

## Prime CAT 10 2022 QA

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### Section-1

## Sec 1

### Q.1 [11831809]

If the vertices of a triangle are  $(0, 4)$ ,  $(3, 0)$  and  $(1, 19/4)$ , then what is the area of the circle passing through these three points?

1 ☐  $\frac{201\pi}{8}$

2 ☐  $\frac{213\pi}{32}$

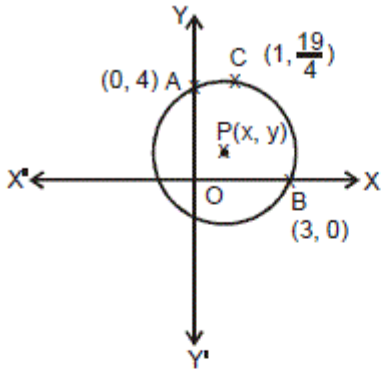
3 ☐  $\frac{53\pi}{8}$

4 ☐  $\frac{425\pi}{64}$

**Solution:**

**Correct Answer : 4**

[Answer key/Solution](#)



Let  $P(x, y)$  be the center of the circle.

$PA = PB = PC = \text{Radii}$

$$\text{Then, } PA^2 = (x-0)^2 + (y-4)^2 = x^2 + y^2 + 16 - 8y \quad \dots (i)$$

$$PB^2 = (x-3)^2 + (y-0)^2 = x^2 + 9 - 6x + y^2 \quad \dots (ii)$$

$$PC^2 = (x-1)^2 + \left(y - \frac{19}{4}\right)^2 = x^2 + 1 - 2x + y^2 + \frac{361}{16} - \frac{19}{2}y$$
$$= x^2 + y^2 - 2x - \frac{19}{2}y + \frac{377}{16} \quad \dots (iii)$$

From (i) and (ii),  
 $6x - 8y = -7 \quad \dots (iv)$

From (i) and (iii),  
 $2x + \frac{3}{2}y = \frac{121}{16} \quad \dots (v)$

Solving (iv) and (v), we get  
 $x = 2$  and  $y = 19/8$

$$\text{Therefore, radius} = PA = \sqrt{4 + \left(\frac{13}{8}\right)^2}$$

$$\text{Hence, area of the circle} = \pi \times PA^2 = \pi \left[ 4 + \left(\frac{13}{8}\right)^2 \right] = \frac{425\pi}{64} \text{ sq. units.}$$

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### Q.2 [11831809]

In a round-robin T20 cricket tournament, every team played every other team exactly once. Every team won 6 matches and lost 6 matches; there were no ties. Find the number of sets of three teams  $\{P, Q, R\}$  such that P beats Q, Q beats R and R beats P.

1 ☐ 91

2 ☐ 195

3 ☐ 81

4 ☐ 286

**Solution:**

**Correct Answer : 1**

[Answer key/Solution](#)

Since each team played 12 other teams, therefore total number of teams = 13  
Total number of sets of 3 team

$$= {}^{13}C_3 = \frac{13!}{10! \times 3!} = \frac{13 \times 12 \times 11 \times 10!}{10! \times 3!} = 286$$

All sets that do not have P beat Q, Q beat R, and R beat P have one team that beats both the other teams. Therefore, total number of such sets =  $13 \times {}^6C_2 = 13 \times 15 = 195$

Hence, required answer is  $286 - 195 = 91$ .

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### Q.3 [11831809]

Two runners Amit and Ravi start running simultaneously from point A and point B of a track and run towards B and A at a constant speed respectively. They meet at a point between two points and then reach their destination in 32 sec and 18 sec respectively. The time taken (in seconds) by Ravi to cover the entire distance between point B and point A is

**Solution:**

**Correct Answer : 42**

[Answer key/Solution](#)

Let speed of Amit and Ravi be 'a' and 'b' respectively.

Let us assume that they meet after t seconds.

Distance travelled by Amit before meeting = at and by Ravi = bt

Therefore, at = 18b ... (i)

and bt = 32a ... (ii)

Multiplying (i) and (ii),  $ab \times t^2 = 32 \times 18 \times ab$

$\Rightarrow t = 24$  sec

Hence, total time taken by Ravi =  $24 + 18 = 42$  seconds.

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### Q.4 [11831809]

If  $(a^b)^c = bac25$ , where a, b and c are all one-digit natural numbers, find the value of  $a + b + c$ .

1 ☐ 10

2 ☐ 11

3 ☐ 12

4 ☐ 13

**Solution:**

**Correct Answer : 3**

 Answer key/Solution

$$(a^b)^c = bac25$$

The powers of 5 which have five-digits are  $5^6 = 15625$  and  $5^7 = 78125$ .

Since  $a = 5$ , therefore,  $5^b = 15625$ .

Therefore,  $b = 1$  and  $c = 6$ .

So,  $a + b + c = 5 + 1 + 6 = 12$ .

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### Q.5 [11831809]

Two vessels contain two mixtures A and B. Mixture A contains ingredients X, Y and Z in the ratio of 2 : 7 : 3 respectively and mixture B contains ingredients X and Y in the ratio of 3 : 4 respectively. We have to make 189 liters of a new mixture by adding the mixtures A and B in the ratio of 4 : 5. What will be the quantity (in liters) of ingredient X in the final mixture?

1 ☐ 61

2 ☐ 93

3 ☐ 77

4 ☐ 59

**Solution:**

**Correct Answer : 4**

 Answer key/Solution

Let us start making the mixture with 4 liters of A and 5 liters of B.

In 4 liters of A, the quantities of ingredients are:

$X = 8/12$  liters

$Y = 28/12$  liters

$Z = 1$  liter

In 5 liters of B the quantities of ingredients are:

$X = 5 \times 3/7 = 15/7$  liters

$Y = 5 \times 4/7 = 20/7$  liters

Therefore, quantity of ingredient X in 9 liters of mixture will be

$= 8/12 + 15/7 = (56 + 180)/84 = 236/84$ .

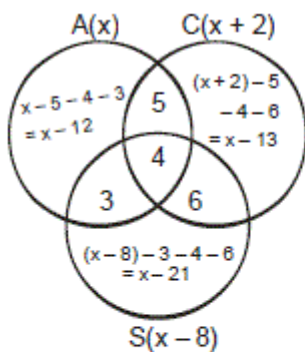
Hence, the quantity of ingredient X in 189 liters of mixture  $= 236/84 \times 189/9 = 59$  liters.

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**Q.6 [11831809]**

When Mr. John looked at the rosters for this term's classes, he saw that the roster for his Algebra class (A) had  $x$  names, the roster for his Calculus class (C) had  $x + 2$ , and the roster for his Statistics class (S) had  $x - 8$ . When he compared the rosters, he saw that A and C had 9 names in common, A and S had 7, and C and S had 10. He also saw that 4 names were on all 3 rosters. If the rosters for Mr. John's 3 classes are combined with no student's name listed more than once, then how many names in the following options can be on the combined roster?

1 ☐ 322 ☐ 423 ☐ 504 ☐ 60**Solution:****Correct Answer : 3**[Answer key/Solution](#)

Now, total number of students on all rosters combined =  $x - 12 + x - 13 + x - 21 + 5 + 3 + 4 + 6 = 3x - 28$ .

Only option (3) satisfies

$$\therefore 3x - 28 = 50$$

$$\Rightarrow x = \frac{78}{3} = 26.$$

Hence, the answer is option (3).

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**Q.7 [11831809]**

What is the number of integers that satisfy the equation  $(x^2 - 7x + 11)^{x-1} = 1$ ?

**Solution:**

**Correct Answer : 4**

 Answer key/Solution

The given equation is  $(x^2 - 7x + 11)^{x-1} = 1$ .

Case 1:  $x - 1 = 0 \Rightarrow x = 1$

$1^2 - 7 + 11 = 5$  (Acceptable)

Case 2:  $x^2 - 7x + 11 = 1$

$\Rightarrow x^2 - 7x + 10 = 0$

$\Rightarrow (x - 2)(x - 5) = 0$

So  $x = 2$  or  $x = 5$  (Acceptable)

Case 3:  $x^2 - 7x + 11 = -1$

$\Rightarrow x^2 - 7x + 12 = 0$

$\Rightarrow (x - 3)(x - 4) = 0$

So  $x = 3$  (Acceptable) or  $x = 4$  (Not acceptable)

Hence, 4 integer values satisfy the equation.

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### Q.8 [11831809]

From a class of 50 students with roll numbers 1, 2, 3, ..., 50, some students were selected for an event but the condition was that their roll numbers should be either a multiple of 3 or a multiple of 4. The average weight of all the students who were not selected was 48 kg and the average weight of all the students who were selected was 44 kg. What was the average weight (in kg) of the class?

1 ☐ 44.8

2 ☐ 47.2

3 ☐ 46.08

4 ☐ 45.6

**Solution:**

**Correct Answer : 3**

 Answer key/Solution

The total students whose number was multiple of 3 = 16

The total students whose number was multiple of 4 = 12

The total students whose number was multiple of both 3 and 4 i.e., of 12 = 4

The total students whose number was either multiple of 3 or a multiple of 4 =  $16 + 12 - 4 = 24$

It means, 24 students were selected and 26 students were not selected.

The sum of the weight of all the students =  $(48 \times 26 + 44 \times 24) = 1248 + 1056 = 2304$  kg

Hence, the average weight of all the students =  $2304/50 = 46.08$  kg.

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**Q.9 [11831809]**

On a circle of diameter 8 cm and center O, an ant starts from a point A on the circumference and moves along a chord AB of length 4 cm. Then it moves along another chord BC whose length also is 4 cm and reaches point C. If the point B lies on the minor arc AC, then what is the area (in sq. cm) of the quadrilateral OABC?

1 ☐  $4\sqrt{3}$

2 ☐ 12

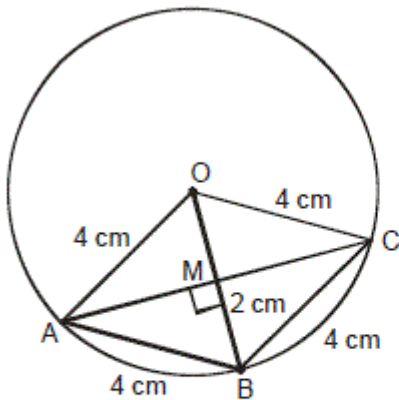
3 ☐  $8\sqrt{3}$

4 ☐ 15

**Solution:**

**Correct Answer : 3**

[Answer key/Solution](#)



$OA = OB = OC = 4$  cm

OABC is a rhombus whose one diagonal is 4 cm.

In  $\triangle AMB$ ,  $AM = \sqrt{4^2 - 2^2} = 2\sqrt{3}$  cm

So  $AC = 4\sqrt{3}$  cm

Hence, area of rhombus OABC =  $\frac{1}{2} \times 4 \times 4\sqrt{3} = 8\sqrt{3}$  sq. cm.

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**Q.10 [11831809]**

Let  $a_n$  be a sequence such that  $a_n = 2a_{n-1} - x$  for  $n \geq 2$  and a certain number  $x$ . If  $a_1 = 9$  and  $a_5 = 99$ , then how many factors does  $x + a_2 + a_3$  have?

1 ☐ 4

2 ☐ 6

3 ☐ 8

4 ☐ More than 8

**Solution:**

**Correct Answer : 2**

 Answer key/Solution

$$a_n = 2a_{n-1} - x$$

$$a_2 = 2a_1 - x$$

$$a_3 = 2a_2 - x$$

$$= 2(2a_1 - x) - x$$

$$= 2^2 a_1 - 3x$$

$$= 2^2 a_1 - (2^2 - 1)x$$

$$a_4 = 2(2^2 a_1 - 3x) - x$$

$$= 2^3 a_1 - 7x$$

$$= 2^3 a_1 - (2^3 - 1)x$$

$$a_5 = 2(2^3 a_1 - 7x) - x$$

$$= 2^4 a_1 - 15x$$

$$= 2^4 a_1 - (2^4 - 1)x$$

And so on. Substituting  $a_5$  and  $a_1$ , we get  $x = 3$ .

And, so  $a_2 = 15$  and  $a_3 = 27$ .

Therefore,  $x + a_2 + a_3 = 45$ . Which has 6 factors.

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#### Q.11 [11831809]

A shopkeeper can make a profit of 17% on the cost price by selling a washing machine for Rs. 7,020. If the cost of storage for a month is 10% of the cost price and the shopkeeper wants to earn the same initial amount as profit by selling the washing machine after a month, then what will be the new percentage profit (approximately)?

1 ☐ 14.55%

2 ☐ 15.45%

3 ☐ 13.65%

4 ☐ 17.45%



**Solution:**

**Correct Answer : 2**

 Answer key/Solution

Cost price of the washing machine =  $7020/117 \times 100 = \text{Rs.}6,000$   
Profit =  $7020 - 6000 = \text{Rs.}1,020$   
New cost price (adding storage cost) =  $6000 \times 1.1 = \text{Rs.}6,600$   
New selling price =  $6600 + 1020 = \text{Rs.}7,620$   
Hence, the required profit % =  $1020/6600 \times 100 \approx 15.45\%$ .

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**Q.12 [11831809]**

Let  $f(x + y) = f(x)f(y)$ , for all  $x, y$ . If  $f(6) = 5$ , then  $f(-6) + f(-12)$  is

1 ☐  $6/5$

2 ☐  $25$

3 ☐  $6/25$

4 ☐  $24$

**Solution:**

**Correct Answer : 3**

 Answer key/Solution

$f(x + 0) = f(x)f(0) \Rightarrow f(0) = 1$   
 $f(6 + (-6)) = f(6)f(-6) \Rightarrow f(-6) = 1/5$   
So  $f(-12) = f(-6 + (-6)) = f(-6)f(-6) = 1/5 \times 1/5 = 1/25$   
Hence,  $f(-6) + f(-12) = 1/5 + 1/25 = 6/25$ .

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**Q.13 [11831809]**

Piya and Riya start from two points A and B towards B and A respectively at 8:20 AM. The speeds of Piya and Riya are in the ratio of 4:5. They meet at point C, somewhere between A and B and then both started towards their destination at 9:27 AM. If Piya reaches B at 10:32 AM, then how much time (in minutes) did they spend together?

**Solution:**

**Correct Answer : 15**

 Answer key/Solution

The distances covered by them to meet at C are in the direct ratio of their speeds.

Therefore,  $AC:BC = 4 : 5$ .

Now, for any particular person (say Piya) the time required to cover different distances is directly proportional to the different distances. So, time taken by the person to cover AC and BC are the ratio of 4:5 (excluding the waiting time.)

Thus, the time required to cover AC is 52 minutes only since she covers BC in 65 minutes. But since she leaves C for B at 9: 27 AM i.e., 67 minutes later, when she left A. That means she must have stayed at C for  $67 - 52$  minutes = 15 minutes.

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#### **Q.14 [11831809]**

Raghu does 60% of a piece of work in 18 days. Later, with Shambhu's help, he completes the remaining work in 6 days. In how many days can Shambhu complete 70% of the work?

**Solution:**

**Correct Answer : 21**

 Answer key/Solution

Let total work = 180 units

Since Raghu does 60% of the work (i.e., 108 units) in 18 days,

Raghu does =  $108/18 = 6$  units per day

Remaining work =  $180 - 108 = 72$  units

Let Shambhu do  $x$  units of work per day.

Given that Shambhu and Raghu finish the remaining work in 6 days.

$\therefore 6(x + 6) = 72$

$\Rightarrow 6x = 72 - 36 = 36 \Rightarrow x = 6$  units

$\therefore$  Time taken by Shambhu to complete the entire work alone =  $180/6 = 30$  days

Hence, the time taken by Shambhu to complete 70% of the work = 21 days.

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#### **Q.15 [11831809]**

In triangle ABC,  $\angle B = 90^\circ$ ,  $AB = 6$  cm and  $BC = 8$  cm. If the bisector of  $\angle A$  meets BC at D, then the length (in cm) of AD is

1 ☐  $5\sqrt{3}$

2 ☐  $3\sqrt{5}$

3 ☐  $4\sqrt{3}$

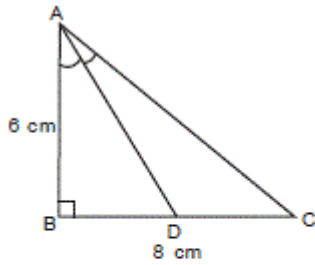
4 ☐  $6\sqrt{5}$

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**Solution:**

**Correct Answer : 2**

[Answer key/Solution](#)



$$AC = \sqrt{36 + 64} = 10 \text{ cm}$$

Since AD is bisector of  $\angle A$ .

Therefore,  $BD/DC = 6/10$

$$\Rightarrow BD = 3/5 \times (8 - BD)$$

$$\Rightarrow BD = 3 \text{ cm}$$

$$\text{Hence, } AD = \sqrt{36 + 9} = 3\sqrt{5} \text{ cm.}$$

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#### Q.16 [11831809]

What is the sum of all integral solutions of the equation  $x^{\log_3 x^2 + (\log_3 x)^2 - 10} = \frac{1}{x^2}$ ?

**Solution:**

**Correct Answer : 10**

[Answer key/Solution](#)

$$x^{\log_3 x^2 + (\log_3 x)^2 - 10} = \frac{1}{x^2}$$

Taking log of both sides with base 3 we get,

$$\log \left( x^{\log_3 x^2 + (\log_3 x)^2 - 10} \right) = \log \left( \frac{1}{x^2} \right)$$

$$\Rightarrow \log_3 x^2 + (\log_3 x)^2 - 10 = -2 \text{ or } \log_3 x = 0$$

$$\Rightarrow 2\log_3 x + (\log_3 x)^2 - 8 = 0 \text{ or } \log_3 x = 0$$

$$\Rightarrow (\log_3 x + 4)(\log_3 x - 2) = 0 \text{ or } x = 1$$

$$\text{So } x = \frac{1}{81}, 9, 1$$

Hence, the sum of all integral values of  $x = 10$ .

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#### Q.17 [11831809]

In a to-and-fro journey, the speed of the car is 25 km/h and 40 km/h respectively. If it takes 2.6 hours to complete the whole ride, what will be the total distance (in km) traveled by the car?

**Solution:**

**Correct Answer : 80**

 Answer key/Solution

Average speed between 2 points  $2UV/(U + V)$  (where U and V are the to and fro speeds)

Average speed =  $2 \times 25 \times 40/65 = 400/13$  km/h

Hence, the distance traveled by the car in 2.6 hours at  $400/13$  km/h =  $400/13 \times 13/5 = 80$  km.

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**Q.18 [11831809]**

If the equation  $2x^2 + (k + 6)x + 4kx + 8 = 0$  has equal roots, then the sum of all values of k is

1 ☐ 0

2 ☐ -1.2

3 ☐ -2.4

4 ☐ 3.2

**Solution:**

**Correct Answer : 3**

 Answer key/Solution

The equation is  $2x^2 + (k + 6)x + 4kx + 8 = 0$ .

$\Rightarrow 2x^2 + (5k + 6)x + 8 = 0$

Since roots of the equation are equal.

Therefore,  $B^2 - 4AC = 0 \Rightarrow (5k + 6)^2 - 4 \times 2 \times 8 = 0$

$\Rightarrow (5k + 6)^2 = 64 \Rightarrow (5k + 6) = \pm 8$

Therefore,  $k = 2/5$  or  $k = -14/5$

Hence, the sum of two values =  $2/5 - 14/5 = -12/5 = -2.4$ .

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**Q.19 [11831809]**

The marks scored by Bob in three subjects is equal to x, y and z such that they are in the ratio 3 : 4 : 5 and  $x + y + z = 192$ . If marks obtained by Ben in these three subjects are a, b and c respectively such that  $x = 2a - c$ ,  $y = 2x - a$ , and  $z = 2b - y$ , then find the value of  $2b - 3a + c$ .

**Solution:**

**Correct Answer : 64**

 Answer key/Solution

Let the values of  $x$ ,  $y$ , and  $z$  be  $3k$ ,  $4k$  and  $5k$  respectively.

So,  $3k + 4k + 5k = 192$  or  $k = 16$ .

Thus,  $x = 48$ .  $Y = 64$  and  $z = 80$

Given that,  $y = 2x - a$  and  $z = 2b - y$

Therefore,  $a = 32$  and  $2b = 144$ ,  $b = 72$

And,  $48 = 64 - c$ ,  $c = 16$ .

Hence,  $2b - 3a + c = 48 + 16 = 64$ .

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**Q.20 [11831809]**

If the interest compounded annually on a certain sum at a certain rate of interest for 2 years is equal to 44% of the simple interest on the same amount at the same interest rate for five years, then find the rate percentage.

1 ☐ 12%

2 ☐ 20%

3 ☐ 24%

4 ☐ 18%

**Solution:**

**Correct Answer : 2**

 Answer key/Solution

Let  $P$  be the sum and  $R$  be the rate of interest.

Let  $r = R/100$

According to the question,

$$P(1 + r)^2 - P = 0.44 \times (5Pr)$$

$$\Rightarrow P(1 + 2r + r^2 - 1) = 2.2Pr$$

$$\Rightarrow 2r + r^2 = 2.2r$$

$$\Rightarrow r = 0.2$$

$$\Rightarrow R = 20\%.$$

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**Q.21 [11831809]**

A truncated cone has horizontal bases with radii 25 cm and 4 cm. If a sphere is tangent to the top, bottom, and lateral surface of the truncated cone, then the surface area (in sq. cm) of the sphere is

1 ☐  $100\pi$

2 ☐  $400\pi$

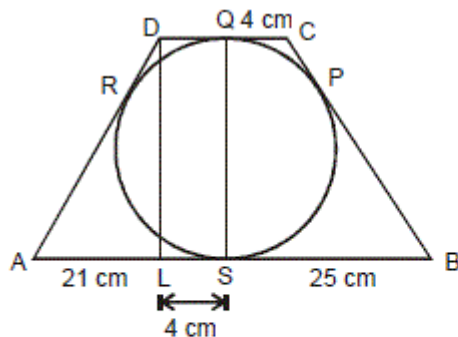
3  $\bigcirc 800\pi$

4  $\bigcirc 1600\pi$

**Solution:**

**Correct Answer : 2**

[Answer key/Solution](#)



By the two tangents theorem,  $BS = BP = 25$  cm and  $CP = CQ = 4$  cm  
 Therefore,  $AL = 25 - 4 = 21$  cm and  $AD = 25 + 4 = 29$  cm  
 So  $DL = \sqrt{29^2 - 21^2} = 20$  cm  
 So radius of the sphere =  $20/2 = 10$  cm  
 Hence, surface area of the sphere =  $4\pi \times 10 \times 10 = 400\pi$  sq. cm.

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### Q.22 [11831809]

In a chemical reaction, two compounds A and B are formed at different rates every second. When the time was  $T = 0$  seconds, the ratio of molecules of compounds A and B was 2 : 3 but when  $T = 1$  second, the ratio became 5 : 9. The rate of formation of compound B is what percentage above the rate of formation of compound A?

**Solution:**

**Correct Answer : 20**

[Answer key/Solution](#)

Let compound A be formed at the rate of  $x\%$  per second.

Let compound B be formed at the rate of  $y\%$  per second.

When  $T = 0$ , let the number of molecules of A be =  $2k$

At the same time the number of molecules of B =  $3k$

When  $T = 1$ ,  $(x\% \text{ of } 2k)/(y\% \text{ of } 3k) = 5/9$

$$\Rightarrow 2x/3y = 5/9$$

$$\Rightarrow 18x = 15y$$

$$\Rightarrow x : y = 5 : 6$$

Let compound A be formed at the rate of  $5k\%$  per second, then compound B is formed at the rate of  $6k\%$  per second

Hence, the required percentage =  $(6k - 5k)/5k \times 100 = 20\%$ .

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