



Top 100 CAT Quant Questions 2022

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Questions

Instructions

For the following questions answer them individually

Question 1

The mean score of ten batsmen of Hyderabad cricket team in a match is 60. If the top five scores of the batsmen are removed while calculating the average, the average falls by five. If the top six scores are distinct integers, what is the maximum possible score of any batsmen?

- A 102
- B 87
- C 95
- D 126

Answer: C

Explanation:

Total score of the 10 batsmen = 600

Average of bottom five batsmen = 55

Total score of bottom five batsmen = 275

Total score of top 5 batsmen = 325

To obtain the maximum score, the scores of others are to be minimised

The minimum score of the top five batsmen can be 56 when all the bottom five batsman have 55 as their score.

Hence, 56,57,58,59,95 are the scores of the top five batsmen.

Question 2

A dishonest milkman dilutes milk with water and then sells the diluted milk at 25% more than the price at which he purchased the milk. If he makes a profit of 40% by implementing this process. Find the volume of water(in ml) added to every litre of pure milk (Assume water is free of cost)

Answer:120

Explanation:

Let the cost price of 1 litre of pure milk = Rs. 12 (value taken for easier calculations)

Then the selling price of 1 liter of solution= Rs 15

y be the volume of water added to every 1 litre of solution => SP of (1+y) litres of solution = 15 x (1+y)

$$\frac{(1+y)15-12}{12} = 0.4$$

$$y = \frac{1.8}{15}$$

The volume of water added in ml = $\frac{1.8}{15} \times 1000 = 120\text{ml}$

120 is the correct answer.

Question 3

You travel by Delhi Metro every day from Botanical Garden, Noida to Hauz Khas, Delhi. At Hauz Khas metro station, you use an escalator to get out of the station. The escalator takes 80 seconds to get you down. One day, the escalator was not working and you walk up the escalator in 50 seconds. How many minutes does it approximately take you to walk up the working escalator?

- A 1.5 minutes
- B 2.2 minutes
- C 2.8 minutes
- D 2.6 minutes

Answer: B

Explanation:

It is given that by using the escalator, one can get out of the station in 80 sec.

Let us consider the number of steps = 80

Speed of the escalator = 1 step/sec

When the escalator was not working, the time taken by a person = 50 sec

The speed of the person = $80/50 = 8/5$ steps/sec

Time taken by a person walking down a moving escalator = $\frac{80}{\frac{8}{5} - 1}$

$$= \frac{80}{\frac{3}{5}}$$

= 2.22 min

B is the correct answer.

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Question 4

The ratio of the cost price of item A and item B is 3:2. The ratio of marked price of both the items is 5:3. The ratio of the percentage discount is 9:5. What is the discount percentage on item A if the profit percentage is the same?

A 33.33%

B 40%

C 20%

D 30%

Answer: C

Explanation:

Assuming the cost price of A = 3x and the cost price of B = 2x

The marked price of A = 5y and the marked price of B = 3y

Now selling price of A = a and the selling price of B = b

Equating profit percentages, $\frac{a-3x}{3x} = \frac{b-2x}{2x}$

$$\Rightarrow \frac{a}{3x} - 1 = \frac{b}{2x} - 1$$

$$\Rightarrow \frac{a}{3} = \frac{b}{2} \Rightarrow 2a = 3b \Rightarrow b = \frac{2a}{3}$$

Now, ratio of the discount percentages =

$$\Rightarrow \frac{9(5y-a)}{5(9y-2a)} = \frac{9}{5}$$

$$\Rightarrow 5y - a = 9y - 2a \Rightarrow a = 4y$$

$$\text{Hence, discount percentage on item A} = \frac{5y-a}{5y} \times 100 = \frac{5y-4y}{5y} \times 100 = 20\%$$

Question 5

Two natural numbers m and n are in the ratio 17:19. When a natural number k is subtracted from each of the numbers, the new ratio is less than 5/6. What is the minimum value that 'k' can take?

Answer: 8

Explanation:

Let the two numbers be $17x$ and $19x$ respectively.

So we have

$$\begin{aligned} 17x - k &= 5 \\ 19x - k &< 6 \end{aligned}$$

$$\Rightarrow 102x - 6k < 95x - 5k$$

$$\Rightarrow 7x < k$$

$$\Rightarrow k > 7x$$

For k to be minimum, x has to be minimum.

Putting $x = 1$, we get $k > 7$

Hence $k > 7$, so the minimum possible integral value of k is 8

Question 6

Rinesh dropped a ball from a height of 360m. Each time the ball hits the ground it rebounds to 60% of the height from where it fell. Find the total distance (in metres) travelled by the ball before coming to rest.

Answer: 1440

Explanation:

Total distance travelled by the ball = $360 + 360 \cdot 0.6 + 360 \cdot 0.6 + 360 \cdot 0.6 \cdot 0.6 + 360 \cdot 0.6 \cdot 0.6 \cdot 0.6 + \dots \infty$

$$= 360 + 360 \cdot 0.6 \cdot 2 + 360 \cdot 0.6 \cdot 0.6 \cdot 2 + \dots \infty$$

$$= 360 + 2[360 \cdot 0.6 + 360 \cdot 0.6 \cdot 0.6 + \dots \infty]$$

$$= 360 + 2[360 \cdot 0.6^1 + 360 \cdot 0.6^2 + \dots \infty]$$

$$= 360 + 2 \cdot \frac{360 \cdot 0.6}{1 - 0.6}$$

$$= 360 + 2 \cdot \frac{360 \cdot 0.6}{0.4}$$

$$= 1440\text{m}$$

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Question 7

A table is sold at 20% profit from a manufacturer to a whole seller. The whole seller sells each table at 60% profit with an offer of 1 table free on every purchase of 5 tables. The retailer bought 30 tables (free tables included) at Rs 24000. The retailer sold the table to customers with a profit margin of 10%. What is the difference between the manufacturing cost and the customer price of a table?

A Rs 420

B Rs 380

C Rs 240

D Rs 300

Answer: B

Explanation:

Let the Manufacturing cost = M

A table is sold at 20% profit from a manufacturer to a whole seller.

Price of the table for the whole seller = $1.2M$

The whole seller sold the tables at 60% profit, with an offer of 1 table free with a purchase of 5 tables.

Price of 5 tables for the whole seller = $1.2M \cdot 5 = 6M$

The retailer bought 30 tables (free tables included) at Rs 24000.

Price of 6 tables (+1 free) for retailer = $1.6 \cdot 6M = 9.6M$

Price of 30 tables = $5 \cdot 9.6M = 24000$

$M = \text{Rs } 500$

Price of each table for Retailer = $24000/30 = \text{Rs } 800$

Price for the customers = $1.1 \times 800 = \text{Rs } 880$

The difference between the manufacturing cost and the customer price of the table = $\text{Rs } 880 - \text{Rs } 500 = \text{Rs } 380$

Question 8

Ten men can complete a piece of work in 8 days while fifteen women take 6 days to complete the work. If 9 women and x men can complete the work in 8 days. What is the value of x?

- A 5
- B 4
- C 2
- D 3

Answer: C

Explanation:

Let m be the number of units of work done by a man on one day.

w be the number of units of work done by a woman in one day.

$$10m \times 8 = 15w \times 6$$

$$\frac{m}{w} = \frac{9}{8}$$

$$(9w + xm) \times 8 = 10m \times 8$$

$$9 \times 8 + x \times 9 = 10 \times 9$$

$$8 + x = 10$$

$$x = 2$$

C is the correct answer.

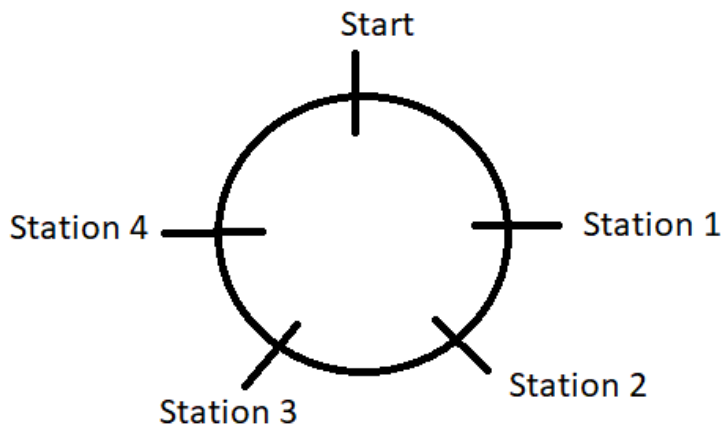
Question 9

A toy train is running around a circular track and a boy is running next to it. If the toy train stops at all 4 of the equally spaced stations (excluding the originating station) for 10 minutes each, the boy is able to catch up with the train just before it leaves the 4th station. If the train covers the length of the track in 1 hour (without stoppages) what is the ratio of the speed of the train (without stoppages) to that of the boy?

- A 11:6
- B 20:9
- C 2:1
- D 25:12

Answer: A

Explanation:



Consider the diagram, we know that the boy catches up with the train at the 4th station (if the train is going in clockwise direction)
 Time taken by the boy to cover $\frac{4}{5}$ th of the distance = time taken by the train to cover it + 40 minutes
 Time taken by the train to cover the full distance = 60 minutes
 To cover $\frac{4}{5}$ th of the distance without stoppages = $60 \times \frac{4}{5} = 48$ minutes.
 Speed of the train: Speed of the boy

$\frac{1}{48} : \frac{1}{60}$
 = Time taken by train : Time taken by boy

$\frac{1}{48} : \frac{1}{60}$
 48 : 48 + 40

= 11:6

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Question 10

In a ceremony, a total of 5000 people were present. The ratio of boys to the ratio of girls was 13:12 and the ratio of men to the ratio of women was 14:15. If there is atleast one boy and one man present in the ceremony, what can be the maximum number of males (men+boys) in the ceremony?

A 2453

B 2573

C 2237

D 2593

Answer: B

Explanation:

Assuming the number of boys and girls to be $13x$ and $12x$, the number of men and women to be $14y$ and $15y$.

The total number of people present = $25x + 29y = 5000 \Rightarrow x = \frac{(5000 - 29y)}{25}$

Total number of males = $13x + 14y = 14y + \frac{13(5000 - 29y)}{25} = 14y - \frac{29 \times 13y}{25} + 2600 = 2600 - \frac{27y}{25}$

Since x and y cannot be zero as the ratio will become undefined.

To maximize number of males, $y = 25$

$2600 - \frac{27y}{25} = 2600 - \frac{27 \times 25}{25} = 2600 - 27 = 2573$

Question 11

Two types of rice, type A and type B are mixed in the ratio 3:2 and sold at a profit of 25%. If the selling price per kg is kept the same and the ratio is changed to 2:3, then the profit would be 20%. What would be the approximate percentage profit if they are mixed in the ratio 1:4 and sold on the same price per kg?

- A 17.3
- B 15.4
- C 13.7
- D 11.2

Answer: B

Explanation:

Assume the price per kg for type A = a and the price per kg for type B = b

$$\text{Cost price per kg} = \frac{3a+2b}{5}$$

$$\Rightarrow \text{Selling Price} = \frac{3a+2b}{5} \times \left(1 + \frac{25}{100}\right) = \frac{3a+2b}{5} \times \frac{5}{4} = \frac{3a+2b}{4}$$

$$\text{After changing the ratio, the new cost price} = \frac{2a+3b}{5}$$

$$\text{The new selling price per kg} = \frac{2a+3b}{5} \times \left(1 + \frac{20}{100}\right) = \frac{6(2a+3b)}{25}$$

$$\text{Since both the selling prices are the same. } \frac{3a+2b}{4} = \frac{6(2a+3b)}{25}$$

$$\Rightarrow 25(3a+2b) = 24(2a+3b)$$

$$\Rightarrow 75a - 48a = 72b - 50b$$

$$\Rightarrow 27a = 22b$$

$$\Rightarrow \frac{a}{b} = \frac{22}{27} \dots (1)$$

$$\text{Cost price per kg while mixing in the ratio 1:4} = \frac{a+4b}{5}$$

$$\text{Selling price per kg} = \frac{3a+2b}{4}$$

$$\% \text{ Profit} = \left(\frac{SP}{CP} - 1 \right) \times 100 = \left(\frac{(3a+2b) \times 5}{4 \times (a+4b)} - 1 \right) \times 100$$

$$= \left(\frac{15a+10b}{4a+16b} - 1 \right) \times 100 = \frac{\frac{11a}{b} - 6}{\frac{4a}{b} + 16} \times 100$$

$$= \frac{11 \times \frac{22}{27} - 6}{4 \times \frac{22}{27} + 16} \times 100 = \frac{11 \times 0.815 - 6}{4 \times 0.815 + 16} \times 100$$

$$\frac{2.965}{19.26} \times 100 = 15.4\%$$

Question 12

A class of 100 students is divided into two groups such that the average of the first group is 10 less than the average of the second group. The overall average is 58 and the number of students in the first group can not be more than 75. Find the maximum integral value of the average of the first group.

Answer: 55

Explanation:

Assuming the average of the first group is 'a' and the average of the second group = a+10. Assume the number of first group = x and the number of the second group = 100-x

$$\text{Overall average} = 58 = \frac{ax + (a+10)(100-x)}{100}$$

$$\Rightarrow 5800 = ax + 1000 + 100a - 10x - ax$$

$$\Rightarrow 10a - x = 480$$

$$\Rightarrow a = \frac{x}{10} + 48$$

To get an integral value of a, x should be a multiple of 10. Since, the value of x cannot be more than 75, x will be 70.

$$\text{Hence, } a = \frac{70}{10} + 48 = 55$$

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Question 13

A sum of 36 lakhs is divided into n equal parts and deposited in a bank such that the first part is deposited at a simple interest of 2% for 1 year, the second part is deposited for a simple interest of 4% for 2 years, the third part is deposited for 6% for 3 years and so on until the n th year. If the total interest earned is 14.4 lakhs, then find the value of n .

- A 7
- B 6
- C 5
- D 8

Answer: A

Explanation:

The initial value of each amount = $\frac{36}{n}$

The interest from the first part = $\frac{36 \times 1 \times 2}{n \times 100}$

The interest from the second part = $\frac{36 \times 2 \times 4}{n \times 100}$

.....

The interest from n th part = $\frac{36 \times n \times 2n}{n \times 100}$

Sum of all the interests = $\left(\frac{36}{n \times 100} \right) (1 \times 2 + 2 \times 4 + 3 \times 6 + \dots + n \times 2n)$

= $\left(\frac{36 \times 2}{n \times 100} \right) (1^2 + 2^2 + 3^2 + \dots + n^2)$

Hence, $\frac{72}{n \times 100} \times \frac{n(n+1)(2n+1)}{6} = 14.4$

$\Rightarrow (n+1)(2n+1) = 120$

$\Rightarrow 2n^2 + 3n - 119 = 0$

$\Rightarrow n = 7$ or $-\frac{17}{2}$

Rejecting the negative value, we have $n = 7$

Question 14

Three pipes P1, P2 and P3 can fill a tank in 5, 10 and 25 minutes respectively. All the three taps are opened simultaneously but after some time P1 is closed and sequentially after some more time P2 is closed. The difference in the duration for which P1 and P2 stayed open is double that between P2 and P3. If the tank was filled in 6 minutes, for how many minutes was tap P2 open?

- A 28/35 minutes
- B 158/35 minutes
- C 122/35 minutes
- D 54/35 minutes

Answer: B

Explanation:

Three pipes P1, P2 and P3 can fill a tank in 5, 10 and 25 minutes respectively.

Let the capacity of the tank = 50l

Rate of flow of pipe P1 = 10l/min

Rate of flow of pipe P2 = 5l/min

Rate of flow of pipe P3= 2l/min

The difference in the duration for which P1 and P2 were opened is double as that between P2 and P3.

P1 was open for A minutes, P2 was open for A+2B minutes, P3 was open for A+3B minutes

If the tank was filled in 6 minutes,

$$A+3B=6$$

$$10A+5(A+2B)+2(A+3B)= 50$$

$$17A+16B=50$$

$$B=52/35 \text{ minutes}$$

$$\text{tap P2 was open for } A+2B \text{ minutes} = 6-B = 6-52/35 = 158/35 \text{ minutes}$$

Option B

Question 15

An ice-cream vendor can sell 100 ice-cream bricks for Rs.800 each. He realizes that he can sell 50 more bricks for every 25 rupees he reduces in the selling price of the ice-cream brick. What should be his selling price if he wants to maximize revenue? (The answer must be a multiple of 25)

Answer:425

Explanation:

The revenue can be written as a function of quantity into price.

$$\text{Revenue} = (800-25x)(100+50x)$$

$$\text{Taking 25 common from both the brackets, we get } 25 \cdot 25 \cdot (32-x)(4+2x) = 625 \cdot (32-x)(4+2x)$$

$$\text{Again, we can take 2 in common from the term in the second bracket, so revenue} = 1250(32-x)(2+x)$$

We need to maximize this. So, we need to maximise $(32-x)(x+2)$

$$= 32x + 64 - x^2 - 2x$$

$$= 64 + 30x - x^2$$

There are two methods in which we can find the maximum value of x.

Method 1: Differentiation

$$\text{Differentiating } 64 + 30x - x^2 \text{ and equating with 0 we get } 2x=30 \text{ so, } x=15$$

Method 2: Completion of squares

$$64 + 30x - x^2 \text{ can be rewritten as } 289 - [225 - 30x + x^2] = 289 - (x - 15)^2$$

$$\text{We must maximise } 289 - (x - 15)^2$$

$$(x - 15)^2 \text{ will always be positive, the minimum value it can take is when } x=15, (x - 15)^2=0$$

$$\text{So, } 289 - (x - 15)^2 \text{ is maximum when } x=15$$

$$\text{Hence, price} = 800 - 25 \cdot 15$$

$$= 800 - 375$$

$$\text{Price} = 425$$

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Question 16

Nawab has two sons Saif and Amir who have export businesses. Nawab's satisfaction/ utility level is given by adding twice of the satisfaction level of Saif with the satisfaction level of Amir. If Saif makes a profit of ₹ 100, his satisfaction level goes up by 10% and if he suffers a loss of ₹ 100, his satisfaction level goes down by 10%. If Amir makes profit of ₹ 100, his satisfaction level goes up by 5% and if he suffers a loss of ₹ 100, his satisfaction level goes down by 15%. Currently, Nawab's satisfaction level is 24 and the satisfaction level of Saif is the same as the satisfaction level of Amir. If Saif makes a profit of 100 and Amir suffers a loss of ₹ 100, what is the approximate percentage change in Nawab's satisfaction level?

- A 1.25%
- B 1.33%
- C 1.5%
- D 1.66%

Answer: D

Explanation:

Nawab's satisfaction/ utility level is given by adding twice of the satisfaction level of Saif with the satisfaction level of Amir.

Saif makes a profit of ₹ 100, his satisfaction level goes up by 10% and if he suffers a loss of ₹100, his satisfaction level goes down by 10%.

Amir makes profit of ₹ 100, his satisfaction level goes up by 5% and if he suffers a loss of ₹ 100, his satisfaction level goes down by 15%.

Nawab's satisfaction level is 24 and the satisfaction level of Saif is the same as the satisfaction level of Amir

Let x be the satisfaction level of Saif

$$24 = 3x$$

$$x = 8$$

If Saif makes a profit of 100 and Amir suffers a loss of ₹ 100, the satisfaction level of Saif and Amir goes up by 10% and goes down by 15% respectively.

The satisfaction of Saif and Amir = 8.8 and 6.8

Nawab's new satisfaction/ utility level = $2 \times 8.8 + 6.8 = 24.4$

$$\text{Percentage change} = \frac{24.4 - 24}{24}$$

$$= 1.67\%$$

D is the correct answer.

Question 17

Pipes A, B and C are fitted to a tank such that A is an inlet pipe, B and C are outlet pipes. Pipe A is at the bottom of the tank, Pipe B is situated at half the height of the tank while C is situated at one fourth the height of the tank from the bottom. All the pipes are opened simultaneously for an empty tank. The ratio of the outlet flow of pipes B & C is 1:5. The tank is full in a total of 16 hours and was half-filled in 6 hours. Which of the following is the ratio of the rate of flow of in pipe A to pipe B?

- A 10:1
- B 15:4
- C 4:1
- D 8:1

Answer: A

Explanation:

Pipes A, B and C are fitted to a tank, such that A is an inlet pipe, B and C are outlet pipes.

Pipe B is situated at half the height of the tank while C is situated at one fourth the height of the tank from the bottom.

All the pipes are opened simultaneously for an empty tank.

Let the flow in pipe A = y

The ratio of the outlet flow of pipes B & C is 1 : 5.

The flow in pipe B and C is x and 5x.

.

The time taken to fill T/4 tank = t

The net rate of flow of water = y

Thus, $yt = T/4 \dots (1)$

The time taken to next fill T/4 tank = $6 - t$

Now, the net rate of flow of water = $y - 5x$

$$(y - 5x)(6 - t) = T/4 \dots (2)$$

The time taken to next fill T/2 tank = $16 - 6 = 10$ h

The net rate of flow of water = $y - 5x - x = y - 6x$.

$$10(y - 6x) = T/2 \dots (3)$$

From (1) and (3)

$$2 \cdot yt = 10(y - 6x)$$

$$t = 5(y - 6x)/y \dots (4)$$

From (3) and (2)

$$(y - 5x)(6 - t) = 5(y - 6x) \dots (5)$$

Thus,

$$\frac{(y - 5x)(y + 30x)}{y} = 5(y - 6x) \text{ (Substituting the value of } t \text{ from (4) into (5))}$$

$$4y^2 - 55xy + 150x^2 = 0$$

$$4y^2 - 40xy - 15xy + 150x^2 = 0$$

$$(4y - 15x)(y - 10x) = 0$$

$$y/x = 15/4 \text{ or } y/x = 10$$

Now, $15/4$ will be rejected because the flow rate $y - 6x$ will become negative.

Hence, $y:x = 10:1$

Option A

Question 18

Joseph is in a dilemma. He has been offered a job which would pay him ₹ 80,000 per month for first three years and ₹ 1,20,000 per month for the next three years, and ₹ 1,50,000 per month for the remaining four years. He has also been offered an MBA at a prestigious place and he is considering whether to accept the job or go for the MBA. The first year tuition fee for the MBA program is ₹ 16,00,000 and the second year tuition fee for the MBA program is ₹ 20,00,000. After MBA, he'll get a salary of ₹ 2,00,000 per month for the first four years and then ₹ 2,50,000 per month for the remaining four years. What will be the approximate percentage gain for Joseph in opting for the MBA instead of the job in the 10 years horizon considering no discounting of money ?

A 23%

B 25%

C 27%

D 29%

Answer: B

Explanation:

The sum accrued by Joseph if he had taken the job = $(80000 \cdot 3 + 120000 \cdot 3 + 150000 \cdot 4) \cdot 12$

$$= 144 \cdot 10^5$$

If Joseph has taken the MBA program, tuition fee for the program = $1600000 + 2000000$

Sum accrued post MBA = $200000 \cdot 12 \cdot 4 + 250000 \cdot 12 \cdot 4 = 21600000$

$$\text{Net amount} = 21600000 - 3600000 = 180 \cdot 10^5$$

Net gain if Joseph had taken MBA over job 10 years down the lane = $36 \cdot 10^5$

$$\text{Percentage of gain} = \frac{36 \times 10^5}{144 \times 10^5}$$

=25%

B is the correct answer.

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Question 19

Ram and Shyam start a business together by investing a fixed amount of money on the first day of each month. In the year 2019, Ram invested an amount of A each month starting from January. Shyam invested an amount of B each month starting from May. They made a profit of Rs 210,000 at the end of September. If Ram got Rs 60,000 more in profit than Shyam, find the ratio of A and B.

- A 3:4
- B 2:3
- C 4:5
- D 3:5

Answer: D

Explanation:

Assume Shyam's profit is equal to S, then the Ram's profit = S+60,000

Now, S+S+60,000 = Rs 210,000 $\Rightarrow 2S = \text{Rs } 150,000 \Rightarrow S = \text{Rs } 75,000$

Profit share of Ram = 75,000+60,000 = Rs 135,000

Assume the return for an amount of Rs 1 invested for 1 month is k.

Ram invests from January to September 9 months. For the amount invested in January, the return will be for 9 months = 9kA

For the amount invested in February by Ram, the return will be 8kA and so on.

Total Return of Ram = $kA(9+8+7+6+\dots+2+1) = 45kA = 135,000 \Rightarrow kA = 3,000 \dots\dots(1)$

Similarly, the total return for Shyam = $kB(5+4+3+2+1) = 15kB = 75,000 \Rightarrow kB = 5,000 \dots\dots(2)$

From (1) and (2), $\frac{A}{B} = \frac{3}{5}$

Question 20

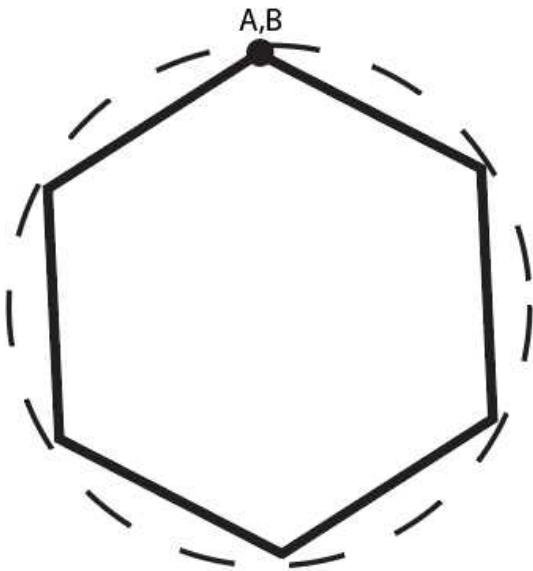
Aman and Bala started running from the same point around a hexagonal track. They started running in the same direction with their speed in the ratio a:b. If they meet each other only at the corners of the hexagon, not necessarily all corners, which of the following cannot be the value of the ratio a:b?

- A 7:6
- B 3:1
- C 5:2
- D 5:1

Answer: D

Explanation:

The number of points of intersection of two racers running around a circular track in the same direction is $|a-b|$ where a:b is the ratio of their speeds.



The number of points of intersections must be a factor of 6 (1, 2, 3 or 6) so that they meet only at the corners.

$$A: |7-6| = 1$$

$$B: |3-1| = 2$$

$$C: |5-2| = 3$$

$$D: |5-1| = 4$$

4 does not belong to 1, 2, 3 or 6. Hence, D is the answer.

Question 21

One day, Rahul started a work at 9 AM and Gautam joined him two hours later. They then worked together and completed the work at 5 PM the same day. If both had started at 9 AM and worked together, the work would have been completed 30 minutes earlier. Working alone, the time Rahul would have taken, in hours, to complete the work is

A 11.5

B 10

C 12.5

D 12

Answer: B

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Explanation:

Let Rahul work at a units/hr and Gautam at b units/hour

Now as per the condition :

$$8a + 6b = 7.5a + 7.5b$$

so we get $0.5a = 1.5b$

$$\text{or } a = 3b$$

$$\text{Therefore total work} = 8a + 6b = 8a + 2a = 10a$$

$$\text{Now Rahul alone takes } 10a/10 = 10 \text{ hours.}$$

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Question 22

In a running race, when one runner allows another runner to stay ahead at the start of the race, then it is termed as startup and when runners reach the finishing line at the same time, then it is termed as dead heat. In a race of 4 km distance, Anu wins by 600m over Binu. Binu can give a startup of 200m to Caira in a 4 km race. By how much distance should Caira get startup so that the race between Anu and Caira ends in dead heat in the same race of 4 km?

- A 700m
- B 750m
- C 770m
- D 725m

Answer: C

Explanation:

Let Anu finishes the race in t hours.

$$\text{Speed of Anu} = \frac{4000}{t} \text{ m/hour}$$

$$\text{Speed of Bhanu} = \frac{(4000-600)}{t} \text{ m/hour} \text{ Since Anu wins the race by 600m}$$

Time taken by Bhanu to finish the race = Time taken by Caira to cover 3800m.

$$\text{Time taken by Bhanu} = \frac{4000}{\frac{3400}{t}} = \frac{20}{17} t$$

$$\text{Speed of Caira} = \frac{3800}{\frac{20}{17} t} = \frac{3230}{t} \text{ m.hr.}$$

To finish the race at the same time Anu should give Caira a headstart of $4000-3230 = 770\text{m}$

C is the correct answer.

Question 23

Three metals A, B and C are mixed such that the quantity of A is $x\%$ more than that of C and the quantity of A is $x\%$ less than that of B. The quantity of C is increased by 66.67% by adding pure C to the alloy mixture. This results in the metal C contribution to the alloy becoming 33.33% of the total. Find the value of x .

- A 66.67
- B 25
- C 33.33
- D 50

Answer: C

Explanation:

Assuming the quantity of C initially = c

$$\text{Hence, the quantity of A} = \left(1 + \frac{x}{100}\right) c$$

$$\text{Also, the quantity of B} = \left(1 - \frac{x}{100}\right) c$$

Now, after increasing the quantity of c by 66.67%, we get

$$\begin{aligned} c \left(1 + \frac{66.67}{100}\right) + c \left(1 + \frac{x}{100}\right) + \frac{1}{1 - \frac{x}{100}} &= 33.33 \\ &= 100 \end{aligned}$$

$$\Rightarrow \frac{5}{3} \left(1 - \frac{x}{100}\right) c + c \left(1 + \frac{x}{100}\right) + c \left(1 - \frac{x^2}{100}\right) = \frac{33.33}{100}$$

Assuming $\frac{x}{100} = y$, we have

$$5(1-y) + 3(1+y) + 3(1-y^2) = 3$$

$$15-15y = 5-5y+3+3y+3-3y^2$$

$$\Rightarrow 3y^2 - 13y + 4 = 0$$

$$\Rightarrow (3y-1)(y-4) = 0$$

$$\Rightarrow y = \frac{1}{3}$$

Hence, $x = 100y = 33.33\%$

C is the answer.

Question 24

Three solutions A, B and C having equal volume are made up of water and alcohol in the ratio 1:3, 2:5 and 3:4 respectively. 24 litres of A is taken out and mixed into B, then the composition of water and alcohol in B changes to 11:29. Had 14 litres been taken from the original B solution and mixed into C, what would have been the final ratio of C?

A 4:7

B 2:3

C 5:8

D 3:5

Answer: B

Explanation:

Since volumes of A, B and C are the same. It can be assumed as multiple of $\text{LCM}(1+3, 2+5, 3+4) = \text{LCM}(4, 7, 7) = 28$

Consider the volume as 28x.

In solution A, volume of water = 7x, volume of alcohol = 21x

In solution B, the volume of water = 8x, volume of alcohol = 20x

In solution C, the volume of water = 12x, volume of alcohol = 16x

If 24 litres of A and B is taken out, then water and alcohol in the ratio 1:3.

$$\text{So water taken out will be } 24 \times \frac{1}{1+3} = 6$$

$$\text{Alcohol taken out will be } 24 \times \frac{3}{1+3} = 18$$

$$\text{After adding 24 litres of A to B, the final ratio of B} = \frac{8x+6}{20x+18} = \frac{11}{29}$$

Solving for x, we get x=2

So the volume = 28x = 28*2 = 56 litres

$$\text{If 14 litres is taken out of original solution B, the water taken out will be } 14 \times \frac{2}{2+5} = 4$$

And the alcohol taken out will be 14-4 = 10

Volume of C = 56 litres, Volume of water in C = 12x = 24 and the volume of alcohol = 16x = 32

$$\text{Now adding this to C, the ratio of water and alcohol} = \frac{24+4}{32+10} = \frac{2}{3}$$

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Question 25

In a class of 60 students, the average weight of the class is 65kg. If the average weight of boys and girls in the class is 75 and 50 respectively. then the ratio of girls and boys is

- A $\frac{2}{3}$
- B $\frac{3}{2}$
- C $\frac{2}{5}$
- D $\frac{5}{3}$

Answer: A

Explanation:

The total number of students in class = 60

Let the number of boys and girls be x, y respectively.

$$\frac{75x+50y}{60} = 65$$

$$3x+2y = 156$$

$$3x+3y = 180$$

$$y = 24, x = 36$$

$$\text{Required ratio} = \frac{2}{3}$$

A is the correct answer.

Question 26

Four runners are running along a circular track. They start from the same point and run in the same direction. The speeds of the runners are in the ratio 1:2:3:5. At how many unique points on the circular track will the runners (two or more) cross each other?

- A 4
- B 12
- C 6
- D 13

Answer: C

Explanation:

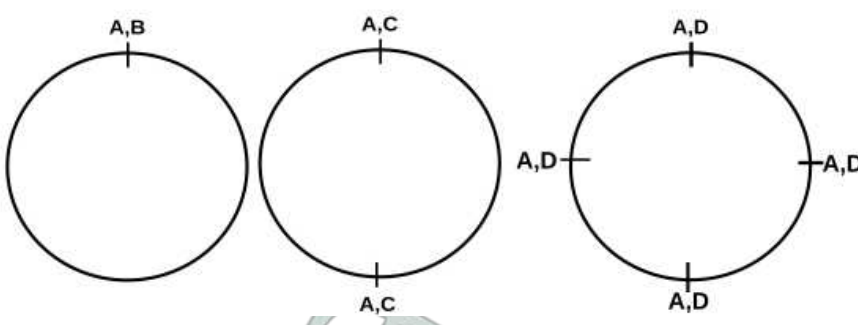
Two runners running in the same direction at the speed a:b will intersect at b-a different points. Similarly, two runners running in different directions will intersect at a+b points. Given 'a' and 'b' are coprime.

For the data given in the question, Lets assume four runners be A,B,C,D such that the run at the speed in ratio 1:2:3:5 respectively

The runners A and B with speed in ratio 1:2 will intersect at $2-1 = 1$ point i.e. the point they begin the race.

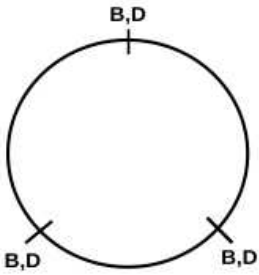
The runners A and C with speed in ratio 1:3 will intersect at $3-1 = 2$ points.

The runners A and D with speed in ratio 1:5 will intersect at $5-1 = 4$ points.



The runners B and C with speed in ratio 2:3 will intersect at $3-2 = 1$ points.

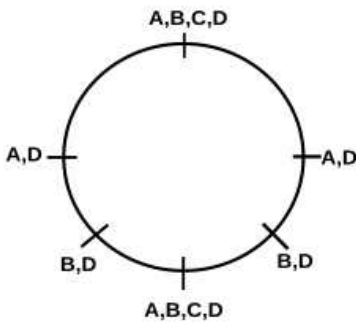
The runners B and D with speed in ratio 2:5 will intersect at $5-2 = 3$ points.



The runners C and D with speed in ratio 3:5 will intersect at $5-3 = 2$ points.

The points will coincide for runners A,B; A,C; B,C ;C,D and A,D with each other as they are start the race from the same point.

Number of different points at which they will intersect is given in the figure below.



They will intersect at 6 different points.

Question 27

Swarn a SME enterprise borrowed a sum of money from a nationalized bank at 10% simple interest per annum and the same amount at 8% simple interest per annum from a microfinance firm for the same period: It cleared the first loan 6 months before the scheduled date of repayment and repaid the second loan just at the end of the scheduled period: If in each case it had to pay Rs. 62100 as amount then how much money and for what time period did it borrow?

- A Rs. 55750, 2 years
- B Rs. 52500, 2 years
- C Rs. 51750, 2.5 years
- D Rs. 55750, 2.5 years

Answer: C

Explanation:

The sum that was returned is same in both cases that means interest accrued is same in both cases.

Assume that the duration is 't' years for which amount is borrowed in both case and principal amount is 'P'.

$$\frac{P \times (t - 0.5) \times 10}{100} = \frac{P \times t \times 8}{100}$$

$$t = 2.5 \text{ years}$$

Principal amount that the enterprise borrowed :

$$P \left(1 + \frac{2 \times 10}{100} \right) = 62100$$

$$P = 51750$$

CAT Syllabus (Download PDF)

Question 28

Ramesh, in order to achieve his sales target, started selling pens in packs of 15. To attract customers, he sells the pack at the marked price of 12 pens. He also started giving 1 pack free for every 4 packs purchased. Suresh bought 11 packets on which he got some packets free. He unpacked the pens and started selling them individually. He raised the marked price of an individual pen by 30% and offered a discount of 20%. What is the profit % earned by Suresh on selling all the pens?

- A 58.33%
- B 62.57%
- C 53.64%
- D 46.88%

Answer: C

Explanation:

Let the CP of 1 pen be Rs.10.

Thus, CP of 1 packet of pens = Rs.120.

He raises the CP by 30% and thus, MP = Rs. 13.

He is offering a discount of 20% and thus, the SP of 1 pen = Rs. 10.4.

Suresh buys 11 packets costing him $120 \times 11 = \text{Rs. } 1320$.

He got 2 packet free on these 11 packets and thus, CP of 1 packet for Suresh = Rs. $1320/13$

Each packet has 15 pens and thus, CP of 1 pen = $1320/(13 \times 15) = \text{Rs. } 6.77$.

$$10.4 - 6.77$$

Thus, Profit percentage = $\frac{6.77}{10.4} = 53.64\%$

Hence, option C is the correct answer.

Question 29

In a class of 20 students, the average age decreases by 2 years when a new student joins. 3 more students whose ages are 12, 13 and 17 years join. The ratio of new average to the original average is $\frac{p}{q}$, where p,q are co-prime integers. Find p+q.

- A 15
- B 45
- C 30
- D 20

Answer: A

Explanation:

Assuming the original average is a.

After 1 student joins, the sum of the ages = $21(a-2) = 21a-42$

After three more students join, the sum of age = $21a-42+12+13+17 = 21a$

The new average age = $\frac{21a}{20+1+3} = \frac{21a}{24} = \frac{7a}{8}$

The ratio of new average to the original average = $\frac{7}{8} = \frac{p}{q}$

$p+q = 7+8 = 15$

Question 30

A right circular cylindrical tank is connected with pipe 1 and pipe 2. Pipe 1 is connected at the bottom and it is used to fill the tank. Pipe 2 is connected at half the height of the tank and used to drain the tank. It takes t_1 hours to fill the tank completely. If the pipe 2 was connected at three-fourth the height of the tank, it would have taken t_2 hours. The ratio of t_1 and t_2 is 18:11. Find the ratio of the flow rate of pipe 1 and pipe 2?

- A 4:3
B 5:4
C 6:5
D 8:7

Answer: D

Explanation:

Assuming the flow rate of pipe 1 is a , the flow rate of pipe 2 is b and the capacity of the tank as 1 unit.

Also $t_1 = 18t$, $t_2 = 11t$

Time taken to fill half the tank = $\frac{\text{Capacity}}{\text{Flow rate}} = \frac{1}{2a}$

While filling the rest half, pipe 2 will start draining, hence the time taken to fill the rest of the half = $\frac{1}{2(a-b)}$

Total time taken = $\frac{1}{2a} + \frac{1}{2(a-b)} = t_1 = 18t \dots\dots(1)$

Similarly, if pipe 2 was connected to the three-fourth of the tank,

Total time taken = $\frac{3}{4a} + \frac{1}{4(a-b)} = t_2 = 11t \dots\dots(2)$

=> Multiplying equation (2) by 18 and equation (1) by 11 and equating, we get,

$$\frac{54}{4a} + \frac{18}{4(a-b)} = \frac{11}{2a} + \frac{11}{2(a-b)}$$

$$\Rightarrow \frac{32}{4a} = \frac{11}{2(a-b)} - \frac{9}{2(a-b)}$$

$$\Rightarrow \frac{8}{a} = \frac{1}{(a-b)}$$

$$\Rightarrow 8(a-b) = a$$

$$\Rightarrow 7a = 8b$$

$$\Rightarrow \frac{a}{b} = \frac{8}{7}$$

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Question 31

Ram invest 20% of his savings in a fixed deposit which gives 12.5% annually as simple interest. Of the remaining, he spends 25% to buy a car and rest he gives loan at an annual compound rate of $x\%$. The rate by which the value of the car gets reduced each year is $3x\%$. After 2 years the total value of his investments increases by 20%. What is the value of x ?

Answer: 25

Explanation:

Assuming the original amount = 100

$$\text{So, after 2 years, the fixed deposit will become } 20 + \frac{20 \times 12.5 \times 2}{100} = 25$$

$$\text{Amount invested in car} = \frac{80 \times 25}{100} = 20$$

$$\text{Amount invested in loan} = \frac{80 - 20}{x} = 60$$

Assume, $100 = r$

$$\text{The value of car after 2 years} = 20(1 - 3r)^2$$

$$\text{The value of loan amount after 2 years} = 60 \frac{(1 + r)^2}{20}$$

$$\text{Total net investment after 2 years} = 100(1 + 100)$$

$$120 = 25 + 20(1 - 3r)^2 + 60(1 + r)^2$$

$$\Rightarrow 95 = 20 - 120r + 180r^2 + 60 + 120r + 60r^2$$

$$\Rightarrow 15 = 240r^2$$

$$\Rightarrow r^2 = \frac{1}{16}$$

$$\begin{aligned} &1 \\ \Rightarrow r &= 4 \\ \text{Hence, } x &= 100r = 25\% \end{aligned}$$

Question 32

In an election, the citizens vote for either candidate A or candidate B. Candidate A got 25% more female votes than candidate B. Candidate B got 50 less male votes than the candidate A. The ratio of the number of females who voted candidate A to the number of male voters of B is 3:2. Find the minimum possible population of the city if at least 1 male and at least 1 female voted to each candidate.

- A 101
- B 97
- C 93
- D 87

Answer: B

Explanation:

Assume, the number of the female voter of B = $4x$, then the number of female voters of A = $4x \left(1 + \frac{25}{100}\right) = 5x$

Assume the number of the male voter of A = y , then the number of male voters of B = $y - 50$

$$\text{Now, } \frac{5x}{y-50} = \frac{3}{2}$$

$$\Rightarrow 3y - 10x = 150$$

$$\Rightarrow 3y = 10x + 150 \Rightarrow y = \frac{(10x+150)}{3}$$

$$\text{Population of the city} = 4x + 5x + y + y - 50 = 9x + 2y - 50 = 9x + \frac{2(10x+150)}{3} - 50$$

$$= 100 + 9x + \frac{20x}{3} - 50$$

The minimum value of x can be 3 (x should be multiple of 3)

Hence, the minimum population of the city = $100 + 9 \times 3 + 20 - 50 = 97$

Question 33

A train is approaching a tunnel XY. A man is seen at a point inside the tunnel XY, at a distance, which is $\frac{2}{5}$ of the length of the tunnel from X. If the man moves away from the train, the train meets the man at the exit of the tunnel i.e. Y. If the man moves towards the train, the train will meet the man at the entrance i.e. X. Find the ratio of the speeds of the train and the man.

- A 4:1
- B 5:1
- C 4:3
- D 5:3

Answer: B

Explanation:

Let the length of the tunnel = $5x$

Let the speed of the train = t

Let the speed of the man = m

At the instant the distance of the train from the entrance of the tunnel, $X = d$

$$\text{The initial distance of the man from X} = \frac{2}{5} \times 5x = 2x$$

$$\Rightarrow \text{The distance of the man from Y} = 5x - 2x = 3x$$

If the man moves away from the train, the train meets the man at the exit of the tunnel i.e. Y.

$$\frac{t}{m} = \frac{(d+5x)}{3x} \dots\dots(1)$$

If the man moves towards the train, the train will meet the man at the entrance i.e. X

$$\frac{t}{m} = \frac{d}{2x} \dots\dots(2)$$

From (1) and (2), $\frac{d}{2x} = \frac{d+5x}{3x}$

$$\Rightarrow d=10x$$

Now, $\frac{t}{m} = \frac{d}{2x} = \frac{10x}{2x} = 5$

Option B is the correct answer.

CAT Percentile Predictor

Question 34

On an island, the male population is 25% more than the female population. The food is limited and enough for only 20 days for the given population. After 10 days, 20% of men leave and 25% more women join and the food lasts for 12 more days. Had all the male population left at the beginning and no one joined in the middle, how many days would the food have lasted?

Assume that the daily food consumption of all the men is the same. Same is the case for all the women.

- A 240
- B 300
- C 250
- D 270

Answer: D

Explanation:

Assume a male consumes m units of food per day and a female consumes w units of food per day.

Assume, the female population is 4x, then the male population will be $4x \left(1 + \frac{25}{100}\right) = 5x$

Now, the total amount of food = $(5xm+4xw)*20$

After 10 more days, food left = $(20-10) = 10$ days of food = $10(5xm+4xw)$

20% men leave and 25% women join. So the new population of men = $5x \left(1 - \frac{20}{100}\right) = 4x$

New population of women = $4x \left(1 + \frac{25}{100}\right) = 5x$

Hence, $10(5xm+4xw)=12(4xm+5xw)$

$\Rightarrow 2xm = 20xw \Rightarrow m=10w$

So the total amount of food in the beginning = $(5xm+4xw)*20 = 20(50xw+4xw) = 1080xw$

Had all the male population left in the beginning, food would have lasted for $\frac{1080xw}{4xw} = 270$ days

Question 35

The following analysis was made by an expert regarding the scores of 5 batsmen in a match. The score of Farukh was equal to the average score of Eman and Ganguli. The average score of Hasim and Farukh is equal to 4 times the score of Ganguli. The score of Hasim is equal to the average score of Imran and Ganguli. If the overall average of all 5 batsmen is 115, then find the score of Ganguli?

- A 20
- B 30
- C 25
- D 35

Answer: C

Explanation:

Representing the players by the initial letters of their names, we get E, F, G, H and I.

$$\text{Now, } F = \frac{E+G}{2} \Rightarrow E+G=2F \Rightarrow E+F+G = 3F$$

$$H = \frac{I+G}{2} \Rightarrow I+G=2H \Rightarrow G+H+I = 3H$$

Now, the sum $E+F+G+H+I = 3F+3H-G$

$$\text{It is given that } \frac{(F+H)}{2} = 4G \Rightarrow F+H = 8G$$

Hence, the sum will be equal to $3(F+H)-G = 3*8G-G = 23G$

$$E+F+G+H+I = 115*5$$

$$\Rightarrow G = 115*5/23$$

$$\Rightarrow G = 25$$

Question 36

Mira and Amal walk along a circular track, starting from the same point at the same time. If they walk in the same direction, then in 45 minutes, Amal completes exactly 3 more rounds than Mira. If they walk in opposite directions, then they meet for the first time exactly after 3 minutes. The number of rounds Mira walks in one hour is

Answer: 8

[Video Solution](#)

Explanation:

Considering the distance travelled by Mira in one minute = M,

The distance traveled by Amal in one minute = A.

Given if they walk in the opposite direction it takes 3 minutes for both of them to meet. Hence $3*(A+M) = C$. (1)

C is the circumference of the circle.

Similarly, it is mentioned that if both of them walk in the same direction Amal completes 3 more rounds than Mira :

$$\text{Hence } 45*(A-M) = 3C. \text{ (2)}$$

Multiplying (1)*15 we have :

$$45A + 45M = 15C.$$

$$45A - 45M = 3C.$$

$$\text{Adding the two we have } A = \frac{18C}{90}$$

$$\text{Subtracting the two } M = \frac{12C}{90}$$

$$\text{Since Mira travels } \frac{12C}{90} \text{ in one minute, in one hour she travels : } \frac{12C}{90} \cdot 60 = 8C$$

Hence a total of 8 rounds.

Alternatively,

Let the length of track be L

and velocity of Mira be a and Amal be b

Now when they meet after 45 minutes Amal completes 3 more rounds than Mira

so we can say they met for the 3rd time moving in the same direction

so we can say they met for the first time after 15 minutes

So we know Time to meet = Relative distance / Relative velocity

$$\text{so we get } \frac{15}{60} = \frac{L}{a-b} \quad (1)$$

Now When they move in opposite direction

They meet after 3 minutes

$$\text{so we get } \frac{3}{60} = \frac{L}{a+b} \quad (2)$$

Dividing (1) and (2)

$$\text{we get } \frac{(a+b)}{(a-b)} = 5$$

$$\text{or } 4a = 6b$$

$$\text{or } a = 3b/2$$

Now substituting in (1)

we get :

$$\frac{L}{b} \times 2 = \frac{15}{60}$$

$$\text{so } \frac{L}{b} = \frac{1}{8}$$

So we can say 1 round is covered in $\frac{1}{8}$ hours
so in 1-hour total rounds covered = 8.

Important Verbal Ability Questions for CAT (Download PDF)

Question 37

In a textile factory, a man starts working on a project on day 1. On day 2, two more men joined him on the project. On day 3, three more men join the project and so on till the entire project is completed in exactly 10 days. In how many days can the project be completed by 20 women, if each woman is twice as fast as a man?

- A 5 days
- B 5.5 days
- C 6 days
- D 6.5 days

Answer: B

Explanation:

Let each man do one unit of work on a day.

So, total work required to complete the project = $1 + (1+2) + (1+2+3) + (1+2+3+4) + \dots + (1+2+3+\dots+10) = 1*10 + 2*9 + 3*8 + 4*7 + 5*6 + 6*5 + 7*4 + 8*3 + 9*2 + 10*1 = 20 + 36 + 48 + 56 + 60 = 220$ units

Work done by 1 woman in 1 day = 2 units

So, work done by 20 women in 1 day = 40 units

So, number of days required to complete the project = $220/40 = 5.5$ days

Question 38

A given amount of wheat is to be sold in the market. Two-fifth of the total quantity is sold at a loss of 5%. Half of the remaining quantity is sold at a profit of 15%. For what % profit must the remaining amount be sold such that the overall gain is 30%?

- A 121.67
- B 106.67
- C 91.67
- D 66.67

Answer: C

Explanation:

Assume the total cost price of wheat = x

Then the cost price of $\frac{2}{5}$ quantity of wheat = $\frac{2x}{5}$
Selling price of this quantity = $\frac{2x}{5} \times \left(1 - \frac{5}{100}\right) = \frac{2x}{5} \times \frac{95}{100} = \frac{38x}{100} = \frac{19x}{50}$

The cost price of half the remaining quantity = $\frac{1}{2} \times \frac{3x}{5} = \frac{3x}{10}$

The selling price of this quantity = $\frac{3x}{10} \times \left(1 + \frac{15}{100}\right) = \frac{3x}{10} \times \frac{115}{100} = \frac{69x}{200}$

Now we have $\frac{3}{10}$ of the total quantity left to sell.

So, the cost price of this quantity = $\frac{3x}{10}$

To get an overall 30% selling price, the total selling price will be $x \left(1 + \frac{30}{100}\right) = 1.3x$

So the selling price of the remaining quantity left will be $\frac{13x}{10} - \frac{19x}{50} - \frac{69x}{200} = \frac{260x}{200} - \frac{76x}{200} - \frac{69x}{200} = \frac{115x}{200} = \frac{23x}{40}$

Hence, profit % = $\frac{\frac{23x}{40} - \frac{3x}{10}}{\frac{3x}{10}} \times 100 = \frac{11x}{40} \times \frac{10}{3x} \times 100 = 91.67\%$

Question 39

A metal trader sells zinc, copper and iron. On a particular day, the cost price of iron is 25% more than copper which in turn has cost price 33.33% more than zinc. The profit booked on zinc, copper and iron is 50%, 40% and 30% respectively. If the overall profit is 40%, what should be the ratio of quantities of zinc and iron sold on that day assuming that every metal was traded?

- A 5/3
- B 3/5
- C 5/4
- D Cannot be determined

Answer: A

Explanation:

Assuming the cost price of zinc/kg = a

Hence the price of copper/kg = $4a/3$

Hence the price of iron/kg = $5a/3$

Assuming $a/3 = b$, The price per kg for zinc, iron and copper be $3b$, $4b$ and $5b$ respectively.

The profit made on zinc/kg = $3b \times 0.5 = 1.5b$

Profit on copper/kg = $4b \times 0.4 = 1.6b$

Profit on iron/kg = $5b \times 0.3 = 1.5b$

Now assuming the quantities for zinc, iron and copper be x , y and z respectively.

Overall profit = $(1.5bx + 1.6by + 1.5bz) / (3bx + 4by + 5bz) = 40/100 = 0.4$

$\Rightarrow (1.5bx + 1.6by + 1.5bz) = 1.2bx + 1.6by + 2bz$

$\Rightarrow 0.3x = 0.5z$

$\Rightarrow x/z = 5/3$

Data Interpretation for CAT Questions (download pdf)

Question 40

A, a fitness enthusiast, goes for a run everyday for 4 hours at a circular park. He runs at a speed of 5 km/hr and is able to finish a lap of the park in 36 mins. A starts running at 5 am. Another runner B arrives at 6:15 am and is 20% slower than A. At how many distinct points will A and B meet each other? Assume that they both leave at the same time.

- A 1 point
- B 2 points
- C 3 points
- D 4 points

Answer: A

Explanation:

36

Circumference of the park = $60 \times 5 = 3 \text{ kms}$

75

When B arrives, distance run by A = $60 \times 5 = 6.25 \text{ kms}$

6.25

Thus, position of A when B arrives = $R(3) = 0.25 \text{ kms}$ from the starting point

4

Speed of B = $5 \times 5 = 4 \text{ km/hr}$

Distance between A and B when B arrives = 0.25 kms

Thus, the 2 runners will meet only if the distance is either 0 or a multiple of 3 kms (circumference of the park)

Since A is faster than B, only the second case is a possibility.

Relative speed of A and B = $5 - 4 = 1$ km/hr

Distance required between the runners to make sure they meet = $3 - 0.25 = 2.75$ kms

Time needed to cover the required distance = 2.75 hrs = 2 hr 45 mins

Time when the runners meet for the first time = $6:15 + 2:45 = 9:00$ AM

Since A runs for 4 hours starting from 5 AM, we know that he will stop at 9 AM.

Therefore, the runners meet only once at one distinct point.

Question 41

The value of $1^3 - 2^3 + 3^3 - 4^3 \dots - 100^3$ is

A -507500

B -681750

C -676700

D -504000

Answer: A

Explanation:

$$\begin{aligned} & 1^3 - 2^3 + 3^3 - 4^3 \dots - 100^3 \\ &= 1^3 + 2^3 + 3^3 \dots 100^3 - 2(2^3 + 4^3 + 6^3 \dots 100^3) \\ &= 1^3 + 2^3 + 3^3 \dots 100^3 - 2 \times 2^3 (1^3 + 2^3 + 3^3 \dots 50^3) \\ &= \left(\frac{100 \times 101}{2} \right)^2 - 16 \left(\frac{50 \times 51}{2} \right)^2 \\ &= 50^2 \times 101^2 - 4 \times 50^2 \times 51^2 \\ &= 50^2 (101^2 - 2^2 \times 51^2) \\ &= 50^2 (101 - 102)(101 + 102) \\ &= -507500 \end{aligned}$$

A is the correct answer.

Question 42

The number of integral solutions of the equation $2^x(4 - x) = 2(x + 2)$ is

Answer: 3

Explanation:

$$2^x > 0$$

$$\text{So } \frac{2(x+2)}{4-x} > 0$$

$$(x + 2)(4 - x) > 0$$

$$-2 < x < 4$$

From this range of values only $x = 0, 1, 2$ satisfies the equation.

Hence 3 is the correct answer.

Logical Reasoning for CAT Questions (download pdf)

Question 43

If $\log_9(x - 1) = \log_3(x - 3)$, then the sum of all the possible solutions of x is

Answer:5

Explanation:

$$\log_9 (x - 1) = \log_3 (x - 3)$$

$$\frac{\log(x-1)}{\log 9} = \frac{\log(x-3)}{\log 3}$$

$$\frac{\log(x-1)}{2 \log 3} = \frac{\log(x-3)}{\log 3}$$

$$(x - 1) = (x - 3)^2$$

$$x^2 - 6x + 9 - x + 1 = 0$$

$$x = 5, 2$$

Let's see if the values satisfies the equation

If $x = 2$, the expression inside the log will become negative, which is invalid.

$$\text{If } x = 5, \log_9 4 = \log_3 2$$

The sum of the values of x which satisfies the equation is 5

Question 44

21

Which of the following can't be the sum of the squares of the roots of the equation: $x^2 + (p + 6)x + (p + 4) = 0$, if both the roots are imaginary.

A $\frac{21}{4}$

B $\frac{17}{4}$

C $\frac{15}{4}$

D $\frac{13}{4}$

Answer: A

Explanation:

We are given that root are imaginary, therefore,

$$\Rightarrow (p + 6)^2 - 4(p + 4) < 0$$

$$\Rightarrow p^2 + 12p + 36 - 4p - 16 < 0$$

$$\Rightarrow p^2 + 8p + 20 < 0$$

$$\Rightarrow (p + 5)(p + 4) < 0$$

Therefore, $p \in (-5, -4) \dots (1)$

Let 'a' and 'b' be the roots of the given quadratic equation,

$$\Rightarrow a^2 + b^2 = (a + b)^2 - 2ab$$

$$\Rightarrow a^2 + b^2 = (p + 6)^2 - 2(p + 4)$$

$$\Rightarrow a^2 + b^2 = p^2 + 10p + 20$$

$$\Rightarrow a^2 + b^2 = p^2 + 10p + 25 - 25 + 2$$

$$\Rightarrow a^2 + b^2 = (p+5)^2 + 2 \dots (2)$$

We know that $-5 < p < -3$

$$\Rightarrow -5 + 5 < p + 5 < -3 + 5$$

$$\Rightarrow 0 < p + 5 < 2$$

$$\Rightarrow 0 < (p+5)^2 < 4$$

$$\Rightarrow 0 + 2 < (p+5)^2 + 2 < 4 + 2$$

$$\Rightarrow 2 < a^2 + b^2 < 6$$

21

Hence we can say that the sum of the squares of the roots of the given equation can't be 4. Hence, option A is the correct answer.

Question 45

If $x = 8 - \sqrt{32}$ and $y = 2 + \sqrt{2}$, then $\left(x + \frac{1}{y}\right)^2$ is given by:

A $\frac{16}{25}x^2$

B $\frac{64}{81}y^2$

C $\frac{25}{16}y^2$

D $\frac{81}{64}x^2$

Answer: D

Explanation:

$$x = 8 - \sqrt{32} \text{ and } y = 2 + \sqrt{2}$$

We have to find the value of $\left(x + \frac{1}{y}\right)^2$

$$\left(8 - \sqrt{32} + \frac{1}{2+\sqrt{2}}\right)^2$$

$$\left(\frac{8(2+\sqrt{2}) - \sqrt{32}(2+\sqrt{2}) + 1}{2+\sqrt{2}}\right)^2$$

$$\left(\frac{9}{2+\sqrt{2}}\right)^2$$

$$\frac{81}{6+2\sqrt{2}}$$

$$\left(\frac{1}{y}\right)^2 = \left(\frac{1}{2+\sqrt{2}}\right)^2 = 6 + 2\sqrt{2}$$

$$= \left(\frac{2-\sqrt{2}}{2}\right)^2$$

$$= \frac{6-4\sqrt{2}}{4}$$

$$= \frac{3-2\sqrt{2}}{2}$$

$$x^2 = 64 + 32 - 64\sqrt{2}$$

$$= 96 - 64\sqrt{2}$$

$$= 32(3 - 2\sqrt{2}) = 32 \cdot 2y^2$$

$$\text{we get, } x^2 = 64y^2$$

$$\frac{81}{y^2} = \frac{81}{64}x^2$$

D is the correct answer.

Alternative solution,

$$xy = (8 - \sqrt{32})(2 + \sqrt{2}) = 4\sqrt{2}(\sqrt{2} - 1) \times \sqrt{2}(\sqrt{2} + 1) = 8(2 - 1) = 8$$

$$(As \ xy = 8 \longrightarrow y = \frac{8}{x})$$

$$\left(x + \frac{1}{y}\right)^2 = \left(\frac{xy+1}{y}\right)^2 = \left(\frac{(xy+1) \times x}{8}\right)^2 = \left(\frac{(8+1) \times x}{8}\right)^2 = \frac{81}{64} \times x^2$$

Quantitative Aptitude for CAT Questions (download pdf)

Question 46

The number of distinct pairs of integers (m,n), satisfying $|1 + mn| < |m + n| < 5$ is:

Answer:12

▶ Video Solution

Explanation:

Let us break this up into 2 inequations [Let us assume x as m and y as n]

$$|1 + mn| < |m + n|$$

$$|m + n| < 5$$

Looking at these expressions, we can clearly tell that the graphs will be symmetrical about the origin.

Let us try out with the first quadrant and extend the results to the other quadrants.

We will also consider the +X and +Y axes along with the quadrant.

So, the first inequality becomes,

$$1 + mn < m + n$$

$$1 + mn - m - n < 0$$

$$1 - m + mn - n < 0$$

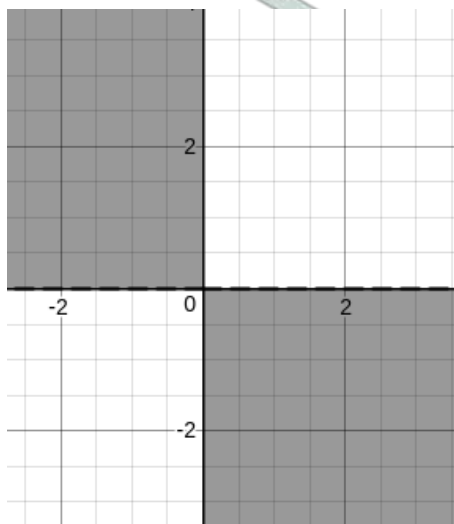
$$(1-m) + n(m-1) < 0$$

$$(1-m)(1-n) < 0$$

$$(m-1)(n-1) < 0$$

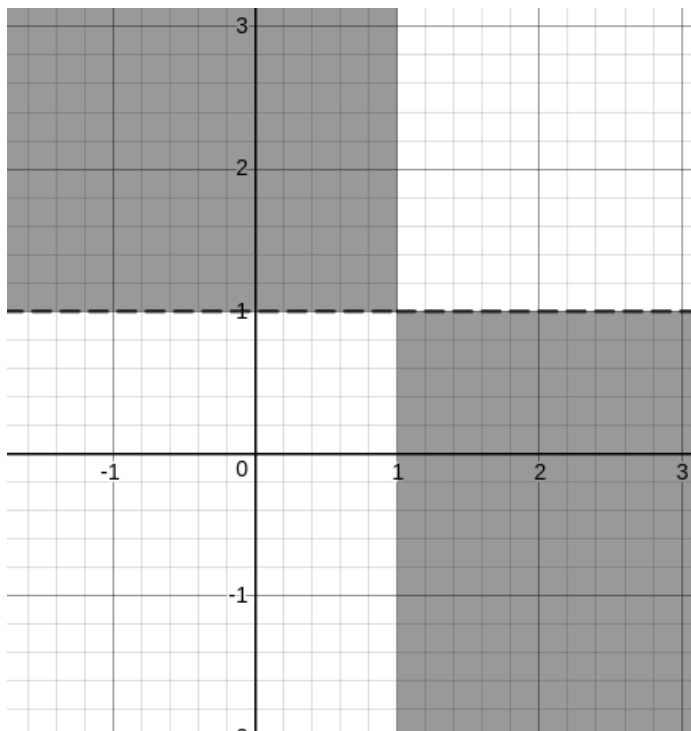
Let us try to plot the graph.

If we consider only $mn < 0$, then we get

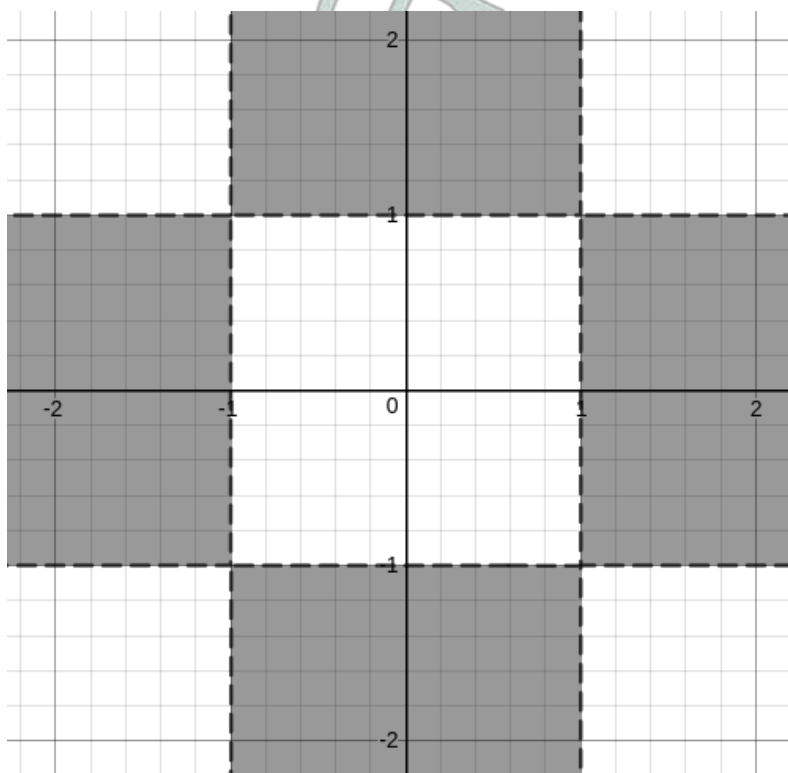


But, we have $(m-1)(n-1) < 0$, so we need to shift the graphs by one unit towards positive x and positive y.

So, we have,



But, we are only considering the first quadrant and the +X and +Y axes. Hence, if we extend, we get the following region.



So, if we look for only integer values, we get

(0,2), (0,3),.....

(0,-2), (0, -3),.....

(2,0), (3,0),

(-2,0), (-3,0),

Now, let us consider the other inequation as well, in which $|x + y| < 5$

Since one of the values is always zero, the modulus of the other value is less than or equal to 4.

Hence, we get

(0,2), (0,3), (0,4)

(0,-2), (0, -3), (0, -4)

(2,0), (3,0), (4,0)
(-2,0), (-3,0), (-4,0)

Hence, a total of 12 values.

Question 47

If $\log_2 2 - 2 \log_{\sqrt{2}} 4 + 3 \log_{\sqrt[3]{2}} 8 - \dots - 10 \log_{\sqrt[10]{2}} 1024 = k$, then what is the value of $|k|$?

Answer: 575

Explanation:

$\log_2 2 - 2 \log_{\sqrt{2}} 4 + 3 \log_{\sqrt[3]{2}} 8 - \dots - 10 \log_{\sqrt[10]{2}} 1024$ can be written as
 $\log_2 2 - 2 \log_{\sqrt{2}} 2^2 + 3 \log_{\sqrt[3]{2}} 2^3 - \dots - 10 \log_{\sqrt[10]{2}} 2^{10}$

$\Rightarrow \log_2 2 - 2 * 2 \log_{\sqrt{2}} 2 + 3 * 3 \log_{\sqrt[3]{2}} 2 - \dots - 10 * 10 \log_{\sqrt[10]{2}} 2$

\Rightarrow we know that $\log_{y^x} x = n \log_y x$

Thus, $1 - 2 * 2 * 2 \log_2 2 + 3 * 3 * 3 \log_2 2 - \dots - 10 * 10 * 10 \log_2 2$

$\Rightarrow 1 - 2^3 + 3^3 - 4^3 + 5^3 - \dots - 10^3$

$\Rightarrow 1 - 8 + 27 - 64 + 125 - 216 + 343 - 512 + 729 - 1000$

$= -575 = k$

Thus, $|k| = 575$

Question 48

Ravi has coins of denominations Rs 5 and Rs 16 only. Find the sum of digits of the maximum whole number amount that he cannot pay using these denominations and also the number of such amounts that he cannot pay using the coins he has.

A 12, 25

B 14, 30

C 12, 30

D 14, 25

Answer: B

Explanation:

The problem can be re-written as "find the largest whole number that cannot be represented by the linear equation $5x + 16y$ such that both x and y are non-negative integers".

Here, let's use the Chicken McNugget's Theorem which states that if a and b are positive co-prime integers, then the largest positive integer that cannot be represented by $ma + nb$ is $(ab - a - b)$. The number of such positive integers that cannot be represented by $ma + nb$

is equal to $\frac{(a-1)(b-1)}{2}$.

$5x + 16y \Rightarrow$ Largest amount that cannot be represented by these denominations $= (16)(5) - 16 - 5 = 59 \Rightarrow$ Sum of the digits $= 5 + 9 = 14$

\Rightarrow Number of amounts that cannot be represented by these denominations $= \frac{(16-1)(5-1)}{2} = 30$.

Hence B is the answer.

Alternate Method:

$16 \equiv 1 \pmod{5} \Rightarrow$ Any number greater than 16 and of the form $5k+1$ can be represented by $5x + 16y$

$32 \equiv 2 \pmod{5} \Rightarrow$ Any number greater than 32 and of the form $5k+2$ can be represented by $5x + 16y$

$48 \equiv 3 \pmod{5} \Rightarrow$ Any number greater than 48 and of the form $5k+3$ can be represented by $5x + 16y$

$64 \equiv 4 \pmod{5} \Rightarrow$ Any number greater than 64 and of the form $5k+4$ can be represented by $5x + 16y$

\Rightarrow Last $5k+4$ number less than 64 cannot be represented by $5x + 16y \Rightarrow 59$ is the answer.

The number of numbers of the form $5k+1$ which cannot be represented is 1, 6, 11. $\Rightarrow 3$

The number of numbers of the form $5k+2$ which cannot be represented is 2, 7, 12 ... 27 $\Rightarrow 6$

The number of numbers of the form $5k+3$ which cannot be represented is 3, 8, 13, ... 43 $\Rightarrow 9$

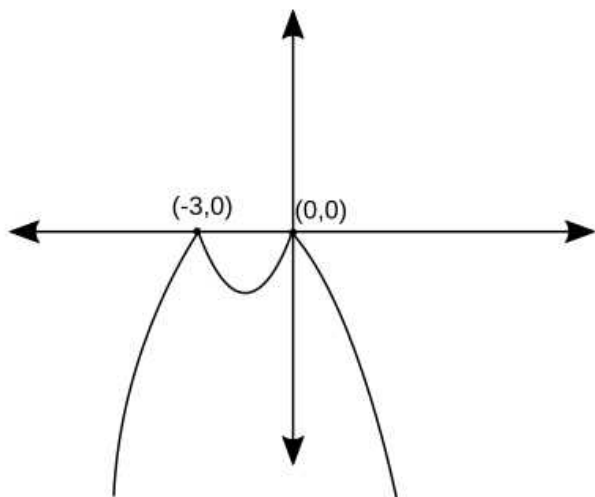
The number of numbers of the form $5k+4$ which cannot be represented is 4, 9, 14 ... 59 $\Rightarrow 12$

Therefore, the number of such numbers $= 3 + 6 + 9 + 12 = 30$

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Question 49

If $f(x) = x^2 + 3x$, then which of the following options represents the graph given below?



A $-f(x)$

B $-|f(x)|$

C $-f(-x)$

D $|f(x)|$

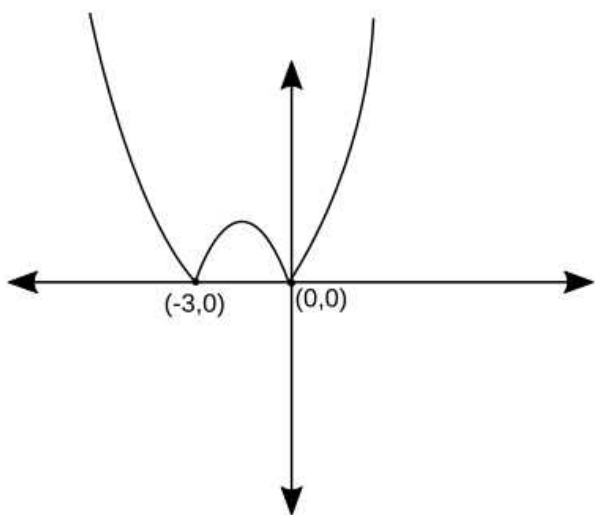
Answer: B

Explanation:

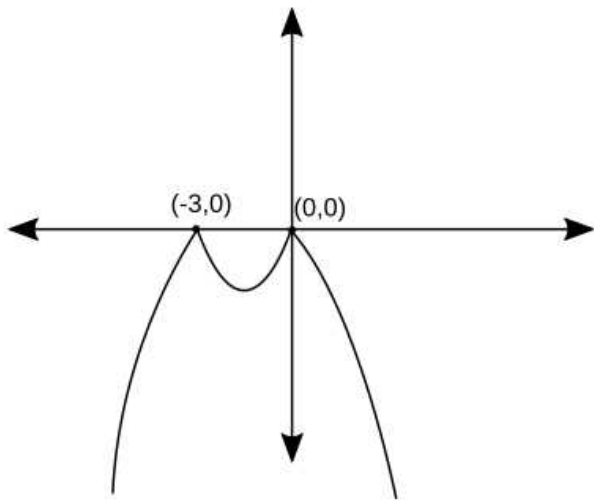
$$f(x) = x(x+3).$$

$$f(x) = 0 \text{ at } x = 0, -3$$

The graph of the function $|f(x)|$:



We can invert the graph by $-|f(x)|$.



Option B is the correct answer.

Question 50

For real x , if $x^2 - 5x + \frac{1}{x^2} - \frac{5}{x} - 4 \leq 0$. Find the difference of the largest and smallest possible integral value of x .

Answer:4

Explanation:

We have, $x^2 - 5x + \frac{1}{x^2} - \frac{5}{x} - 4 \leq 0$ which can be rearranged as:

$$x^2 + \frac{1}{x^2} + 2 - 2 - 5x - \frac{5}{x} - 4 \leq 0$$

$$\Rightarrow x^2 + \frac{1}{x^2} + 2 - 5x - \frac{5}{x} - 6 \leq 0$$

$$\Rightarrow \left(x + \frac{1}{x}\right)^2 - 5\left(x + \frac{1}{x}\right) - 6 \leq 0$$

Assuming $x + \frac{1}{x} = t$

$$\Rightarrow t^2 - 5t - 6 \leq 0$$

$$\Rightarrow (t-6)(t+1) \leq 0$$

$$\Rightarrow -1 \leq t \leq 6$$

$$\Rightarrow -1 \leq x + \frac{1}{x} \leq 6$$

Using AM-GM, the minimum value of $x + \frac{1}{x}$ for $x > 0$ will be 2.

$$\Rightarrow x + \frac{1}{x} \geq 2$$

Hence, in $2 \leq x + \frac{1}{x} \leq 6$

$x + \frac{1}{x} \geq 2$, will be true for all positive real values of x . $\Rightarrow x > 0$

The smallest integral value satisfying will be $x=1$

Also, $x + \frac{1}{x} \leq 6$, the largest value satisfying the equation will be 5 because $x=6$, then $6 + \frac{1}{6}$ (a positive value) will be greater than 6.

Hence the smallest value integral value satisfying is 1 and the largest integral value satisfying is 5.

Difference = $5 - 1 = 4$

Question 51

The average of 33 consecutive 3 digit even numbers increases by 6 if the digits of 30th number in series are reversed. If digits of the 30th term are in strictly increasing or strictly decreasing order and hundreds digits of all numbers are the same, what is the sum of digits of the 3rd term in series?

A 15

B 12

C 21

D 18

Answer: B

Explanation:

Consider average of given numbers = a

Total sum = $33a$

Assuming x,y and z are hundreds digit, tens digit and units digit of 30th term of the series respectively.

After reversing the digits, new average = $\frac{33a - (100x + 10y + z) + ((100z + 10y + x))}{33} = a + 6$

$$\Rightarrow a + \frac{99(z-x)}{33} = a + 6$$

$$\Rightarrow z - x = 2$$

x cannot be 0 as all are 3 digit numbers

Case 1: $z=8$ $x=6$ $y=7$ The digits are in strictly increasing or strictly decreasing order.

30th number = 678 = $a + 2 \times 29$ Hence 1st term of series = 620, Last term = $a + 32 \times d = 684$

Hundreds digits of all numbers are the same.

Case 2: $z=6$ $x=4$ $y=5$ The digits are in strictly increasing or strictly decreasing order.

30th number = 456 = $a + 2 \times 29$ Hence 1st term of series = 398, Last term = $a + 32 \times d = 462$

Hundreds digits of all numbers are not the same.

Case 3: $z=4$ $x=2$ $y=3$ The digits are in strictly increasing or strictly decreasing order.

30th number = 234 = $a + 2 \times 29$ Hence 1st term of series = 176, Last term = $a + 32 \times d = 240$

Hundreds digits of all numbers are not the same.

Only 1st case is possible.

3rd term = $a + 2 \times 2 = 624$

Sum of digits of 624 = $6 + 2 + 4 = 12$

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Question 52

Consider the quadratic equation $4x^2 - a^2x + 12 = 0$ where a is a positive integer and at least one root is an integer. Another quadratic equation $x^2 - ax - 18 = 0$ has both its roots as integers. The value of a is

Enter -1 if the answer can't be found.

Answer:7

Explanation:

We have, $4x^2 - a^2x + 12 = 0$

For at least 1 integral roots, the factors of $12 \times 4 = 48$ are taken.

$48 = 1 \times 48 = 2 \times 24 = 3 \times 16 = 4 \times 12 = 6 \times 8$

Sum of these factors should be a^2

Only two possibilities = $1 + 48 = 49$ and $4 + 12 = 16$

Hence, $a=7$ or $a=4$

$$x^2 - 7x - 18 = 0 \text{ or } x^2 - 4x - 18 = 0$$

Consider the first equation: $x^2 - 7x - 18 = 0 \Rightarrow x^2 - 9x + 2x - 18 = 0 \Rightarrow (x-9)(x+2) = 0 \Rightarrow x=9$ or -2 (Both roots are integral)

In the second equation, $D = 4^2 + 4 \times 18 = 88$ which is not a perfect square. Hence integral roots are not possible.

$\Rightarrow a=7$

Question 53

The given system of linear equations has no solution:

$$9ax + 2y = 3$$

$$4x + (2-a)y = 2$$

Then which of the following is true?

A $3a-4=0$

- B** $3a-2=0$
- C** $3a+2=0$
- D** $3a+4=0$

Answer: A

Explanation:

We have, $9ax+2y=3$

$$4x+(2-a)y=2$$

Since, given system of equation does not have any solution:

$$\frac{9a}{4} = \frac{2}{2-a} \neq \frac{3}{2}$$

$$\Rightarrow 9a(2-a)=8$$

$$\Rightarrow 9a^2 - 18a + 8 = 0$$

$$\Rightarrow 9a^2 - 12a - 6a + 8 = 0$$

$$\Rightarrow (2a-3)(4a-3)=0$$

$$\Rightarrow a = \frac{2}{3} \text{ or } a = \frac{4}{3}$$

Now, if we put $a = \frac{2}{3}$, $\frac{2}{2-a}$ will be equal to $\frac{3}{2}$. Hence it will be rejected.

$$\Rightarrow a = \frac{4}{3}$$

Question 54

Suppose that $a = \frac{2b}{3}$ and $a^b = b^a$. The sum of a and b can be expressed as a rational number $\frac{p}{q}$, where p and q are co-prime positive integers. Find the value of $p + q$?

- A** 35
- B** 91
- C** 47
- D** 53

Answer: D

Explanation:

Let us assume that $a = kb$ where k can take any positive value.

We are given that $a^b = b^a$

$$\Rightarrow (kb)^b = b^{kb}$$

$$\Rightarrow (k^b) \times (b^b) = (b^b)^k$$

$$\Rightarrow (k)^b = (b^b)^{k-1}$$

Taking b^{th} root each side

$$\Rightarrow k = (b)^{k-1}$$

$$\Rightarrow b = (k)^{\frac{1}{k-1}}$$

By substituting $k = \frac{2}{3}$

$$\Rightarrow b = \left(\frac{2}{3}\right)^{-3}$$

$$\Rightarrow b = \left(\frac{3}{2}\right)^3$$

$$\Rightarrow b = \frac{27}{8}$$

$$\text{Hence } a = \frac{2}{3} \times \frac{27}{8}$$

$$\Rightarrow a = \frac{9}{4}$$

$$\text{We can calculate } a + b = \frac{9}{4} + \frac{27}{8}$$

$$\Rightarrow a + b = \frac{45}{8} = \frac{p}{q}$$

Hence $p + q = 45 + 8 = 53$, Therefore option D is the correct answer.

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Question 55

How many integer pairs satisfy $p^2 + 9q^2 \leq 144$, where p, q are integers?

Answer: 145

Explanation:

Since p, q are integers, p^2 and $9q^2$ are integers.

The maximum value which p^2 and $9q^2$ can take is 144

Now consider $9q^2 \leq 144$, q can range from -4 to 4.

When $q = 0$, $p^2 \leq 144$ p can range from -12 to 12 = 25 values

When $q = \pm 1$, $p^2 \leq 135$ p can range from -11 to 11 = 23 values

When $q = \pm 2$, $p^2 \leq 108$ p can range from -10 to 10 = 21 values

When $q = \pm 3$, $p^2 \leq 63$ p can range from -7 to 7 = 15 values

When $q = \pm 4$, $p^2 \leq 0$ p can take one value i.e 0

Number of integral pairs = $25 + (23 + 21 + 15 + 1) \times 2 = 145$

145 is the correct answer.

Question 56

What is/are the number of integers of x that satisfy the inequality $|x + 3| > 2x^2 + 11x + 11$ is _____.

A 4

B 3

C 1

D 6

Answer: B

Explanation:

Let $x > -3$,

$$x + 3 > 2x^2 + 11x + 11$$

$$0 > 2x^2 + 10x + 8$$

$$0 > x^2 + 5x + 4$$

$$0 > (x + 4)(x + 1)$$

$x \in (-4, -1)$...but $x > -3$, thus

$$x \in (-3, -1)$$

Let $x \leq -3$

$$-x - 3 > 2x^2 + 11x + 11$$

$$0 > 2x^2 + 12x + 14$$

$$0 > x^2 + 6x + 7$$

$x \in (-4.414, -1.586)$...but $x \leq -3$, thus

$$x \in (-4.414, -3]$$

Set of integers $\{-2, -3, -4\}$

Option B

Question 57

The cost of 5 apples, 7 bananas and 9 mangoes is Rs 204 and the cost of 8 apples, 5 bananas and 2 mangoes is Rs 159. Find the total cost of 1 apple, 1 banana and 1 mango.

Answer:30

Explanation:

Let the cost of 1 apple, 1 banana and 1 mango be a, b and c respectively.

$$5a + 7b + 9c = 204$$

$$8a + 5b + 2c = 159$$

Coefficients are in AP in both the equations.

The differences of coefficients in the first equation are 2 and the differences of coefficients in the second equation are 3.

Hence, multiply the first equation by 3 and multiply the second equation by 2.

$$15a + 21b + 27c = 612$$

$$16a + 10b + 4c = 318$$

$$\Rightarrow 31a + 31b + 31c = 930$$

$$\Rightarrow a + b + c = 30$$

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Question 58

$$\log(\tan 1^\circ) * \log(\tan 2^\circ) * \log(\tan 3^\circ) \dots \log(\tan 89^\circ)$$

A -1

B 1

C 0

D 90

Answer: C

Explanation:

$$\log(\tan 1^\circ) * \log(\tan 2^\circ) * \log(\tan 3^\circ) \dots \log(\tan 89^\circ)$$

We know that $\tan 45 = 1$

$$\log 1 = 0$$

$$\log(\tan 1^\circ) * \log(\tan 2^\circ) * \log(\tan 3^\circ) \dots \log(\tan 89^\circ)$$

$$= 0$$

C is the correct answer.

Question 59

$A = (1 + a)(1 + a^2)(1 + a^4)(1 + a^8)$ is written in increasing powers of a, then the sum of first 5 terms when $a = 3$ is?

Answer:121

Explanation:

$$A = (1 + a)(1 + a^2)(1 + a^4)(1 + a^8)$$

Multiply both the sides of the equation by $(1 - a)$.

$$A(1 - a) = (1 - a)(1 + a)(1 + a^2)(1 + a^4)(1 + a^8)$$

$$= (1 - a^2)(1 + a^2)(1 + a^4)(1 + a^8)$$

$$= (1 - a^4)(1 + a^4)(1 + a^8)$$

$$= (1 - a^8)(1 + a^8)$$

$$= (1 - a^{16})$$

$$A = \frac{1 - a^{16}}{1 - a}$$

$$= 1 + a + a^2 + a^3 + a^4 + \dots a^{15} \dots \text{sum of G.P.}$$

$$\begin{aligned} \text{Sum of the first five terms} &= 1 + a + a^2 + a^3 + a^4 \\ &= \frac{a^5 - 1}{a - 1} \\ &= \frac{3^5 - 1}{3 - 1} \\ &= \frac{242}{2} = 121 \end{aligned}$$

121 is the correct answer.

Question 60

For how many integral values of x , the function, $f(x) = \frac{\sqrt{16-x^2}}{\log_{x+2} \left(\left| \frac{x}{5} \right| \right)}$ is defined?

Answer: 4

Explanation:

$$\text{We have, } f(x) = \frac{\sqrt{16-x^2}}{\log_{x+2} \left(\left| \frac{x}{5} \right| \right)}$$

We know that the base of a log cannot be 1. The value inside the square should be positive. Also, the argument of the log should be positive.

The argument $\left| \frac{x}{5} \right|$ is always positive. So $x \neq 0$

Also, $\left| \frac{x}{5} \right|$ cannot be 1 as denominator would become 0. Hence $x \neq 5$ and $x \neq -5$

$$\text{Also, } 16 - x^2 \geq 0 \Rightarrow -4 \leq x \leq 4$$

$$\text{Now, } x+2 > 0 \Rightarrow x > -2 \text{ Also, } x+2 \neq 1 \Rightarrow x \neq -1$$

$$\text{Hence, } x \in (-2, -1) \cup (-1, 0) \cup (0, 4]$$

The integral values of x are 1, 2, 3, 4

Hence, there are 4 integral values of x for which $f(x)$ is defined.

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Question 61

A function is defined as $f(x) = \sin x(\sin x - 4) + 3$ for all the real values of x . Find the maximum value of $f(x)$.

Answer: 8

Explanation:

$$\text{The expression } f(x) \text{ can be written as: } f(x) = \sin^2 x - 4 \sin x + 3 = \sin^2 x - 4x + 4 - 1 = (\sin x - 2)^2 - 1$$

To maximize the value of $f(x)$, the value of $\sin x$ will be -1.

$$\text{Hence, the maximum value of } f(x) = (-1 - 2)^2 - 1 = 9 - 1 = 8$$

Question 62

Find the number of ordered pairs of (x, y) where $x^2 + y^3 = 6$ and both x and y are integers.

- A 31
- B 16
- C 24
- D 32
- E None of the above

Answer: A

Explanation:

$$\begin{matrix} 2 & 3 & -1 \\ x + y = & 6 \end{matrix}$$

$$\Rightarrow 18x + 12y + xy = 0$$

$$\Rightarrow (x+12)(y+18) = 216$$

We have to factorize 216 in prime factor form.

$$216 = 2^3 * 3^3$$

$$\text{Total number of factors} = (3+1)*(3+1) = 16$$

Among these 16 values, when we express $(x+12)(y+18) = 12 * 18$, the values of both x and y is 0. This case is negated.

Hence, we can say that ' x ' can take any of these 15 values. We can write $(1*216)$ as $(-1*-216)$ as well hence, ' x ' can take 16 negative values as well. Hence, a total of 31 solutions are possible. Therefore, option A is the correct answer.

Question 63

A function $f(x)$ is defined as $f(x) = x^2 - 2x$. Another function $g(x)$ exists such that $f(g(x)) = 4x^2 - 1$. The value of $g(0)$ is

A 2

B 1

C -1

D -2

Answer: B

Explanation:

$$\text{We have, } f(x) = x^2 - 2x \text{ and } f(g(x)) = 4x^2 - 1$$

$$\text{Adding 1 to both the expressions, we get } f(x)+1 = x^2 - 2x + 1 = (x-1)^2$$

$$\text{Also, } f(g(x))+1 = 4x^2 \dots\dots(1)$$

$$\text{Replacing } x \text{ by } g(x) \text{ in the first expression, we get } f(g(x))+1 = (g(x)-1)^2 \dots\dots(2)$$

$$\Rightarrow \text{Equating 1 and 2, we get, } 4x^2 = (g(x)-1)^2$$

$$\text{Put } x=0, \text{ then, } 0 = g(0)-1 \Rightarrow g(0)=1$$

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Question 64

There are 200 students in a class. The number of students who do not watch Money heist is 8 more than the number of students who do not watch Game of Thrones. If the number of students who watch neither of the shows is 6 less than those who watch both, then what is the number of students who watch Money heist?

A 99

B 100

C 101

D 102

Answer: A

Explanation:

Let the number of students who watch both the shows be ' $x+6$ '

Then the number of students who watch neither of the shows will be ' x '

Let the number of students who watch only money heist be ' y '

Given,

The number of students who do not watch Money heist is 8 more than the number of students who do not watch Game of Thrones.

\Rightarrow Students who watch only game of thrones + students who watch none = 8 + Students who watch only money heist + students who

watch none

=> Students who watch only game of thrones = $y+8$

Now,

Only money heist + only game of thrones + both + none = 200

$$\Rightarrow (y) + (y + 8) + (x + 6) + x = 200$$

$$\Rightarrow x + y = 93$$

\therefore number of students who watch Money heist = Students who watch only money heist + both = $x+y+6 = 99$

Question 65

Ramesh buys some pens, pencils and erasers from stationary. If the total amount of money spent on buying pens and pencils is 300. The amount spent on buying pencils to that spent on buying erasers is 3:7. The costs of 1 pen, 1 pencil and 1 eraser are Rs 5, Rs 7 and Rs 10 respectively. Find the total number of items bought.

(If the answer cannot be determined, enter -1)

Answer:97

Explanation:

Assume the number of pens, pencils and erasers bought is x , y and z respectively.

$$\text{Then, } 5x+7y=300 \dots\dots(1)$$

$$\text{Also, } \frac{7y}{10z} = \frac{3}{7}$$

$$\Rightarrow 49y=30z \dots\dots(2)$$

The value of y should be a multiple of 30. So y can be 30, 60, 90 and so on.

From 1, the value of y cannot be 60, 90 and so on because x will become negative.

Hence, the only possible value of y is 30.

$$\Rightarrow z = 49 \dots\dots(\text{From 2})$$

On putting $y=30$ in the equation (1),

$$5x = 300 - 7 \times 30 = 90 \Rightarrow x = 18$$

The total number of items = $18+30+49 = 97$

Question 66

What is the value of the following expression?

$$(1/(2^2 - 1)) + (1/(4^2 - 1)) + (1/(6^2 - 1)) + \dots + (1/(20^2 - 1))$$

A 9/19

B 10/19

C 10/21

D 11/21

Answer: C

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Explanation:

$$(1/(2^2 - 1)) + (1/(4^2 - 1)) + (1/(6^2 - 1)) + \dots + (1/(20^2 - 1)) = 1/[(2+1) \times (2-1)] + 1/[(4+1) \times (4-1)] + \dots + 1/[(20+1) \times (20-1)]$$

$$= 1/(1 \times 3) + 1/(3 \times 5) + 1/(5 \times 7) + \dots + 1/(19 \times 21)$$

$$= 1/2 \times (1/1 - 1/3 + 1/3 - 1/5 + 1/5 - 1/7 + \dots + 1/19 - 1/21)$$

$$= 1/2 \times (1 - 1/21) = 10/21$$

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Question 67

If the domain of $\frac{x^3+3x^2-10x-24}{x^3+4x^2-11x-30} > 2$ is (x,y) what is |x+y|?

Answer:11

Explanation:

After factorising , the equation becomes

$$\frac{(x+4)(x-3)(x+2)}{(x+2)(x-3)(x+5)} > 2$$

$$\frac{x+4}{x+5} > 2$$

$$\frac{x+4}{x+5} - 2 > 0$$

$$\frac{x+4}{x+5} - \frac{2(x+5)}{x+5} > 0$$

$$\frac{-(x+6)}{x+5} > 0$$

$$\frac{(x+6)}{x+5} < 0$$

$x > -6$ and $x < -5$. Therefore the domain of x is (-5,-6)

$$|x+y|=11.$$

Question 68

For all natural numbers greater than 1, $f(n) = f(n-1)[n+1+\frac{1}{n-1}]$

It is known that $f(1) = 1$

Find the value of $n+2$ for which $f(1) + f(2) + \dots + f(n) = 362879$

Answer:10

Explanation:

Given $f(1) = 1 = 1*1!$

Lets try to find the values of $f(2), f(3), f(4)$, so that we can arrive at a pattern

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

$$= 1*4 = 4$$

$$f(3) = f(2) * [3+1+(\frac{1}{2})]$$

$$= 18$$

$$f(4) = f(3) * [4+1+(\frac{1}{3})]$$

$$= 96$$

If we try to look at the pattern of these numbers

$f(2)$ can be expressed as $2*2!$

Similarly $f(3)=3*3!, f(4)=4*4!$

So $f(n)=n*n!$

$$n*n! = (n+1-1)*n!$$

$$= (n+1)*n! - n!$$

$$= (n+1)! - n!$$

$$f(1) + f(2) + \dots + f(n)$$

$$= (2!-1!) + (3!-2!) + (4!-3!) + \dots + (n+1!-n!)$$

$$(n+1)! - 1 = 362879$$

$$(n+1)! = 362880$$

$$n=8$$

$$\therefore n=8$$

$$n+2 = 10$$

Hence 10 is the answer.

Question 69

$f(x) = \max(x^2 + 3x - 10, -x^2 - 10x - 16)$ where x is real.

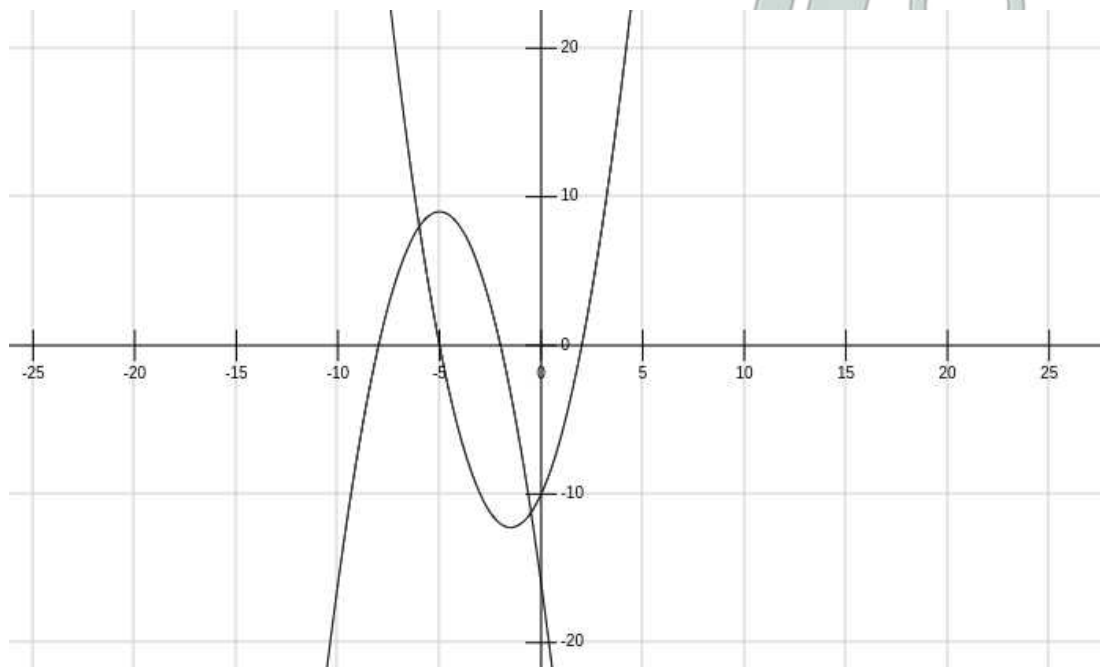
What is the least value of $f(x)$?

- A -4
- B -4
- C -24
- D -2

Answer: B

Explanation:

$$f(x) = \max(x^2 + 3x - 10, -x^2 - 10x - 16)$$



From the graph, we can see that the minimum value will occur when

$$x^2 + 3x - 10 = -x^2 - 10x - 16$$

$$\text{or, } 2x^2 + 13x + 6 = 0$$

$$\text{or, } 2x^2 + 12x + x + 6 = 0$$

$$\text{or, } 2x(x + 6) + 1(x + 6) = 0$$

$$\text{or, } (x + 6)(2x + 1) = 0$$

$$\Rightarrow x = -6 \text{ or } x = -\frac{1}{2}$$

So, there are two intersecting points, as was evident from the graph

$$\text{For } x = -6, f(x) = 8 \text{ and for } x = -\frac{1}{2}, f(x) = -\frac{45}{4}$$

We can see that for $x = -\frac{1}{2}$, $f(x)$ is minimum.

Thus, the required value is -4

Hence, option B is the correct answer.

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Question 70

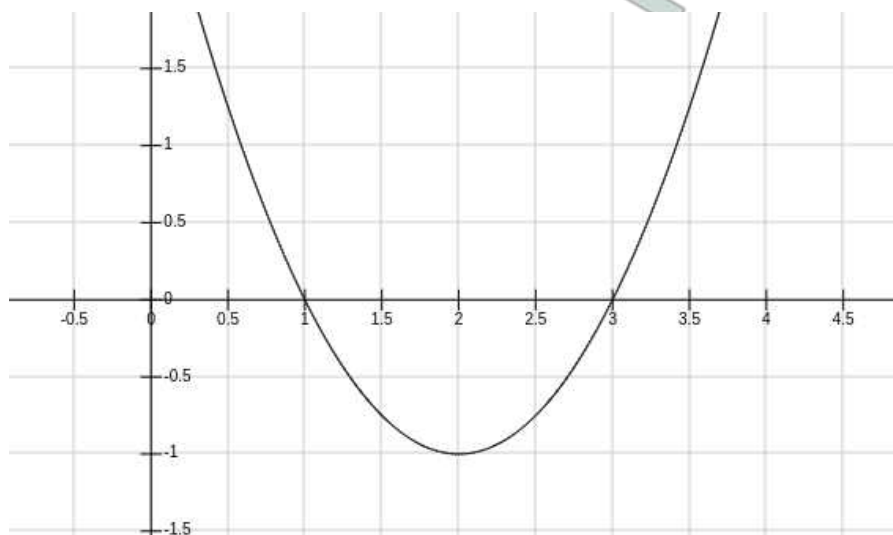
One of the roots of the equation $x^2 - (m - 2)x + 6 = 0$ lies between $(0, 2)$ and the other root lies between $(3, 4)$. It is known that m is an integer. What is the sum of all the possible values of m ?

- A 11
- B -3
- C 5
- D No such value exists

Answer: D

Explanation:

We know that the graph of a quadratic polynomial cuts x-axis at the points which are also the roots of the quadratic equation. Therefore, the value of the polynomial will be opposite in sign on the two points between which the roots lie.



In this graph, we can observe that the polynomial changes its sign at the roots.

In the given question, one of the roots lie between $(0, 2)$ and the other root lie between $(3, 4)$

Let $f(x) = x^2 - (m - 2)x + 6$

So, $f(0) > 0$(i)

So, $f(2) < 0$(ii)

So, $f(3) < 0$(iii)

So, $f(4) > 0$(iv)

We can write (i) as $6 > 0$ which is always true

We can write (ii) as

$$(14 - 2m) < 0$$

$$m > 7$$

We can write (iii) as

$$9 - 3 * (m - 2) + 6 < 0$$

$$\text{or } m > 7$$

We can write (iv) as

$$16 - 4 * (m - 2) + 6 > 0$$

or, $m < 7.5$

15

Therefore, m belongs to $(7, 2)$

Thus, no integral value of m satisfies it.

Hence, option D is the correct answer.

Question 71

What is the remainder when 123412341234..... (1234 digits) is divided by 625?

Answer: 287

Explanation:

$625 = 5^4$, so we have to check the remainder obtained when the last 4 digits are divided by 625

12341234.....123412

3412 is the last 4 digits

The remainder obtained when 3412 is divided by 625 is 287.

Hence, 287 is the correct answer.

Question 72

After distributing the sweets equally among 25 children, 8 sweets remain. Had the number of children been 28, 22 sweets would have been left after equally distributing. What is the smallest possible total number of sweets ?

- A 328
- B 348
- C 358
- D Data inadequate

Answer: C

Explanation:

Let the total number of chocolates be C

let chocolates received by each child = x

After distributing the sweets equally among 25 children, the number of chocolates left = 8

$$25x + 8 = C \quad \text{--- Eq 1}$$

Had there been 28 children, the number of chocolates that would be required = 22

$$25x + 8 - 22 \text{ should be divisible by } 28 \quad \text{--- Eq 2}$$

$$25x - 14 \text{ should be divisible by } 28$$

$$28x - (3x + 14) \text{ should be divisible by } 28$$

$$(3x + 14) \text{ should be divisible by } 28.$$

$$\Rightarrow x = 14$$

$$\text{The total number of chocolates} = 25x + 8 = 25 * 14 + 8 = 358$$

C is the correct answer.

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Question 73

Sum of two non co-prime numbers a, b and their HCF gives 77. What is the number of possible values of (a, b)?

Answer:6

Explanation:

Let the HCF be h , then the numbers can be expressed as, $a=hx, b=hy$, where x, y are co-primes.

$$h+hx+hy = 77$$

$$h(1+x+y) = 77$$

h can be 1 or 7 or 11

$h \neq 1$ (as a, b are non co-primes)

$$\text{If } h = 7, (1+x+y) = 11$$

$$x+y = 10$$

Now we have to select the values of x, y such that they are co-prime to each other.

$$x = 1, y = 9$$

$$x = 3, y = 7$$

$$x = 7, y = 3,$$

$$x = 9, y = 1$$

Hence when HCF is 7, there are 4 possible pairs of (x, y)

$$\text{If HCF} = 11, (1+x+y) = 7$$

$$x+y = 6$$

$$x = 1, y = 5$$

$$x = 5, y = 1$$

There are two possible values of (x, y) .

Total values of a and $b = 4+2=6$

Hence 6 is the correct answer.

Question 74

ABC is a three-digit number, which is 42 less than 20 times the sum of its digits. Find the sum of its digits.

Answer:15

Explanation:

ABC is a three-digit number, which is 42 less than 20 times the sum of its digits.

$$100A+10B+C=20(A+B+C)-42$$

$$80A=10B+19C-42$$

$$80A-10B=19C-42$$

$80A-10B$ ends with zero so, $19C-42$ should also end with 0 $\Rightarrow C=8$

$80A-10B=110$, The only possible values are $A=2$ and $B=5$

$$\therefore ABC = 258$$

The sum of its digits = $2+5+8=15$

Question 75

A three-digit number N has a total 6 factors. N has 3 as one of the prime factors. What can be the maximum value of N?

Answer:981

Explanation:

Assume $N = a^p b^q \dots$, where a and b are prime factors.

Then the number of factors = $(p+1)(q+1) \dots$

Here number of factors = $6 = 2 \times 3$

Case 1: $2 \times 3 = (1+1)(2+1)$ Here $p = 1$ and $q = 2$

$\Rightarrow N = a b^2$, where a, b are any distinct prime numbers.

Assuming $a=3$, The maximum 3-digit value of $3 b^2 = 3 \times 17 \times 17 = 867$

If $b = 3$, then the largest three digit value of $9a$ such that a is prime will be $9 \times 109 = 981$

Case 2: $6 = 5+1 \Rightarrow p=5$

$$N = a^5$$

Since, 3 is one of the prime factors, hence 3 is the only possible value of a .

$$\text{Hence, } N = 3^5 = 243$$

Here, the value is greater in 1st case when $b=3$
Hence the largest possible value of $N = 981$

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Question 76

For all possible integers n satisfying $2.25 \leq 2 + 2^{n+2} \leq 202$, then the number of integer values of $3 + 3^{n+1}$ is:

Answer: 7

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Explanation:

$$2.25 \leq 2 + 2^{n+2} \leq 202$$

$$2.25 - 2 \leq 2 + 2^{n+2} - 2 \leq 202 - 2$$

$$0.25 \leq 2^{n+2} \leq 200$$

$$\log_2 0.25 \leq n + 2 \leq \log_2 200$$

$$-2 \leq n + 2 \leq 7.64$$

$$-4 \leq n \leq 5.64$$

$$-4 \leq n \leq 5$$

Possible integers = -4, -3, -2, -1, 0, 1, 2, 3, 4, 5

If we see the second expression that is provided, i.e

$3 + 3^{n+1}$, it can be implied that n should be at least -1 for this expression to be an integer.

So, $n = -1, 0, 1, 2, 3, 4, 5$.

Hence, there are a total of 7 values.

Question 77

How many numbers will divide 2460 and 2640 leaving the same remainder?

A 15

B 22

C 18

D 21

Answer: C

Explanation:

Suppose a number K leaves the same remainder R when it divides 2460 and 2640.

So, $2460 - R = K \cdot p$ for some natural number p

Similarly, $2640 - R = K \cdot q$ for some natural number q

When we subtract the two equations, we get $2640 - 2460 = K(q-p)$ or $180 = K(q-p)$

Hence, all the numbers which are factors of the difference (180) between the given numbers will divide both the numbers leaving the same remainder.

So, all the factors of $(2640 - 2460) = 180$ will be such numbers.

So, we have to find the numbers of factors of 180.

$$180 = 2^2 \times 3^2 \times 5$$

$$\text{Number of factors} = (2 + 1)(2 + 1)(1 + 1) = 18$$

So, there are 18 such numbers which will divide 2460 and 2640 leaving the same remainder.

Hence, option c is the correct answer.

Question 78

Ram writes down all positive integers consecutively, starting from 1. He skips every multiple of 10 in the process. What is 3000th digit written by him?

- A 3
- B 7
- C 9
- D 1

Answer: D

Explanation:

Ram skips every 10th number hence he will skip 10, 20, ...

So one digit numbers written by Ram = 9 {From 1 to 9}

Two digit numbers written by Ram = $9 \times 9 = 81$ {From 11 to 99}

Three digit numbers written by Ram = $9 \times 10 \times 9 = 810$ {From 101 to 999}

Exhausting all 3 digit number we will start with four digit number starting from 1001

Four digit numbers from 1001 to 1099 = $9 \times 10 = 90$

Four digit numbers from 1101 to 1199 = 9

Total number of digits so far = $(1 \times 9) + (2 \times 81) + (3 \times 810) + (4 \times 99) = 2997$

3rd digit of next number will be the 3000th digit.

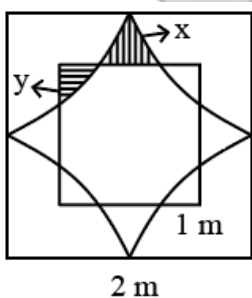
Next number written = 1111

Hence we can say that digit 1 is 3000th digit that is written by Ram. Option D is the correct answer.

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Question 79

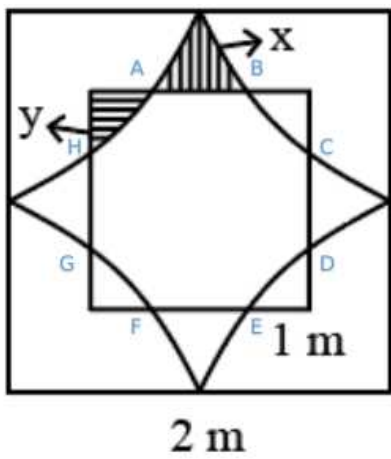
A square of length 1 m is inside a square of length 2 m and four quarter circles are joined as shown in the figure. The value of $y - x$ is given by,



- A $\frac{8-\pi}{10}$
- B $\frac{4-\pi}{5}$
- C $\frac{2\pi-1}{8}$
- D $\frac{\pi-3}{4}$

Answer: D

Explanation:



From the above figure area of the region bounded by ABCDEFGH = Area of the square with side 2 - (4 * quadrants with side 1 cm + 4x)
 $= 4 - \pi - 4x$

Which is same as the area of the square with side 1 cm - 4y

$$4 - \pi - 4x = 1 - 4y$$

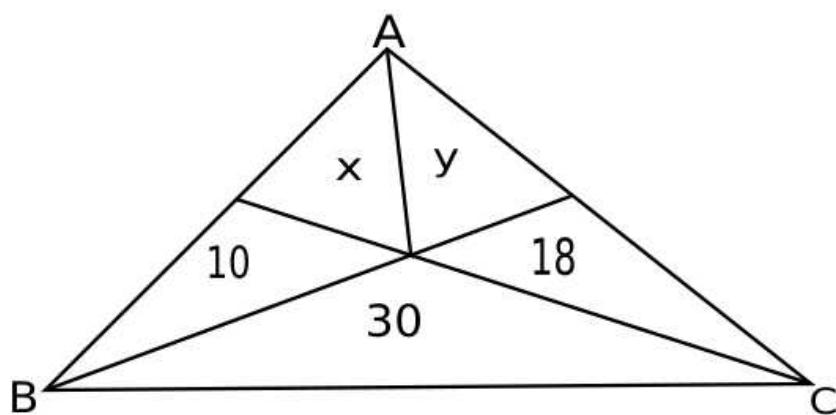
$$4x - 4y = 3 - \pi$$

$$y - x = \frac{\pi - 3}{4}$$

D is the correct answer.

Question 80

Three lines divide a triangle in 5 areas. The areas of 3 parts have been shown in the figure and two unknown areas have been represented as x and y. Find the value of $\frac{x}{y}$?



A $\frac{6}{7}$

B $\frac{5}{6}$

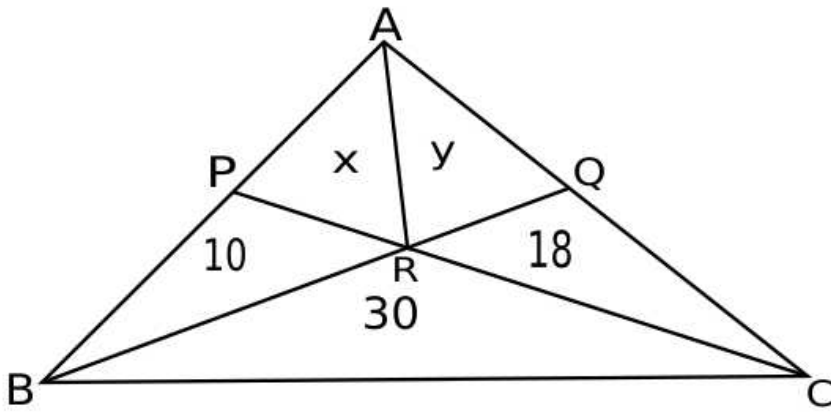
C $\frac{4}{5}$

D $\frac{7}{8}$

Answer: B

Explanation:

From figure,



In triangle ABC, BQ divides the triangle into two parts.

Since the altitude from B is same, the ratio of areas of triangles ABQ and CBQ will be the ratio of AQ and CQ.

$$\Rightarrow \frac{\text{area}(ABQ)}{\text{area}(CBQ)} = \frac{AQ}{CQ}$$

$$\Rightarrow \frac{10+x+y}{18} = \frac{AQ}{CQ} \dots(1)$$

Similarly RQ will divide the triangle ARC in the ratio of AQ and CQ.

$$\Rightarrow \frac{y}{18} = \frac{AQ}{CQ} \dots\dots(2)$$

$$\text{From 1 and 2, } \frac{y}{18} = \frac{10+x+y}{48}$$

$$\Rightarrow 30y-18x=180 \dots\dots(3)$$

Similarly, the equation for triangles ACP and BCP can be written as,

$$\frac{x}{10} = \frac{18+x+y}{40}$$

$$\Rightarrow 3x-y=18 \dots\dots(4)$$

From 3 and 4, $x=10, y=12$

$$\text{Hence, } \frac{x}{y} = \frac{5}{6}$$

Question 81

A man standing on the line joining the two poles finds that the top of the poles make an angle of elevation of 60° and 45° respectively. After walking for sometime towards the other pole, the angles change to 30° and 60° respectively. The ratio of the height of the poles is :

A $\frac{\sqrt{3}-1}{2}$

B $\frac{\sqrt{3}+1}{3}$

C $\frac{\sqrt{3}-1}{4}$

D $\frac{\sqrt{3}+1}{4}$

Answer: A

Explanation:

Let 'a' and 'b' be the heights of the two poles

X be the initial position of the man and the angles of elevation be 60° and 45°

Distance between pole 1 and X = $\frac{a}{\sqrt{3}}$ and distance between pole 2 and X = b

Let Y be the position of the man after walking sometime towards the other pole =

Distance between Y and pole 1 = $a\sqrt{3}$ and distance between the pole 2 and Y = $\frac{b}{\sqrt{3}}$

Since the distance between the poles will remain the same

$$\frac{a}{\sqrt{3}} + b = a\sqrt{3} + \frac{b}{\sqrt{3}}$$

$$\frac{a}{b} = \frac{\sqrt{3}-1}{2}$$

A is the correct answer.

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Question 82

In a quadrilateral ABCD, the length of side AD is equal to the length of side CD. If BD is joined, it is found that $\angle DAB = \angle DBA = 24^\circ$. Then the value of $\angle ACB$ (in degrees)

Answer: 66

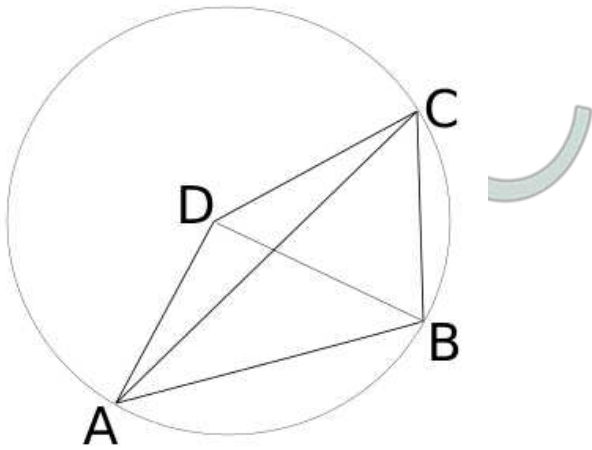
Explanation:

In triangle DAB, $\angle DAB = \angle DBA = 24^\circ$.

Hence, AD = DB

It is given that AB = CD \Rightarrow AD = CD = DB

Taking AB as radius and D as centre,



In triangle ADB, $\angle ADB = 180 - 24 - 24 = 132$

Hence, $\angle ACB = \frac{\angle ADB}{2} = \frac{132}{2} = 66$ (The angle subtended by an arc at the centre is twice the angle subtended at the circumference)

Question 83

A walking track AB is the diameter of a circular park of radius 10 m. A pole of height 6 m is standing on the circumference of the circular park and it subtends equal angles at A and B. A point R lies on the line AB and the pole subtends 30° at R. What is the distance of the point R from the center?

A $2\sqrt{2}$

B $\sqrt{12}$

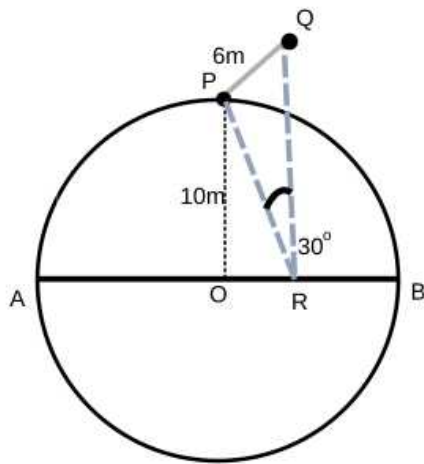
C $\sqrt{15}$

D $3\sqrt{2}$

Answer: A

Explanation:

As given that pole subtends equal angle at the ends of the diameter AB. Then it will be at perpendicular from the center as given in the figure below.



Here suppose the pole PQ subtends 30° on the point R.

Then $PQ/PR = \tan 30^\circ$

$$PR = 6\sqrt{3}$$

Using Pythagoras theorem:

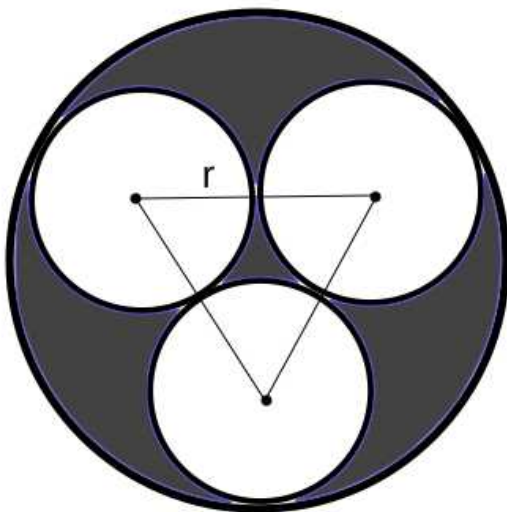
$$PR^2 = PO^2 + OR^2$$

$$36 \times 3 = 100 + X^2$$

$$OR = 2\sqrt{2}$$

Question 84

Three discs are placed on a bigger disc table, such that the smaller discs touch each other and the edges of the table. What is the area of the shaded region?



A $\frac{\pi r^2 (4\sqrt{3} - 3)}{3}$

B $\frac{\pi r^2 (4\sqrt{3} - 2)}{3}$

C $\frac{\pi r^2 (6\sqrt{3} - 2)}{3}$

D $\frac{\pi r^2 (5\sqrt{2} - 2)}{3}$

Answer: B

Explanation:

Area of the smaller discs = $3\pi r^2$

The radius of the bigger disc = $2r/\sqrt{3} + r$

Area of the bigger disc = $\frac{\pi r^2 (2 + \sqrt{3})^2}{3}$

Area of the shaded region = $\frac{\pi r^2 (2 + \sqrt{3})^2}{3} - 3\pi r^2$
 $= \frac{\pi r^2 (4\sqrt{3} - 2)}{3}$

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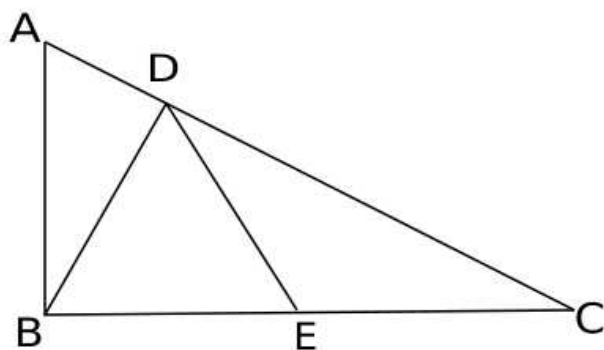
Question 85

A right triangle ABC is drawn such that angle B = 90° . D is a point on AC such that if it is connected to the midpoint E of BC, then ED = EB = EC. If AD = 2 cm and CD = 18 cm then find the length of BD.

Answer: 6

Explanation:

We have,



If ED = EB = EC, then BDC is a right triangle and angle D = 90°

In triangles ADB and BDC, $\angle DAB = \angle DBC = 90^\circ - \angle ACB$

Also, $\angle ADB = \angle BDC = 90^\circ$

Hence, both triangles are similar.

So, $\frac{AD}{BD} = \frac{BD}{CD}$

$\Rightarrow BD = \sqrt{AD \times CD} = \sqrt{2 \times 18} = 6$

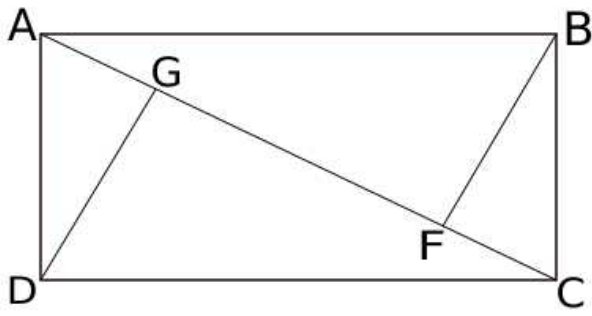
Question 86

In a rectangle, ABCD, points F and G lie on the diagonal AC such that BF and DG are perpendicular to AC. If the ratio AF: AG = 9:4 and the ratio of sides is equal to m:n, then find the value of m+n if m < n and m and n are co-primes.

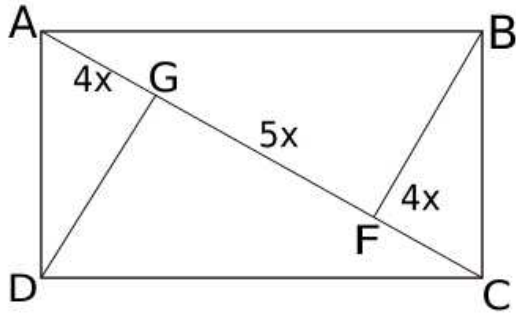
Answer: 5

Explanation:

We have,



Assuming AG as $9-5 = 4x$ and AF as $9x$ and $FC = 4x$ from symmetry.



In right triangles AFB and BFC, angle AFB = angle BFC = 90° and angle BAF = angle CBF = $90^\circ - \text{angle BCA}$. Hence, both triangles are similar.

$$\Rightarrow \frac{BF}{AF} = \frac{CF}{BF}$$

$$\Rightarrow BF^2 = AF \times CF \Rightarrow BF = \sqrt{4x \times 9x} = 6x$$

Since, angle BAC = angle CBF = $90^\circ - \text{angle BCA}$

$$\Rightarrow \tan BAC = \tan CBF$$

$$\Rightarrow \frac{BC}{AB} = \frac{FC}{BF}$$

$$\Rightarrow \frac{BC}{AB} = \frac{4x}{6x} = \frac{2}{3} = \frac{m}{n}$$

Hence, $m+n=2+3=5$

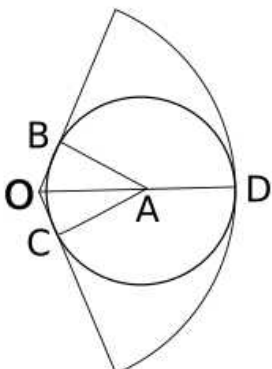
Question 87

A paper is in the shape of a sector of a circle of radius $6 + 4\sqrt{3}$ cm such that the central angle is 120° . Now a circle is drawn on this paper. What is the maximum possible radius of this circle?

- A 8
- B $2\sqrt{3}$ cm
- C $3\sqrt{3}$ cm
- D 6 cm

Answer: D

Explanation:



Using symmetry, $\angle BOA = \angle COA$

Since, $\angle BOC = 120^\circ = \angle BOA + \angle COA = 2\angle BOA$

$\Rightarrow \angle BOA = 60^\circ$

Since OB is tangent to the smaller circle, $\angle OBA = 90^\circ$

In right triangle BOA, $\angle BAO = 90 - \angle BOA = 90 - 60 = 30^\circ$

Now, $OA \cos \angle BAO = AB = r \Rightarrow \frac{OA\sqrt{3}}{2} = r$

$\Rightarrow OA = \frac{2r}{\sqrt{3}}$

Now, $OD = 6 + 4\sqrt{3} = r + \frac{2r}{\sqrt{3}}$

$\Rightarrow r = \frac{(6+4\sqrt{3})\sqrt{3}}{2+\sqrt{3}}$

$\Rightarrow r = \frac{12+6\sqrt{3}}{2+\sqrt{3}} = \frac{6(2+\sqrt{3})}{2+\sqrt{3}} = 6 \text{ cm}$

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Question 88

A semicircle with centre O is drawn inside rectangle ABCD such that the longer side BC is the diameter of the circle. Point E divides AB in the ratio 5:4. Line DE is tangent to the semicircle. If the area of the triangle DEO is 65 square units, then the area (in sq. units) of the rectangle will be

A 260

B 180

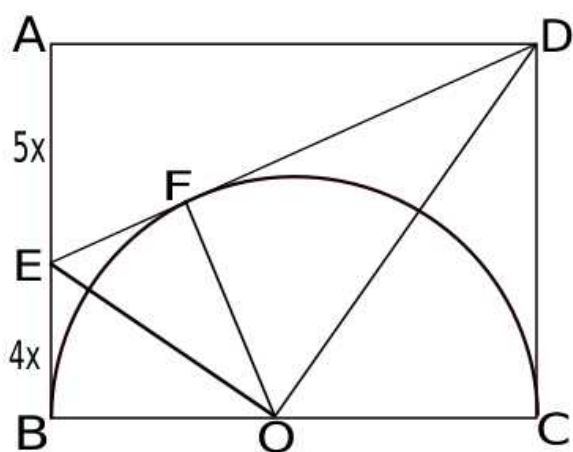
C 130

D 360

Answer: B

Explanation:

Assuming $AE=5x$ and $BE=4x$, we have,



Since, $AB=DC \Rightarrow DC = 5x+4x = 9x$

Now, $BE=EF=4x$ (Tangent from the same external point)(1)

Similarly, $DC=FD=9x$ (2)

In triangles EFO and EBO, EO is common, $BE=FE=4x$ and $BO=FO$ = radius, Hence, both triangles are congruent.

Similarly, DFO and DCO are congruent.

Hence, $\angle FOE = \angle BOE$ and $\angle DOF = \angle DOC$

Since, $\angle BOC = 180$ (angle on a straight line)

$\Rightarrow \angle FOE + \angle BOE + \angle FOD + \angle COD = 180$

$\Rightarrow 2(\angle FOE + \angle FOD) = 180$

$\Rightarrow \angle EOD = 90$

Hence, DOE is a right triangle.

Now, in triangles EFO and OFE, $\angle EFO = \angle OFE = 90^\circ$, $\angle FEO = \angle FOD = 90^\circ - \angle ODF$
Hence, the two triangles are similar.

$$\Rightarrow \frac{FE}{FO} = \frac{FO}{FD}$$

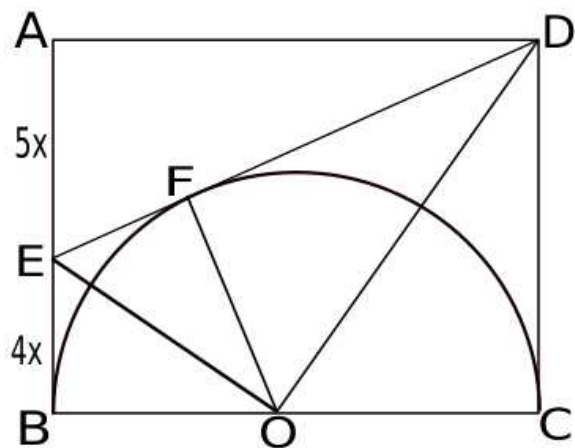
$$\Rightarrow FO = \sqrt{EF \times FD} = \sqrt{4x \times 9x} = 6x$$

$$\text{The area of triangle DEO} = \frac{1}{2} \times FO \times DE = \frac{1}{2} \times 6x \times 13x = 39x^2 = 65 \Rightarrow x^2 = \frac{5}{3}$$

$$\text{Area of the rectangle} = 9x \times 2 \times \text{radius} = 9x \times 12x = 108x^2 = 108 \times \frac{5}{3} = 180 \text{ sq. units}$$

Alternate Solution:

Assuming $AE=5x$ and $BE=4x$, we have,



Since, $AB=DC \Rightarrow DC = 5x+4x = 9x$

Now, $BE=EF=4x$ (Tangent from the same external point)(1)

Similarly, $DC=FD=9x$ (2)

$$\text{Area of the triangle DOE} = \frac{1}{2} \times FO \times DE = \frac{1}{2} \times FO \times (EF + FD) = \frac{1}{2} \times r \times 13x = 65$$

$$\Rightarrow rx = 10 \text{ (where } r = \text{radius)}$$

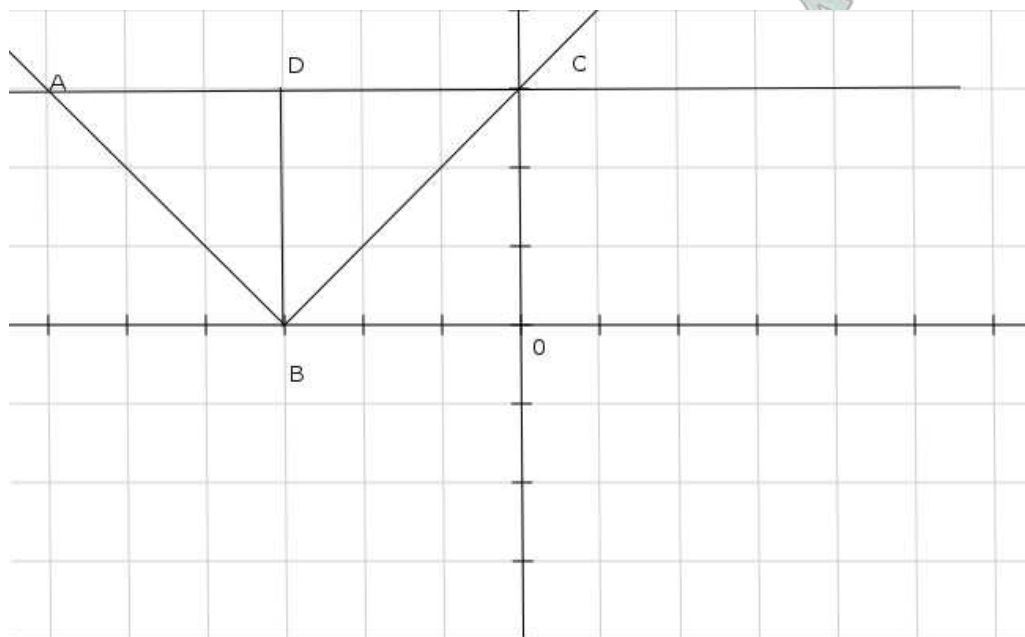
Now, area of the rectangle = $AB \times BC = 9x \times 2r = 18 \times 10 = 180$ sq units.

Question 89

For any positive number, 'p', what is the area bounded by the graph $y = |x+p|$ and $y = 6$

Answer:36

Explanation:

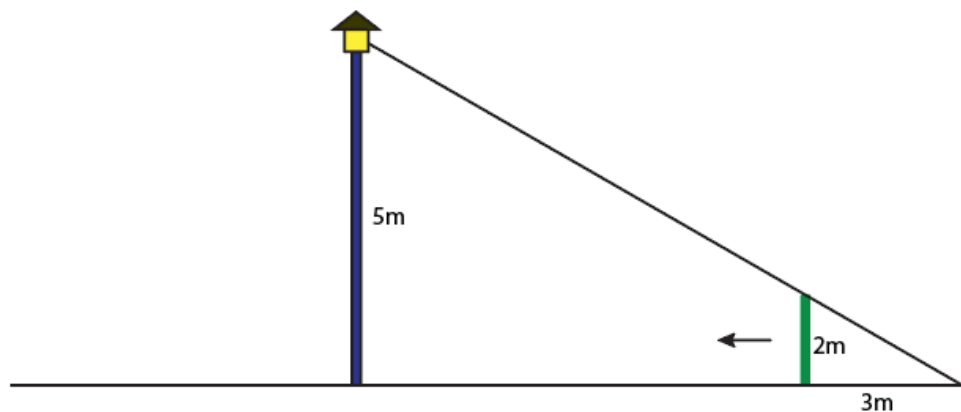


Look at the figure.

Since slope of the lines is 1
 Angle CBO = Angle DCB = 45
 BD = DC = 6
 Similarly AD = 6
 Area = $\frac{1}{2} \times 12 \times 6 = 36$

Question 90

A person of height 2m is travelling toward a lamp post of height 5m as shown below. At the given point of time, the length of the shadow of the person formed on the road is 3m. He travels x meters forward and the length of the shadow becomes 1m. Which of the following can be the value of x ?



- A 6m
- B 3m
- C 5m
- D More than one option correct.

Answer: D

Explanation:

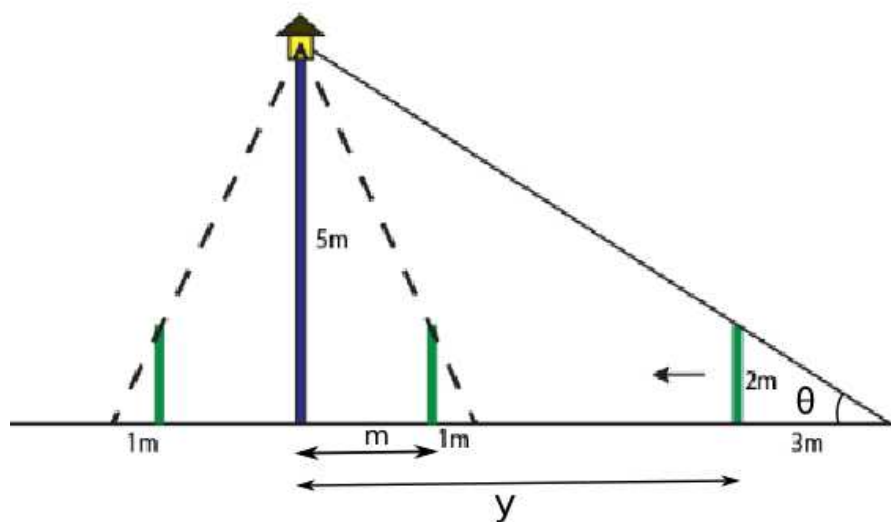
Let the distance of the pole from the person = y

$$\tan \theta = \frac{2}{3} = \frac{5}{y+3}$$

$$y = 4.5\text{m}$$

Let the person be m meters away from the pole when its shadow's length is 1m.

We will get equal shadows on both sides of the lamp.



$$\frac{2}{5}$$

$$\text{Now, } 1 = 1 + m$$

$$m = 1.5m$$

But there will be two positions where the man will form a shadow of 1m, on both the sides of the pole.

$$x = 4.5 - 1.5 = 3m \text{ or } x = 4.5 + 1.5 = 6m$$

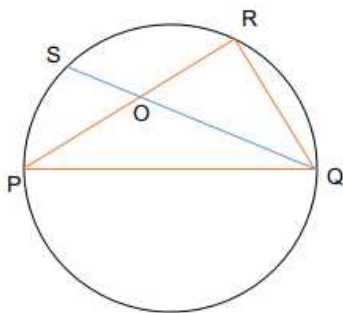
i.e x can be 3m or 6m

Option D

CAT Syllabus (Download PDF)

Question 91

In the below figure, PQ is the diameter of the circle. QS is the angular bisector such that QO: OS = 2:1. Then the measure of angle PQR is



A 30°

B 60°

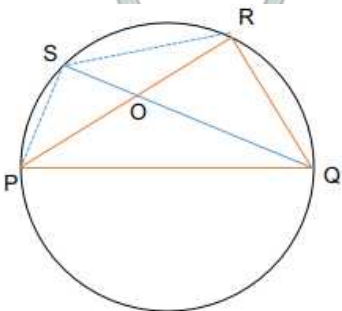
C 45°

D 75°

Answer: B

Explanation:

Join P and S.



$$\angle SQR = \angle SPR = \frac{Q}{2} \text{ [Angle on the same chord]}$$

$$\text{Let } SO = a \text{ then } QO = 2a$$

$$\text{Let } PO = b$$

$$\text{In } \triangle SOP$$

$$\sin \angle SPR = \sin \frac{Q}{2} = \frac{SO}{PO} = \frac{a}{b}$$

$$b = \frac{a}{\sin \frac{Q}{2}}$$

$$\text{In } \triangle POQ$$

$$\sin OPQ = \sin OQP$$

$$\frac{2a}{\sin OPQ} = \frac{b}{\sin \frac{Q}{2}}$$

$$\frac{2a}{\cos Q} = \frac{b}{\sin \frac{Q}{2}} \quad [\because \angle P + \angle Q = 90]$$

$$\frac{2a}{\cos Q} = \sin \frac{Q}{2}$$

$$1 - 2\sin^2 \frac{Q}{2} = \sin^2 \frac{Q}{2}$$

$$\sin^2 \frac{Q}{2} = \frac{1}{4}$$

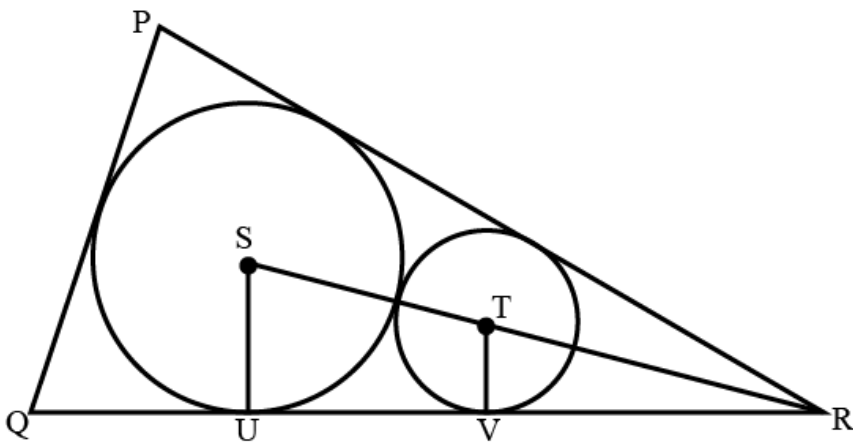
$$\frac{Q}{2} = 30$$

$$Q = 60^\circ$$

B is the correct answer.

Question 92

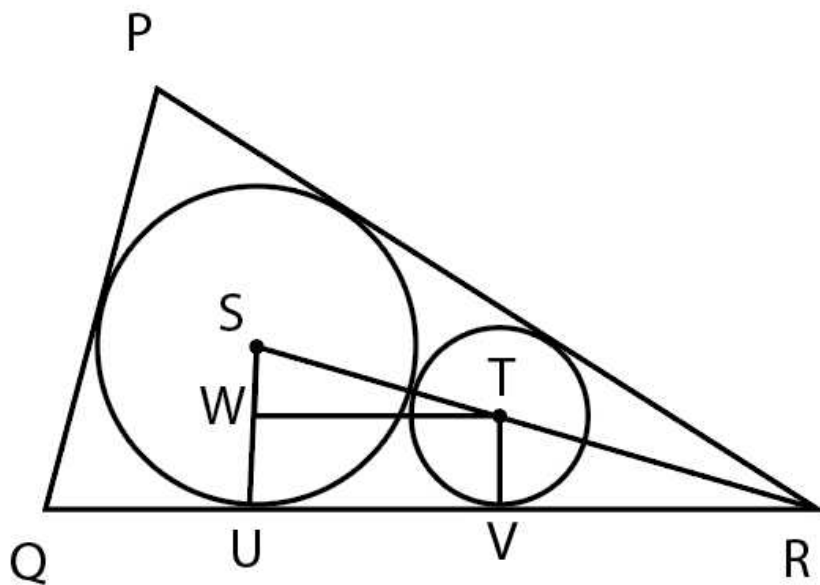
In the figure, PQR is a triangle. A circle with centre S is inscribed inside the triangle such that it touches QR at U. Another circle with centre T is drawn such that it touches sides QR (at point V), PR and the circle with center S. If the radii of the circles with centres at S and T are 8 cm and 2 cm, what is the length of UR?



- A 12cm
- B 8.66cm
- C 10.66cm
- D 9cm

Answer: C

Explanation:



US and VT are perpendicular to QR.

Thus $SW = 8 - 2 = 6\text{cm}$

$ST = R_1 + R_2 = 8 + 2 = 10\text{cm}$

The length of $WT = \sqrt{10^2 - 6^2}$

$UV = WT = 8\text{cm}$

Let $VR = a$

In triangle SUR

$$a/a+8 = 2/8$$

$$8a = 2a + 16$$

$$a = 16/6$$

$$a = 8/3$$

$$UR = 8 + 2.66 = 10.66\text{cm}$$

Option C

Question 93

The Sum $S(n)$ is defined as the sum of the digits of the number till a single-digit number is obtained, order $O(n)$ is defined as the number of times $S(n)$ is performed. The number of 3 digit numbers such that the $S(n)$ is 8 and $O(n) = 2$.

For instance, $n = 96$ $S(n) = 9+6 = 15 = 1+5 = 6$, $O(n) = 2$

A 64

B 45

C 27

D 55

Answer: A

Explanation:

Let abc be the 3 digit number.

Since the order is 2, the single-digit number is obtained after the second addition.

So 8 can be obtained if the two-digit numbers are 17, 71, 26, 62, 35, 53 and 44

The sum of the digits of the three-digit numbers should be 17, 71, 26, 62, 35, 53 and 44.

But the maximum sum of digits for a three-digit number will be $9+9+9 = 27$. So only 17 and 26 are possible.

$$a+b+c = 17, a+b+c = 26$$

Case 1: $a+b+c = 17$

$$\text{Let } a = 9-x, b = 9-y, c = 9-z$$

$$9-x+9-y+9-z = 17$$

$$x+y+z = 10$$

$$\text{Number of ways} = {}^{10+3-1}C_{3-1}$$

As a is the first digit so has to be greater than zero, therefore x cannot be equal to 10 and 9.

From this we have to remove the cases when $x = 9, 10$

When $x = 10, y = z = 0$, so 3 cases

When $x = 9, y+z=1$, 2 cases

$$\text{So the number of cases} = 66-5 = 61$$

Case 2: when $a+b+c = 26$

(998), (989), (899) --- 3 cases

The total number of ways = 64

A is the correct answer.

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Question 94

A deck of cards is shuffled, four cards are picked in random and all of them turned out to be red. What is the probability that two of the cards are kings?

A $\frac{6}{325}$

B $\frac{3}{375}$

C $\frac{9}{325}$

D $\frac{6}{375}$

Answer: A

Explanation:

A deck of cards is shuffled, four cards are picked in random and all of them turned out to be red.

The number of ways 4 red cards are selected = ${}^{26}C_4$ ways.

If two cards are Kings, then the remaining two cards can be selected in ${}^{24}C_2$ ways

$$\text{The probability that two of the cards are kings} = \frac{{}^{24}C_2}{{}^{26}C_4}$$

$$= \frac{6}{325}$$

Option A

Question 95

Rinesh and Dinesh visit a cafeteria every day between 8 PM and 9 PM. Each person spends exactly 10 minutes inside the cafe.

However, the cafe closes at 9 PM every day. Each person must leave the cafeteria at exactly 9 PM irrespective of the time they entered the cafe. What is the probability that they both meet in the cafe?

A $\frac{9}{16}$

B $\frac{25}{36}$

C $\frac{11}{36}$

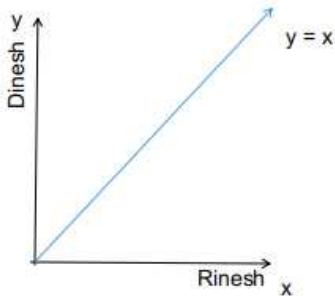
D $\frac{7}{16}$

Answer: C

Explanation:

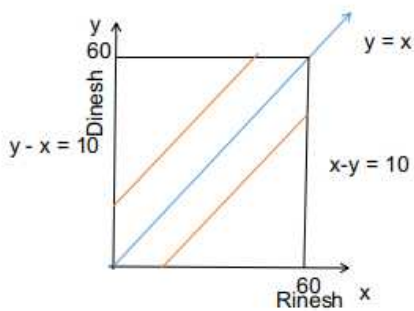
Both Rinesh and Dinesh can come in a timespan of 60 minutes.

Let us represent the time(in minutes) when Rinesh comes on x-axis and Dinesh on the y-axis.



Both of them will wait at the stop for 10 minutes.

Since both of them have to meet, the difference between their arrival time has to be less than or equal to 10 minutes.



The area between the blue and the orange coloured lines is the required region. $(|x-y| \leq 10)$

$$= 60 \times 60 - 2 \times \frac{1}{2} \times 50 \times 50 = 1100$$

$$\text{Probability that both of them would meet} = \frac{1100}{3600}$$

$$= \frac{11}{36}$$

C is the correct answer.

Question 96

12 buses were ordered for painting, the painters were asked to paint the buses in any colour among Black, Yellow and Pink such that there should be minimum one bus of each colour. What is the probability that exactly 6 buses were painted Yellow?

A $\frac{1}{11}$

B $\frac{1}{9}$

C $\frac{3}{11}$

D $\frac{7}{55}$

Answer: A

Explanation:

Let a, b and c buses are painted Black, Yellow and Pink.

$$a+b+c=12$$

There should be minimum one bus of each colour.

$$a' - 1 + b' - 1 + c' - 1 = 12$$

$$a' + b' + c' = 9$$

$$\text{Non-negative integral solution} = {}^{11}C_2 = 55$$

Exactly 6 buses were painted Yellow

$$a = 6$$

$$b + c = 6$$

$$b' + c' = 4$$

$$\text{Non-negative integral solution} = {}^5C_1 = 5$$

The probability that exactly 6 buses were painted Yellow = $\frac{5}{55}$

$$= \frac{1}{11}$$

Option A

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Question 97

In a triangle PQR, there are 4, 7, 6 points on its sides excluding the vertices P, Q, R. How many triangles can be formed using these points and the vertices P, Q, R?

- A 980
- B 1081
- C 1440
- D 890

Answer: A

Explanation:

Total number of points = Vertices P, Q, R (3) + 4 + 7 + 6 = 20

4 + 2 vertices (P, Q) are collinear on the side PQ, 9 points are collinear on side QR and 8 points are collinear on side PR.

To form a triangle 3 non-collinear points are required.

$$\text{Hence the number of triangles} = {}^{20}C_3 - ({}^6C_3 + {}^9C_3 + {}^8C_3)$$

$$= 1140 - (20 + 56 + 84)$$

$$= 980$$

A is the correct answer.

Question 98

What is the total number of ways in which Stefen can distribute 10 distinct chocolates among his 9 wives such that each wife gets at least one chocolate?

- A $11!/2$
- B $11!$
- C $90 \cdot 9!$
- D $45 \cdot 9!$

Answer: D

Explanation:

The number of ways of selecting 9 chocolates out of 10 = ${}^{10}C_9 = 10$.

The number of ways in which he can distribute 9 chocolates such that each wife gets one chocolate = $9!$

Remaining one chocolate can be distributed among any of the wives.

∴ The total number of ways = $(10 \times 9! \times 9)/2! = 45 \times 9!$

Question 99

Janaki starts walking from her school such that she takes a total of 4 steps of equal lengths. She takes each step in any one of the four directions i.e. East, West, North and South. What is the total number of ways in which Janaki will be back at her starting point (school) after completing the above-mentioned operation?

Answer: 36

Explanation:

To ensure that Janaki ends up at the same location as her starting point after taking 4 steps in each direction, we have the following:

Case 1: Take 2 steps in North and 2 steps in South direction

Total arrangements = $\frac{4!}{2! \times 2!} = 6$

Case 2: Take 2 steps in East and 2 steps in the West direction

Total arrangements = $\frac{4!}{2! \times 2!} = 6$

Case 3: Take a step in each of the four directions

Total arrangements = $4! = 24$

Total number of ways in which Janaki can reach her school after completing $6+6+24 = 36$

36 is the correct answer.

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Question 100

Three consecutive natural numbers are selected at random out of first 101 natural numbers. What is the probability that the product of these three numbers is a multiple of 9?

A $1/3$

B $2/3$

C $1/9$

D $1/2$

Answer: A

Explanation:

Three consecutive whole numbers are selected at random.

One of these numbers must be a multiple of 9.

(1,2,3) (2,3,4) (3,4,5) (4,5,6) (5,6,7) (6,7,8) (7,8,9) (8,9,10) (9,10,11)

These 9 pairs will repeat the same pattern.

(10,11,12) (11,12,13) (12,13,14) (13,14,15) (14,15,16) (15,16,17) (16,17,18) (17,18,19) (18,19,20)

.....

(91,92,93) (92,93,94) (93,94,95) (94,95,96) (95,96,97) (96,97,98) (97,98,99) (98,99,100) (99, 100,101)

Last three pairs will be a multiple of 9.

The probability that the product of these three numbers is a multiple of 9 = $3/9 = 1/3$

Option A

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