left(\frac{m_2x_1+m_1x_2}{m_1+m_2}, \frac{m_2y_1+m_1y_2}{m_1+m_2}\right)$

35. **(c)** $\frac{1}{3}$
Explanation: Total number of pieces = 8 triangles + 10 squares = 18
Number of blue squares = 6
Number of possible outcomes = 6

Number of total outcomes = 8 + 10 = 18

∴ Required Probability = $\frac{6}{18} = \frac{1}{3}$

36. **(b)** one or many solutions

Explanation: A system of linear equations is said to be consistent if it has at least one solution or can have many solutions. If a consistent system has an infinite number of solutions, it is dependent. When you graph the equations, both equations represent the same line. If a system has no solution, it is said to be inconsistent. The graphs of the lines do not intersect, so the graphs are parallel and there is no solution.

37. **(a)** a rational number

Explanation: $(1 + \sqrt{2}) + (1 - \sqrt{2}) = 1 + \sqrt{2} + 1 - \sqrt{2} = 1 + 1 = 2$ And 2 is a rational number.
Therefore the given number is rational number.

38. **(c)** 1

Explanation: We have, tan 1°. tan 2°.tan 3° ...... tan 89°

= tan1°.tan 2°.tan 3°...tan 43°.tan 44°.tan 45°.tan 46°.tan 47°...tan 87°.tan 88°.tan 89°

= tan1°.tan 2°.tan 3°...tan 43°.tan 44°.1.tan 46°.tan 47°...tan 87°.tan 88°.tan 89°

(∵ tan 45° = 1)

= tan1°.tan 2°.tan 3°...tan 43°.tan 44°.1.tan(90° - 44°).tan(90° - 43°)...tan(90° - 3°). tan(90° - 2°).tan(90° - 1°)

= tan1°.tan 2°.tan 3°...tan 43°.tan 44°.1.cot 44°.cot 43°...cot 3°.cot 2°.cot 1°

(∵ tan(90°-θ)=cot θ)

= tan1°.tan 2°.tan 3°...tan 43°.tan 44°.1.$\frac{1}{\tan 44^\circ} \cdot \frac{1}{\tan 43^\circ} \cdots \frac{1}{\tan 3^\circ} \cdot \frac{1}{\tan 2^\circ} \cdot \frac{1}{\tan 1^\circ}$

(∵ tan θ = $\frac{1}{\cot \theta}$)

$= \left(\tan 1^\circ \times \frac{1}{\tan 1^\circ}\right) \cdot \left(\tan 2^\circ \times \frac{1}{\tan 2^\circ}\right) \cdots \left(\tan 44^\circ \times \frac{1}{\tan 44^\circ}\right) = 1$

Hence, tan 1°.tan 2°.tan 3° ...... tan 89° = 1

39. **(b)** $\frac{1}{4}$

Explanation: Rolling two different dice, Number of total events = 6 × 6 = 36

Number of even number on both dice are {(2,2), (2,4), (2,6), (4,2), (4,4), (4,6), (6,2), (6,4), (6,6) }= 9

$\therefore\ Probability = \frac{9}{36} = \frac{1}{4}$

40. **(d)** (-1, 2)

Explanation: Let the coordinates of centre O be (x, y).

The endpoints of a diameter of the circle are A(- 4, - 3) and B(2, 7).

Since centre is the midpoint of diameter.

∴ x = $\frac{x_1+x_2}{2} = \frac{-4+2}{2} = \frac{-2}{2}$ = -1 and

y = $\frac{y_1+y_2}{2} = \frac{-3+7}{2} = \frac{4}{2}$ = 2

Therefore, the coordinates of the centre O is (-1, 2)

Section C

41. **(b)** Pythagoras theorem

Explanation: Pythagoras theorem

42. **(a)** 5

Explanation: Using Pythagoras theorem, we have

$PQ^2 = PR^2 + RQ^2$

$\Rightarrow (26)^2 = (2x)^2 + (2(x + 7))^2 \Rightarrow 676 = 4x^2 + 4(x + 7)^2$

$\Rightarrow 169 = x^2 + x^2 + 49 + 14x \Rightarrow x^2 + 7x - 60 = 0$

$\Rightarrow x^2 + 12x - 5x - 60 = 0 \Rightarrow x(x + 12) - 5(x + 12) = 0 \Rightarrow (x - 5)(x + 12) = 0$

$\Rightarrow x = 5, x = -12$

∴ x = 5 [Since length can’t be negative]

43. **(c)** 10 km

Explanation: PR = 2x = 2 × 5 = 10 km

44. **(c)** 24 km

Explanation: RQ = 2(x + 7) = 2(5 + 7) = 24 km

45. **(c)** 8 km

Explanation: Since PR + RQ = 10 + 24 = 34 km

Saved distance = 34 - 26 = 8 km

46. **(b)** 12.5 cm

Explanation: Since BOC is the diameter and $\angle$BAC = 90°

$\therefore$ $BC^2 = AB^2 + AC^2$

$= 7^2 + 24^2 = 625$

$\Rightarrow$ BC = 25 cm

$\therefore$ Radius of circle = $\frac{25}{2}$cm = 12.5 cm

47. **(b)** 491.07 cm^2

Explanation: Area of circle = $\pi(12.5)^2 = \frac{22}{7} \times 12.5 \times 12.5$

= 491.07 cm^2

48. **(c)** 122.76 cm^2

Explanation: Clearly, $\angle$COD = 90° [$\because$ $\angle$COB = 180° and equal arcs subtends equal angles at the centre]

Area of region COD = $\frac{90^\circ}{360^\circ} \times \pi r^2$

$= \frac{1}{4}(491.07) = 122.76$ cm^2

49. **(c)** 84 cm^2

Explanation: Area of $\triangle$BAC = $\frac{1}{2} \times AB \times AC$

$= \frac{1}{2} \times 7 \times 24 = 84$ cm^2

50. **(d)** 284.31 cm^2

Explanation: Area of the polluted region = Area of circle - Area of sector COD - Area of $\triangle$ABC

= 491.07- 122.76 - 84

= 284.31 cm^2