

*Gather and Edited By*

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*Math Book Part 1*

*Best Of Luck*

*You Can Not Help Every one But Every  
One Can Help Someone*

**'FPSC Custom Inspectors BS16 &  
Preventive Officer BS16 Preparation  
group**

## Problems on Trains

### Formulas

#### 1. km/hr to m/s conversion:

$$a \text{ km/hr} = \left( a \times \frac{5}{18} \right) \text{ m/s.}$$

#### 2. m/s to km/hr conversion:

$$a \text{ m/s} = \left( a \times \frac{18}{5} \right) \text{ km/hr.}$$

#### 3. Formulas for finding Speed, Time and Distance

4. Time taken by a train of length  $l$  metres to pass a pole or standing man or a signal post is equal to the time taken by the train to cover  $l$  metres.
5. Time taken by a train of length  $l$  metres to pass a stationary object of length  $b$  metres is the time taken by the train to cover  $(l + b)$  metres.
6. Suppose two trains or two objects bodies are moving in the same direction at  $u$  m/s and  $v$  m/s, where  $u > v$ , then their relative speed is  $= (u - v)$  m/s.
7. Suppose two trains or two objects bodies are moving in opposite directions at  $u$  m/s and  $v$  m/s, then their relative speed is  $= (u + v)$  m/s.
8. If two trains of length  $a$  metres and  $b$  metres are moving in opposite directions at  $u$  m/s and  $v$  m/s, then:

$$\text{The time taken by the trains to cross each other} = \frac{(a + b)}{(u + v)} \text{ sec.}$$

9. If two trains of length  $a$  metres and  $b$  metres are moving in the same direction at  $u$  m/s and  $v$  m/s, then:

$$\text{The time taken by the faster train to cross the slower train} = \frac{(a + b)}{(u - v)} \text{ sec.}$$

10. If two trains (or bodies) start at the same time from points A and B towards each other and after crossing they take  $a$  and  $b$  sec in reaching B and A respectively, then:

$$(\text{A's speed}) : (\text{B's speed}) = (b : a)$$

- 1 A train running at the speed of 60 km/hr crosses a pole in 9 seconds. What is the length of the train?
- A. 120 metres      B. 180 metres  
C. 324 metres      D. 150 metres

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Speed} = \left( 60 \times \frac{5}{18} \right) \text{m/sec} = \left( \frac{50}{3} \right) \text{m/sec.}$$
$$\text{Length of the train} = (\text{Speed} \times \text{Time}) = \left( \frac{50}{3} \times 9 \right) \text{m} = 150 \text{ m.}$$

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2. A train 125 m long passes a man, running at 5 km/hr in the same direction in which the train is going, in 10 seconds. The speed of the train is:
- A. 45 km/hr      B. 50 km/hr  
C. 54 km/hr      D. 55 km/hr

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Speed of the train relative to man} = \left( \frac{125}{10} \right) \text{m/sec.}$$
$$= \left( \frac{25}{2} \right) \text{m/sec.}$$
$$= \left( \frac{25}{2} \times \frac{18}{5} \right) \text{km/hr}$$
$$= 45 \text{ km/hr.}$$

Let the speed of the train be  $x$  km/hr. Then, relative speed =  $(x - 5)$  km/hr.

$$\therefore x - 5 = 45 \quad \Rightarrow \quad x = 50 \text{ km/hr.}$$

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3. The length of the bridge, which a train 130 metres long and travelling at 45 km/hr can cross in 30 seconds, is:

- A.** 200 m                                    **B.** 225 m  
**C.** 245 m                                    **D.** 250 m

## Answer & Explanation

**Answer:** Option C

## Explanation:

$$\text{Speed} = \left( 45 \times \frac{5}{18} \right) \text{m/sec} = \left( \frac{25}{2} \right) \text{m/sec.}$$

Time = 30 sec.

Let the length of bridge be  $x$  metres.

$$\text{Then, } \frac{130 + x}{30} = \frac{25}{2}$$

$$\Rightarrow 2(130 + x) = 750$$

$$\Rightarrow x = 245 \text{ m.}$$

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4. Two trains running in opposite directions cross a man standing on the platform in 27 seconds and 17 seconds respectively and they cross each other in 23 seconds. The ratio of their speeds is:

- A.** 1 : 3      **B.** 3 : 2  
**C.** 3 : 4      **D.** None of these

## Answer & Explanation

**Answer:** Option B

### **Explanation:**

Let the speeds of the two trains be  $x$  m/sec and  $y$  m/sec respectively.

Then, length of the first train =  $27x$  metres,

and length of the second train =  $17y$  metres.

$$\therefore \frac{27x + 17y}{x+y} = 23$$

$$\Rightarrow 27x + 17y = 23x + 23y$$

$$\Rightarrow 4x = 6y$$

$$\Rightarrow \frac{x}{y} = \frac{3}{2}$$

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5. A train passes a station platform in 36 seconds and a man standing on the platform in 20 seconds. If the speed of the train is 54 km/hr, what is the length of the platform?

A. 120 m

B. 240 m

C. 300 m

D. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Speed} = \left( 54 \times \frac{5}{18} \right) \text{m/sec} = 15 \text{ m/sec.}$$

Length of the train =  $(15 \times 20)$ m = 300 m.

Let the length of the platform be  $x$  metres.

$$\text{Then, } \frac{x + 300}{36} = 15$$

$$\Rightarrow x + 300 = 540$$

$$\Rightarrow x = 240 \text{ m.}$$

6. A train 240 m long passes a pole in 24 seconds. How long will it take to pass a platform 650 m long?

A. 65 sec

B. 89 sec

C. 100 sec

D. 150 sec

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$\text{Speed} = \left( \frac{240}{24} \right) \text{m/sec} = 10 \text{ m/sec.}$$

$$\therefore \text{Required time} = \left( \frac{240 + 650}{10} \right) \text{sec} = 89 \text{ sec.}$$

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7. Two trains of equal length are running on parallel lines in the same direction at 46 km/hr and 36 km/hr. The faster train passes the slower train in 36 seconds. The length of each train is:

A. 50 m

B. 72 m

C. 80 m

D. 82 m

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

Let the length of each train be  $x$  metres.

Then, distance covered =  $2x$  metres.

Relative speed =  $(46 - 36)$  km/hr

$$\begin{aligned} &= \left( 10 \times \frac{5}{18} \right) \text{m/sec} \\ &= \left( \frac{25}{9} \right) \text{m/sec} \\ \therefore \frac{2x}{36} &= \frac{25}{9} \end{aligned}$$

$$\Rightarrow 2x = 100$$

$$\Rightarrow x = 50.$$

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8. A train 360 m long is running at a speed of 45 km/hr. In what time will it pass a bridge 140 m

long?

- A. 40 sec      B. 42 sec  
C. 45 sec      D. 48 sec

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

**Formula for converting from km/hr to m/s:**  $X \text{ km/hr} = \left( X \times \frac{5}{18} \right) \text{m/s.}$

$$\text{Therefore, Speed} = \left( 45 \times \frac{5}{18} \right) \text{m/sec.} = \frac{25}{2} \text{ m/sec.}$$

Total distance to be covered =  $(360 + 140)$  m = 500 m.

**Formula for finding Time** =  $\left( \frac{\text{Distance}}{\text{Speed}} \right)$

$$\therefore \text{Required time} = \left( \frac{500 \times 2}{25} \right) \text{sec} = 40 \text{ sec.}$$

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9. Two trains are moving in opposite directions @ 60 km/hr and 90 km/hr. Their lengths are 1.10 km and 0.9 km respectively. The time taken by the slower train to cross the faster train in seconds is:

- A. 36      B. 45  
C. 48      D. 49

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Relative speed =  $(60+ 90)$  km/hr

$$\begin{aligned} &= \left( 150 \times \frac{5}{18} \right) \text{m/sec} \\ &= \left( \frac{125}{3} \right) \text{m/sec.} \end{aligned}$$

Distance covered =  $(1.10 + 0.9)$  km = 2 km = 2000 m.

$$\text{Required time} = \left( 2000 \times \frac{3}{125} \right) \text{sec} = 48 \text{ sec.}$$

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10. A jogger running at 9 kmph alongside a railway track in 240 metres ahead of the engine of a 120 metres long train running at 45 kmph in the same direction. In how much time will the train pass the jogger?

- A.** 3.6 sec      **B.** 18 sec  
**C.** 36 sec      **D.** 72 sec

## Answer & Explanation

**Answer:** Option C

## Explanation:

Speed of train relative to jogger =  $(45 - 9)$  km/hr = 36 km/hr.

$$= \left( 36 \times \frac{5}{18} \right) \text{m/sec}$$

$$= 10 \text{ m/sec.}$$

$$\text{Distance to be covered} = (240 + 120) \text{ m} = 360 \text{ m.}$$

$$\therefore \text{Time taken} = \left( \frac{360}{10} \right) \text{sec} = 36 \text{ sec.}$$

11. A 270 metres long train running at the speed of 120 kmph crosses another train running in opposite direction at the speed of 80 kmph in 9 seconds. What is the length of the other train?

- A. 230 m
  - B. 240 m
  - C. 260 m
  - D. 320 m
  - E. None of these

## Answer & Explanation

**Answer:** Option A

## **Explanation:**

$$\text{Relative speed} = (120 + 80) \text{ km/hr}$$

$$= \left( 200 \times \frac{5}{18} \right) \text{m/sec}$$

$$= \left( \frac{500}{9} \right) \text{m/sec.}$$

Let the length of the other train be  $x$  metres.

$$\text{Then, } \frac{x + 270}{9} = \frac{500}{9}$$

$$\Rightarrow x + 270 = 500$$

$$\Rightarrow x = 230.$$

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12. A goods train runs at the speed of 72 kmph and crosses a 250 m long platform in 26 seconds. What is the length of the goods train?

A. 230 m

B. 240 m

C. 260 m

D. 270 m

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Speed} = \left( 72 \times \frac{5}{18} \right) \text{m/sec.} = 20 \text{ m/sec.}$$

Time = 26 sec.

Let the length of the train be  $x$  metres.

$$\text{Then, } \frac{x + 250}{26} = 20$$

$$\Rightarrow x + 250 = 520$$

$$\Rightarrow x = 270.$$

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13. Two trains, each 100 m long, moving in opposite directions, cross each other in 8 seconds. If one is moving twice as fast the other, then the speed of the faster train is:

A. 30 km/hr

B. 45 km/hr

C. 60 km/hr

D. 75 km/hr

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the speed of the slower train be  $x$  m/sec.

Then, speed of the faster train =  $2x$  m/sec.

Relative speed =  $(x + 2x)$  m/sec =  $3x$  m/sec.

$$\therefore \frac{(100 + 100)}{8} = 3x$$

$$\Rightarrow 24x = 200$$

$$\Rightarrow x = \frac{25}{3}.$$

So, speed of the faster train =  $\frac{50}{3}$  m/sec

$$= \left( \frac{50}{3} \times \frac{18}{5} \right) \text{km/hr}$$

$$= 60 \text{ km/hr.}$$

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14. Two trains 140 m and 160 m long run at the speed of 60 km/hr and 40 km/hr respectively in opposite directions on parallel tracks. The time (in seconds) which they take to cross each other, is:

A. 9

B. 9.6

C. 10

D. 10.8

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Relative speed =  $(60 + 40)$  km/hr =  $\left( 100 \times \frac{5}{18} \right)$  m/sec =  $\left( \frac{250}{9} \right)$  m/sec.

Distance covered in crossing each other =  $(140 + 160)$  m = 300 m.

$$\text{Required time} = \left( 300 \times \frac{9}{250} \right)_{\text{sec}} = \frac{54}{5} \text{ sec} = 10.8 \text{ sec.}$$

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15. A train 110 metres long is running with a speed of 60 kmph. In what time will it pass a man who is running at 6 kmph in the direction opposite to that in which the train is going?



## Answer & Explanation

**Answer:** Option B

## Explanation:

$$\text{Speed of train relative to man} = (60 + 6) \text{ km/hr} = 66 \text{ km/hr.}$$

$$= \left( 66 \times \frac{5}{18} \right) \text{m/sec}$$

$$= \left( \frac{55}{3} \right) \text{m/sec}$$

$$\therefore \text{Time taken to pass the man} = \left( 110 \times \frac{3}{55} \right) \text{sec} = 6 \text{ sec.}$$

16.

A train travelling at a speed of 75 mph enters a tunnel  $\frac{3}{2}$  miles long. The train is  $\frac{1}{4}$  mile long. How long does it take for the train to pass through the tunnel from the moment the front enters to the moment the rear emerges?

- A. 2.5 min B. 3 min  
C. 3.2 min D. 3.5 min

## Answer & Explanation

Answer: Option B

Explanation:

Total distance covered

$$= (7 + 1) \text{ miles}$$

$$2 \quad 4$$

$$= 15 \text{ miles.}$$

4

Therefore Time taken

$$= (15 / 4) \text{ hrs}$$

$$4 \times 75$$

$$= 1 \text{ hrs}$$

20

$$= (1 \times 60) \text{ min.}$$

20

$$= 3 \text{ min.}$$

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17.

A train 800 metres long is running at a speed of 78 km/hr. If it crosses a tunnel in 1 minute, then the length of the tunnel (in meters) is:

A. 130    B. 360

C. 500    D. 540

[Answer & Explanation](#)

Answer: Option C

Explanation:

$$\text{Speed} = \left( \frac{78 \times 5}{18} \right) \text{ m/sec.} = \left( \frac{65}{3} \right) \text{ m/sec.}$$

Time = 1 minute = 60 seconds.

Let the length of the tunnel be  $x$  metres.

$$\text{Then, } \left( \frac{800 + x}{60} \right) = 65$$

$\Rightarrow 3(800 + x) = 3900$

$$\Rightarrow x = 500.$$

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18.

A 300 metre long train crosses a platform in 39 seconds while it crosses a signal pole in 18 seconds.  
What is the length of the platform?

- A. 320 m
- B. 350 m
- C. 650 m
- D. Data inadequate

[Answer & Explanation](#)

Answer: Option B

Explanation:

$$\text{Speed} = \left( \frac{300}{18} \right) \text{ m/sec} = 50 \text{ m/sec.}$$

18      3

Let the length of the platform be  $x$  metres.

Then,  $(x + 300) = 50$

39      3

$$\Rightarrow 3(x + 300) = 1950$$

$$\Rightarrow x = 350 \text{ m.}$$

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19.

A train speeds past a pole in 15 seconds and a platform 100 m long in 25 seconds. Its length is:

A. 50 m    B. 150 m

C. 200 m    D. Data inadequate

[Answer & Explanation](#)

Answer: Option B

Explanation:

Let the length of the train be  $x$  metres and its speed by  $y$  m/sec.

Then,  $\frac{x}{y} = 15 \Rightarrow y = \frac{x}{15}$ .

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

Therefore  $x + 100 = \frac{15}{x} x$

25      15

$$\Rightarrow 15(x + 100) = 25x$$

$$\Rightarrow 15x + 1500 = 25x$$

$$\Rightarrow 1500 = 10x$$

$$\Rightarrow x = 150 \text{ m.}$$

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20.

A train moves past a telegraph post and a bridge 264 m long in 8 seconds and 20 seconds respectively.  
What is the speed of the train?

- A.     69.5 km/hr     B.     70 km/hr
- C.     79 km/hr     D.     79.2 km/hr

[Answer & Explanation](#)

Answer: Option D

Explanation:

Let the length of the train be  $x$  metres and its speed by  $y$  m/sec.

Then,  $\frac{x}{y} = 8 \Rightarrow x = 8y$

$y$

Now,  $x + 264 = y$

$$\Rightarrow 8y + 264 = 20y$$

$$\Rightarrow y = 22.$$

Therefore Speed = 22 m/sec = (      22 x      18/5      (      k

21. How many seconds will a 500 metre long train take to cross a man walking with a speed of 3 km/hr in the direction of the moving train if the speed of the train is 63 km/hr?

**A.** 25

**B.** 30

**C.** 40

**D.** 45

#### Answer & Explanation

**Answer:** Option **B**

#### Explanation:

Speed of the train relative to man =  $(63 - 3)$  km/hr

$$= 60 \text{ km/hr}$$

$$= \left( 60 \times \frac{5}{18} \right) \text{ m/sec}$$

$$= \left( \frac{50}{3} \right) \text{ m/sec.}$$

$$\therefore \text{Time taken to pass the man} = \left( 500 \times \frac{3}{50} \right) \text{ sec}$$

$$= 30 \text{ sec.}$$

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22. Two goods train each 500 m long, are running in opposite directions on parallel tracks. Their speeds are 45 km/hr and 30 km/hr respectively. Find the time taken by the slower train to pass the driver of the faster one.

**A.** 12 sec

**B.** 24 sec

**C.** 48 sec

**D.** 60 sec

### Answer & Explanation

**Answer:** Option B

#### Explanation:

Relative speed =  $= (45 + 30)$  km/hr

$$= \left( 75 \times \frac{5}{18} \right) \text{ m/sec}$$

$$= \left( \frac{125}{6} \right) \text{ m/sec.}$$

We have to find the time taken by the slower train to pass the DRIVER of the faster train and not the complete train.

So, distance covered = Length of the slower train.

Therefore, Distance covered = 500 m.

$$\therefore \text{Required time} = \left( 500 \times \frac{6}{125} \right) = 24 \text{ sec.}$$

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23. Two trains are running in opposite directions with the same speed. If the length of each train is 120 metres and they cross each other in 12 seconds, then the speed of each train (in km/hr) is:

A. 10

B. 18

C. 36

D. 72

### Answer & Explanation

**Answer:** Option C

#### Explanation:

Let the speed of each train be  $x$  m/sec.

Then, relative speed of the two trains =  $2x$  m/sec.

$$\text{So, } 2x = \frac{(120 + 120)}{12}$$

$$\Rightarrow 2x = 20$$

$$\Rightarrow x = 10.$$

∴ Speed of each train =  $10 \text{ m/sec} = \left(10 \times \frac{18}{5}\right) \text{ km/hr} = 36 \text{ km/hr.}$

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24. Two trains of equal lengths take 10 seconds and 15 seconds respectively to cross a telegraph post. If the length of each train be 120 metres, in what time (in seconds) will they cross each other travelling in opposite direction?

A. 10

B. 12

C. 15

D. 20

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Speed of the first train} = \left(\frac{120}{10}\right) \text{ m/sec} = 12 \text{ m/sec.}$$

$$\text{Speed of the second train} = \left(\frac{120}{15}\right) \text{ m/sec} = 8 \text{ m/sec.}$$

$$\text{Relative speed} = (12 + 8) = 20 \text{ m/sec.}$$

$$\therefore \text{Required time} = \left[ \frac{(120 + 120)}{20} \right] \text{ sec} = 12 \text{ sec.}$$

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25. A train 108 m long moving at a speed of 50 km/hr crosses a train 112 m long coming from opposite direction in 6 seconds. The speed of the second train is:

A. 48 km/hr

B. 54 km/hr

C. 66 km/hr

D. 82 km/hr

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let the speed of the second train be  $x$  km/hr.

Relative speed =  $(x + 50)$  km/hr

$$= \left[ (x + 50) \times \frac{5}{18} \right] \text{ m/sec}$$

$$= \left[ \frac{250 + 5x}{18} \right] \text{ m/sec.}$$

Distance covered =  $(108 + 112) = 220 \text{ m.}$

$$\therefore \frac{220}{\left( \frac{250 + 5x}{18} \right)} = 6$$

$$\Rightarrow 250 + 5x = 660$$

$$\Rightarrow x = 82 \text{ km/hr.}$$

26. Two trains are running at 40 km/hr and 20 km/hr respectively in the same direction. Fast train completely passes a man sitting in the slower train in 5 seconds. What is the length of the fast train?

A. 23 m

B.  $23\frac{2}{9} \text{ m}$

C.  $27\frac{7}{9} \text{ m}$

D. 29 m

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$$\text{Relative speed} = (40 - 20) \text{ km/hr} = \left( 20 \times \frac{5}{18} \right) \text{ m/sec} = \left( \frac{50}{9} \right) \text{ m/sec.}$$

$$\therefore \text{Length of faster train} = \left( \frac{50}{9} \times 5 \right) \text{ m} = \frac{250}{9} \text{ m} = 27\frac{7}{9} \text{ m.}$$

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27. A train overtakes two persons who are walking in the same direction in which the train is going, at the rate of 2 kmph and 4 kmph and passes them completely in 9 and 10 seconds respectively. The length of the train is:

A. 45 m

B. 50 m

C. 54 m

D. 72 m

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

$$2 \text{ kmph} = \left( 2 \times \frac{5}{18} \right) \text{ m/sec} = \frac{5}{9} \text{ m/sec.}$$
$$4 \text{ kmph} = \left( 4 \times \frac{5}{18} \right) \text{ m/sec} = \frac{10}{9} \text{ m/sec.}$$

Let the length of the train be  $x$  metres and its speed by  $y$  m/sec.

$$\text{Then, } \left( \frac{x}{y - \frac{5}{9}} \right) = 9 \text{ and } \left( \frac{x}{y - \frac{10}{9}} \right) = 10.$$

$$\therefore 9y - 5 = x \text{ and } 10(y - 10) = 9x$$

$$\Rightarrow 9y - x = 5 \text{ and } 90y - 9x = 100.$$

On solving, we get:  $x = 50$ .

$\therefore$  Length of the train is 50 m.

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28. A train overtakes two persons walking along a railway track. The first one walks at 4.5 km/hr. The other one walks at 5.4 km/hr. The train needs 8.4 and 8.5 seconds respectively to overtake them. What is the speed of the train if both the persons are walking in the same direction as the train?

A. 66 km/hr

B. 72 km/hr

C. 78 km/hr

D. 81 km/hr

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$4.5 \text{ km/hr} = \left( 4.5 \times \frac{5}{18} \right) \text{ m/sec} = \frac{5}{4} \text{ m/sec} = 1.25 \text{ m/sec, and}$$
$$5.4 \text{ km/hr} = \left( 5.4 \times \frac{5}{18} \right) \text{ m/sec} = \frac{3}{2} \text{ m/sec} = 1.5 \text{ m/sec.}$$

Let the speed of the train be  $x$  m/sec.

Then,  $(x - 1.25) \times 8.4 = (x - 1.5) \times 8.5$

$$\Rightarrow 8.4x - 10.5 = 8.5x - 12.75$$

$$\Rightarrow 0.1x = 2.25$$

$$\Rightarrow x = 22.5$$

$$\therefore \text{Speed of the train} = \left( 22.5 \times \frac{18}{5} \right) \text{ km/hr} = 81 \text{ km/hr.}$$

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29. A train travelling at 48 kmph completely crosses another train having half its length and travelling in opposite direction at 42 kmph, in 12 seconds. It also passes a railway platform in 45 seconds. The length of the platform is

A. 400 m

B. 450 m

C. 560 m

D. 600 m

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let the length of the first train be  $x$  metres.

Then, the length of the second train is  $\left(\frac{x}{2}\right)$  metres.

Relative speed =  $(48 + 42)$  kmph =  $\left( 90 \times \frac{5}{18} \right)$  m/sec = 25 m/sec.

$$\therefore \frac{[x + (x/2)]}{25} = 12 \text{ or } \frac{3x}{2} = 300 \text{ or } x = 200.$$

$\therefore$  Length of first train = 200 m.

Let the length of platform be  $y$  metres.

Speed of the first train =  $\left( 48 \times \frac{5}{18} \right)$  m/sec =  $\frac{40}{3}$  m/sec.

$$\therefore (200 + y) \times \frac{3}{40} = 45$$

$$\Rightarrow 600 + 3y = 1800$$

$$\Rightarrow y = 400 \text{ m.}$$

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- 
30. Two stations A and B are 110 km apart on a straight line. One train starts from A at 7 a.m. and travels towards B at 20 kmph. Another train starts from B at 8 a.m. and travels towards A at a speed of 25 kmph. At what time will they meet?
- A. 9 a.m.      B. 10 a.m.  
C. 10.30 a.m.      D. 11 a.m.

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Suppose they meet  $x$  hours after 7 a.m.

Distance covered by A in  $x$  hours =  $20x$  km.

Distance covered by B in  $(x - 1)$  hours =  $25(x - 1)$  km.

$$\therefore 20x + 25(x - 1) = 110$$

$$\Rightarrow 45x = 135$$

$$\Rightarrow x = 3.$$

So, they meet at 10 a.m.

## Time and Work

### Formulas

#### 1. Work from Days:

If A can do a piece of work in  $n$  days, then A's 1 day's work =  $\frac{1}{n}$ .

#### 2. Days from Work:

If A's 1 day's work =  $\frac{1}{n}$ , then A can finish the work in  $n$  days.

#### 3. Ratio:

If A is thrice as good a workman as B, then:

Ratio of work done by A and B = 3 : 1.

Ratio of times taken by A and B to finish a work = 1 : 3.

1. A can do a work in 15 days and B in 20 days. If they work on it together for 4 days, then the fraction of the work that is left is :

A.  $\frac{1}{4}$

B.  $\frac{1}{10}$

C.  $\frac{7}{15}$

D.  $\frac{8}{15}$

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$A's \text{ 1 day's work} = \frac{1}{15};$$

$$B's \text{ 1 day's work} = \frac{1}{20};$$

$$(A + B)'s \text{ 1 day's work} = \left( \frac{1}{15} + \frac{1}{20} \right) = \frac{7}{60}.$$

$$(A + B)'s \text{ 4 day's work} = \left( \frac{7}{60} \times 4 \right) = \frac{7}{15}.$$

$$\text{Therefore, Remaining work} = \left( 1 - \frac{7}{15} \right) = \frac{8}{15}.$$

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2. A can lay railway track between two given stations in 16 days and B can do the same job in 12 days. With help of C, they did the job in 4 days only. Then, C alone can do the job in:

A.  $9\frac{1}{5}$  days

B.  $9\frac{2}{5}$  days

C.  $9\frac{3}{5}$  days

D. 10

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$(A + B + C)'s \text{ 1 day's work} = \frac{1}{4},$$

$$A's \text{ 1 day's work} = \underline{1},$$

$$\text{B's 1 day's work} = \frac{1}{12}.$$

$$\therefore \text{C's 1 day's work} = \frac{1}{4} - \left( \frac{1}{16} + \frac{1}{12} \right) = \left( \frac{1}{4} - \frac{7}{48} \right) = \frac{5}{48}.$$

So, C alone can do the work in  $\frac{48}{5} = 9\frac{3}{5}$  days.

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3. A, B and C can do a piece of work in 20, 30 and 60 days respectively. In how many days can A do the work if he is assisted by B and C on every third day?

A. 12 days

B. 15 days

C. 16 days

D. 18 days

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{A's 2 day's work} = \left( \frac{1}{20} \times 2 \right) = \frac{1}{10}.$$

$$(\text{A} + \text{B} + \text{C})\text{'s 1 day's work} = \left( \frac{1}{20} + \frac{1}{30} + \frac{1}{60} \right) = \frac{6}{60} = \frac{1}{10}.$$

$$\text{Work done in 3 days} = \left( \frac{1}{10} + \frac{1}{10} \right) = \frac{1}{5}.$$

Now,  $\frac{1}{5}$  work is done in 3 days.

$\therefore$  Whole work will be done in  $(3 \times 5) = 15$  days.

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- 
4. A is thrice as good as workman as B and therefore is able to finish a job in 60 days less than B. Working together, they can do it in:

A. 20 days

B.  $22\frac{1}{2}$  days

C. 25 days

D. 30 days

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Ratio of times taken by A and B = 1 : 3.

The time difference is (3 - 1) 2 days while B takes 3 days and A takes 1 day.

If difference of time is 2 days, B takes 3 days.

If difference of time is 60 days, B takes  $\left(\frac{3}{2} \times 60\right)$  = 90 days.

So, A takes 30 days to do the work.

$$\text{A's 1 day's work} = \frac{1}{30}$$

$$\text{B's 1 day's work} = \frac{1}{90}$$

$$(\text{A} + \text{B})'s \text{ 1 day's work} = \left(\frac{1}{30} + \frac{1}{90}\right) = \frac{4}{90} = \frac{2}{45}$$

$\therefore$  A and B together can do the work in  $\frac{45}{2} = 22\frac{1}{2}$  days.

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5. A alone can do a piece of work in 6 days and B alone in 8 days. A and B undertook to do it for Rs. 3200. With the help of C, they completed the work in 3 days. How much is to be paid to C?

A. Rs. 375

B. Rs. 400

C. Rs. 600

D. Rs. 800

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

$$\text{C's 1 day's work} = \frac{1}{3} - \left(\frac{1}{6} + \frac{1}{8}\right) = \frac{1}{3} - \frac{7}{24} = \frac{1}{24}.$$

$$\text{A's wages : B's wages : C's wages} = \frac{1}{6} : \frac{1}{8} : \frac{1}{24} = 4 : 3 : 1.$$

$$\therefore \text{C's share (for 3 days)} = \text{Rs.} \left(3 \times \frac{1}{24} \times 3200\right) = \text{Rs.} 400.$$

6. If 6 men and 8 boys can do a piece of work in 10 days while 26 men and 48 boys can do the same in 2 days, the time taken by 15 men and 20 boys in doing the same type of work will be:

A. 4 days

B. 5 days

C. 6 days

D. 7 days

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

Let 1 man's 1 day's work =  $x$  and 1 boy's 1 day's work =  $y$ .

$$\text{Then, } 6x + 8y = \frac{1}{10} \text{ and } 26x + 48y = \frac{1}{2}.$$

$$\text{Solving these two equations, we get : } x = \frac{1}{100} \text{ and } y = \frac{1}{200}.$$

$$(15 \text{ men} + 20 \text{ boy})\text{'s 1 day's work} = \left( \frac{15}{100} + \frac{20}{200} \right) = \frac{1}{4}.$$

$\therefore$  15 men and 20 boys can do the work in 4 days.

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7. A can do a piece of work in 4 hours; B and C together can do it in 3 hours, while A and C together can do it in 2 hours. How long will B alone take to do it?

A. 8 hours

B. 10 hours

C. 12 hours

D. 24 hours

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$A\text{'s 1 hour's work} = \frac{1}{4};$$

$$(B + C)\text{'s 1 hour's work} = \frac{1}{3};$$

$$(A + C)\text{'s 1 hour's work} = \frac{1}{2}.$$

$$(A + B + C)\text{'s 1 hour's work} = \left( \frac{1}{4} + \frac{1}{3} \right) = \frac{7}{12}.$$

$$B\text{'s 1 hour's work} = \left( \frac{7}{12} - \frac{1}{2} \right) = \frac{1}{12}.$$

$\therefore$  B alone will take 12 hours to do the work.

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8. A can do a certain work in the same time in which B and C together can do it. If A and B together could do it in 10 days and C alone in 50 days, then B alone could do it in:

- A. 15 days      B. 20 days  
 C. 25 days      D. 30 days

#### **Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$(A + B)'s \text{ 1 day's work} = \frac{1}{10}$$

$$C's \text{ 1 day's work} = \frac{1}{50}$$

$$(A + B + C)'s \text{ 1 day's work} = \left( \frac{1}{10} + \frac{1}{50} \right) = \frac{6}{50} = \frac{3}{25}. \dots \text{ (i)}$$

$$A's \text{ 1 day's work} = (B + C)'s \text{ 1 day's work} \dots \text{ (ii)}$$

$$\text{From (i) and (ii), we get: } 2 \times (A's \text{ 1 day's work}) = \frac{3}{25}$$

$$\Rightarrow A's \text{ 1 day's work} = \frac{3}{50}.$$

$$\therefore B's \text{ 1 day's work} = \left( \frac{1}{10} - \frac{3}{50} \right) = \frac{2}{50} = \frac{1}{25}.$$

So, B alone could do the work in 25 days.

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9. A does 80% of a work in 20 days. He then calls in B and they together finish the remaining work in 3 days. How long B alone would take to do the whole work?

- A. 23 days      B. 37 days  
 C.  $37\frac{1}{2}$       D. 40 days

#### **Answer & Explanation**

**Answer:** Option C

**Explanation:**

Whole work is done by A in  $\left( 20 \times \frac{5}{4} \right) = 25$  days.

Now,  $\left( 1 - \frac{4}{5} \right)$  i.e.,  $\frac{1}{5}$  work is done by A and B in 3 days.

Whole work will be done by A and B in  $(3 \times 5) = 15$  days.

$$\text{A's 1 day's work} = \frac{1}{25}, (\text{A} + \text{B})\text{'s 1 day's work} = \frac{1}{15}.$$

$$\therefore \text{B's 1 day's work} = \left( \frac{1}{15} - \frac{1}{25} \right) = \frac{4}{150} = \frac{2}{75}.$$

$$\text{So, B alone would do the work in } \frac{75}{2} = 37\frac{1}{2} \text{ days.}$$

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10. A machine P can print one lakh books in 8 hours, machine Q can print the same number of books in 10 hours while machine R can print them in 12 hours. All the machines are started at 9 A.M. while machine P is closed at 11 A.M. and the remaining two machines complete work. Approximately at what time will the work (to print one lakh books) be finished ?

A. 11:30 A.M.

B. 12 noon

C. 12:30 P.M.

D. 1:00 P.M.

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

$$(\text{P} + \text{Q} + \text{R})\text{'s 1 hour's work} = \left( \frac{1}{8} + \frac{1}{10} + \frac{1}{12} \right) = \frac{37}{120}.$$

$$\text{Work done by P, Q and R in 2 hours} = \left( \frac{37}{120} \times 2 \right) = \frac{37}{60}.$$

$$\text{Remaining work} = \left( 1 - \frac{37}{60} \right) = \frac{23}{60}.$$

$$(\text{Q} + \text{R})\text{'s 1 hour's work} = \left( \frac{1}{10} + \frac{1}{12} \right) = \frac{11}{60}.$$

Now,  $\frac{11}{60}$  work is done by Q and R in 1 hour.

So,  $\frac{23}{60}$  work will be done by Q and R in  $\left( \frac{60}{11} \times \frac{23}{60} \right) = \frac{23}{11}$  hours  $\approx$  2 hours.

So, the work will be finished approximately 2 hours after 11 A.M., i.e., around 1 P.M

11. A can finish a work in 18 days and B can do the same work in 15 days. B worked for 10 days and left the job. In how many days, A alone can finish the remaining work?

A. 5

B.  $5\frac{1}{2}$

C. 6

D. 8

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\text{B's 10 day's work} = \left( \frac{1}{15} \times 10 \right) = \frac{2}{3}$$

$$\text{Remaining work} = \left( 1 - \frac{2}{3} \right) = \frac{1}{3}$$

Now,  $\frac{1}{18}$  work is done by A in 1 day.

$$\therefore \frac{1}{3} \text{ work is done by A in } \left( 18 \times \frac{1}{3} \right) = 6 \text{ days.}$$

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12. 4 men and 6 women can complete a work in 8 days, while 3 men and 7 women can complete it in 10 days. In how many days will 10 women complete it?

A. 35

B. 40

C. 45

D. 50

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let 1 man's 1 day's work =  $x$  and 1 woman's 1 day's work =  $y$ .

$$\text{Then, } 4x + 6y = \frac{1}{8} \text{ and } 3x + 7y = \frac{1}{10}.$$

$$\text{Solving the two equations, we get: } x = \frac{11}{400}, y = \frac{1}{400}$$

$$\therefore 1 \text{ woman's 1 day's work} = \frac{1}{400}.$$

$$\Rightarrow 10 \text{ women's 1 day's work} = \left( \frac{1}{400} \times 10 \right) = \frac{1}{40}.$$

Hence, 10 women will complete the work in 40 days.

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13. A and B can together finish a work 30 days. They worked together for 20 days and then B left. After another 20 days, A finished the remaining work. In how many days A alone can finish the work?

A. 40

B. 50

C. 54

D. 60

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

$$(A + B)'s \text{ 20 day's work} = \left( \frac{1}{30} \times 20 \right) = \frac{2}{3}.$$

$$\text{Remaining work} = \left( 1 - \frac{2}{3} \right) = \frac{1}{3}.$$

Now,  $\frac{1}{3}$  work is done by A in 20 days.

Therefore, the whole work will be done by A in  $(20 \times 3) = 60$  days.

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14. P can complete a work in 12 days working 8 hours a day. Q can complete the same work in 8 days working 10 hours a day. If both P and Q work together, working 8 hours a day, in how many days can they complete the work?

A.  $5\frac{5}{11}$

B.  $5\frac{6}{11}$

C.  $6\frac{5}{11}$

D.  $6\frac{6}{11}$

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

P can complete the work in  $(12 \times 8)$  hrs. = 96 hrs.

Q can complete the work in  $(8 \times 10)$  hrs. = 80 hrs.

$\therefore$  P's 1 hour's work =  $\frac{1}{96}$  and Q's 1 hour's work =  $\frac{1}{80}$ .

$$(P + Q)'s \text{ 1 hour's work} = \left( \frac{1}{96} + \frac{1}{80} \right) = \frac{11}{480}.$$

So, both P and Q will finish the work in  $\left( \frac{480}{11} \right)$  hrs.

$$\therefore \text{Number of days of 8 hours each} = \left( \frac{480}{11} \times \frac{1}{8} \right) = \frac{60}{11} \text{ days} = 5\frac{5}{11} \text{ days.}$$

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- 
15. 10 women can complete a work in 7 days and 10 children take 14 days to complete the work. How many days will 5 women and 10 children take to complete the work?

A. 3

B. 5

C. 7

D. Cannot be determined

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$1 \text{ woman's 1 day's work} = \frac{1}{70}$$

$$1 \text{ child's 1 day's work} = \frac{1}{140}$$

$$(5 \text{ women} + 10 \text{ children})'s \text{ day's work} = \left( \frac{5}{70} + \frac{10}{140} \right) = \left( \frac{1}{14} + \frac{1}{14} \right) = \frac{1}{7}$$

$\therefore$  5 women and 10 children will complete the work in 7 days.

16. X and Y can do a piece of work in 20 days and 12 days respectively. X started the work alone and then after 4 days Y joined him till the completion of the work. How long did the work last?

A. 6 days

B. 10 days

C. 15 days

D. 20 days

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Work done by X in 4 days} = \left( \frac{1}{20} \times 4 \right) = \frac{1}{5}.$$

$$\text{Remaining work} = \left( 1 - \frac{1}{5} \right) = \frac{4}{5}.$$

$$(X + Y)'s \text{ 1 day's work} = \left( \frac{1}{20} + \frac{1}{12} \right) = \frac{8}{60} = \frac{2}{15}.$$

Now,  $\frac{2}{15}$  work is done by X and Y in 1 day.

So,  $\frac{4}{5}$  work will be done by X and Y in  $\left( \frac{15}{2} \times \frac{4}{5} \right) = 6$  days.

Hence, total time taken =  $(6 + 4)$  days = 10 days.

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17. A is 30% more efficient than B. How much time will they, working together, take to complete a job which A alone could have done in 23 days?

- A. 11 days      B. 13 days  
C.  $20\frac{3}{17}$  days      D. None of these

## Answer & Explanation

**Answer:** Option B

## Explanation:

$$\text{Ratio of times taken by A and B} = 100 : 130 = 10 : 13.$$

Suppose B takes  $x$  days to do the work.

$$\text{Then, } 10 : 13 :: 23 : x \Rightarrow x = \left( \frac{23 \times 13}{10} \right) \Rightarrow x = \frac{299}{10}.$$

$$\text{A's 1 day's work} = \frac{1}{23};$$

$$B's \text{ 1 day's work} = \frac{10}{299} .$$

$$(A + B)'s \text{ 1 day's work} = \left( \frac{1}{23} + \frac{10}{299} \right) = \frac{23}{299} = \frac{1}{13}.$$

Therefore, A and B together can complete the work in 13 days.

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18. Ravi and Kumar are working on an assignment. Ravi takes 6 hours to type 32 pages on a computer, while Kumar takes 5 hours to type 40 pages. How much time will they take, working together on two different computers to type an assignment of 110 pages?

- A. 7 hours 30 minutes      B. 8 hours  
  
C. 8 hours 15 minutes      D. 8 hours 25 minutes

## Answer & Explanation

**Answer:** Option C

**Explanation:**

$$\text{Number of pages typed by Ravi in 1 hour} = \frac{32}{6} = \frac{16}{3}.$$

$$\text{Number of pages typed by Kumar in 1 hour} = \frac{40}{5} = 8.$$

$$\text{Number of pages typed by both in 1 hour} = \left( \frac{16}{3} + 8 \right) = \frac{40}{3}.$$

$$\therefore \text{Time taken by both to type 110 pages} = \left( 110 \times \frac{3}{40} \right) \text{ hours}$$

$$= 8\frac{1}{4} \text{ hours (or) 8 hours 15 minutes.}$$

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19. A, B and C can complete a piece of work in 24, 6 and 12 days respectively. Working together, they will complete the same work in:

A.  $\frac{1}{24}$  day

B.  $\frac{7}{24}$  day

C.  $3\frac{3}{7}$  days

D. 4 days

**Answer & Explanation****Answer:** Option C**Explanation:**

**Formula:** If A can do a piece of work in  $n$  days, then A's 1 day's work =  $\frac{1}{n}$ .

$$(A + B + C)'s 1 day's work = \left( \frac{1}{24} + \frac{1}{6} + \frac{1}{12} \right) = \frac{7}{24}.$$

**Formula:** If A's 1 day's work =  $\frac{1}{n}$ , then A can finish the work in  $n$  days.

$$\text{So, all the three together will complete the job in } \left( \frac{24}{7} \right) \text{ days} = 3\frac{3}{7} \text{ days.}$$

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20. Sakshi can do a piece of work in 20 days. Tanya is 25% more efficient than Sakshi. The number of days taken by Tanya to do the same piece of work is:

A. 15

B. 16

C. 18

D. 25

**Answer & Explanation****Answer:** Option B

**Explanation:**

Ratio of times taken by Sakshi and Tanya = 125 : 100 = 5 : 4.

Suppose Tanya takes  $x$  days to do the work.

$$5 : 4 :: 20 : x \Rightarrow x = \left( \frac{4 \times 20}{5} \right)$$

$$\Rightarrow x = 16 \text{ days.}$$

Hence, Tanya takes 16 days to complete the work

21. A takes twice as much time as B or thrice as much time as C to finish a piece of work. Working together, they can finish the work in 2 days. B can do the work alone in:

A. 4 days

B. 6 days

C. 8 days

D. 12 days

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Suppose A, B and C take  $x$ ,  $\frac{x}{2}$  and  $\frac{x}{3}$  days respectively to finish the work.

$$\text{Then, } \left( \frac{1}{x} + \frac{2}{x} + \frac{3}{x} \right) = \frac{1}{2}$$

$$\Rightarrow \frac{6}{x} = \frac{1}{2}$$

$$\Rightarrow x = 12.$$

So, B takes  $(12/2) = 6$  days to finish the work.

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22. A and B can complete a work in 15 days and 10 days respectively. They started doing the work together but after 2 days B had to leave and A alone completed the remaining work. The whole work was completed in :

A. 8 days

B. 10 days

C. 12 days

D. 15 days

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$(A + B)'s \text{ 1 day's work} = \left( \frac{1}{15} + \frac{1}{10} \right) = \frac{1}{6}.$$

$$\text{Work done by A and B in 2 days} = \left( \frac{1}{6} \times 2 \right) = \frac{1}{3}.$$

$$\text{Remaining work} = \left( 1 - \frac{1}{3} \right) = \frac{2}{3}.$$

Now,  $\frac{1}{15}$  work is done by A in 1 day.

$$\therefore \frac{2}{3} \text{ work will be done by A in } \left( 15 \times \frac{2}{3} \right) = 10 \text{ days.}$$

Hence, the total time taken =  $(10 + 2) = 12$  days.

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23. A and B can do a piece of work in 30 days, while B and C can do the same work in 24 days and C and A in 20 days. They all work together for 10 days when B and C leave. How many days more will A take to finish the work?

A. 18 days

B. 24 days

C. 30 days

D. 36 days

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$2(A + B + C)'s \text{ 1 day's work} = \left( \frac{1}{30} + \frac{1}{24} + \frac{1}{20} \right) = \frac{15}{120} = \frac{1}{8}.$$

$$\text{Therefore, } (A + B + C)'s \text{ 1 day's work} = \frac{1}{2 \times 8} = \frac{1}{16}.$$

$$\text{Work done by A, B, C in 10 days} = \frac{10}{16} = \frac{5}{8}.$$

$$\text{Remaining work} = \left( 1 - \frac{5}{8} \right) = \frac{3}{8}.$$

$$A's \text{ 1 day's work} = \left( \frac{1}{16} - \frac{1}{24} \right) = \frac{1}{48}.$$

Now,  $\frac{1}{48}$  work is done by A in 1 day.

$$\text{So, } \frac{3}{8} \text{ work will be done by A in } \left( 48 \times \frac{3}{8} \right) = 18 \text{ days.}$$

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24. A works twice as fast as B. If B can complete a work in 12 days independently, the number of days in which A and B can together finish the work in :

A. 4 days      B. 6 days  
C. 8 days      D. 18 days

## Answer & Explanation

**Answer:** Option A

## Explanation:

Ratio of rates of working of A and B = 2 : 1.

So, ratio of times taken = 1 : 2.

$$\begin{aligned} \text{B's 1 day's work} &= \frac{1}{12} \\ \therefore \text{A's 1 day's work} &= \frac{1}{6}; \text{(2 times of B's work)} \\ (\text{A} + \text{B})' \text{s 1 day's work} &= \left( \frac{1}{6} + \frac{1}{12} \right) = \frac{3}{12} = \frac{1}{4}. \end{aligned}$$

So, A and B together can finish the work in 4 days.

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25. Twenty women can do a work in sixteen days. Sixteen men can complete the same work in fifteen days. What is the ratio between the capacity of a man and a woman?



## Answer & Explanation

**Answer:** Option B

## Explanation:

(20 x 16) women can complete the work in 1 day.

$$\therefore 1 \text{ woman's 1 day's work} = \frac{1}{320}.$$

$(16 \times 15)$  men can complete the work in 1 day.

$$\therefore 1 \text{ man's 1 day's work} = \frac{1}{240}$$

$$\text{So, required ratio} = \frac{1}{240} : \frac{1}{320}$$

$$= \frac{1}{3} : \frac{1}{4}$$

$$= 4 : 3 \text{ (cross multiplied)}$$

26. A and B can do a work in 8 days, B and C can do the same work in 12 days. A, B and C together can finish it in 6 days. A and C together will do it in :

A. 4 days

B. 6 days

C. 8 days

D. 12 days

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$$(A + B + C) \text{'s 1 day's work} = \frac{1}{6};$$

$$(A + B) \text{'s 1 day's work} = \frac{1}{8};$$

$$(B + C) \text{'s 1 day's work} = \frac{1}{12}.$$

$$\therefore (A + C) \text{'s 1 day's work} = \left(2 \times \frac{1}{6}\right) - \left(\frac{1}{8} + \frac{1}{12}\right)$$

$$= \left(\frac{1}{3} - \frac{5}{24}\right)$$

$$= \frac{3}{24}$$

$$= \frac{1}{8}.$$

So, A and C together will do the work in 8 days.

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27. A can finish a work in 24 days, B in 9 days and C in 12 days. B and C start the work but are forced to leave after 3 days. The remaining work was done by A in:

A. 5 days

B. 6 days

C. 10 days

D.  $10\frac{1}{2}$  days

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$(B + C)'s \text{ 1 day's work} = \left( \frac{1}{9} + \frac{1}{12} \right) = \frac{7}{36}.$$

$$\text{Work done by B and C in 3 days} = \left( \frac{7}{36} \times 3 \right) = \frac{7}{12}.$$

$$\text{Remaining work} = \left( 1 - \frac{7}{12} \right) = \frac{5}{12}.$$

Now,  $\frac{1}{24}$  work is done by A in 1 day.

So,  $\frac{5}{12}$  work is done by A in  $\left( 24 \times \frac{5}{12} \right) = 10$  days.

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28. X can do a piece of work in 40 days. He works at it for 8 days and then Y finished it in 16 days. How long will they together take to complete the work?

A.  $13\frac{1}{3}$  days

B. 15 days

C. 20 days

D. 26 days

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$\text{Work done by X in 8 days} = \left( \frac{1}{40} \times 8 \right) = \frac{1}{5}.$$

$$\text{Remaining work} = \left( 1 - \frac{1}{5} \right) = \frac{4}{5}.$$

Now,  $\frac{4}{5}$  work is done by Y in 16 days.

Whole work will be done by Y in  $\left( 16 \times \frac{5}{4} \right) = 20$  days.

$\therefore X$ 's 1 day's work = 1,  $Y$ 's 1 day's work = 1.

$$(X + Y) \text{'s 1 day's work} = \left( \frac{1}{40} + \frac{1}{20} \right) = \frac{3}{40}$$

Hence, X and Y will together complete the work in  $\left( \frac{40}{3} \right) = 13\frac{1}{3}$  days.

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29. A and B can do a job together in 7 days. A is  $1\frac{3}{4}$  times as efficient as B. The same job can be done by A alone in :

- A.  $9\frac{1}{3}$  days      B. 11 days  
 C.  $12\frac{1}{4}$  days      D.  $16\frac{1}{3}$  days

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$(\text{A's 1 day's work}) : (\text{B's 1 day's work}) = \frac{7}{4} : 1 = 7 : 4.$$

Let A's and B's 1 day's work be  $7x$  and  $4x$  respectively.

$$\text{Then, } 7x + 4x = \frac{1}{7} \Rightarrow 11x = \frac{1}{7} \Rightarrow x = \frac{1}{77}.$$

$$\therefore \text{A's 1 day's work} = \left( \frac{1}{77} \times 7 \right) = \frac{1}{11}.$$

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30. A and B together can do a piece of work in 30 days. A having worked for 16 days, B finishes the remaining work alone in 44 days. In how many days shall B finish the whole work alone?

- A. 30 days      B. 40 days  
 C. 60 days      D. 70 days

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Let A's 1 day's work =  $x$  and B's 1 day's work =  $y$ .

Then,  $x + y = \underline{1}$  and  $16x + 44y = 1$ .

Solving these two equations, we get:  $x = \frac{1}{60}$  and  $y = \frac{1}{60}$

$$\therefore B's\ 1\ day's\ work = \frac{1}{60}.$$

Hence, B alone shall finish the whole work in 60 days.

## Profit and Loss

### Formulas

#### IMPORTANT FACTS

##### Cost Price:

The price, at which an article is purchased, is called its **cost price**, abbreviated as **C.P.**

##### Selling Price:

The price, at which an article is sold, is called its **selling prices**, abbreviated as **S.P.**

##### Profit or Gain:

If S.P. is greater than C.P., the seller is said to have a **profit or gain**.

##### Loss:

If S.P. is less than C.P., the seller is said to have incurred a **loss**.

#### IMPORTANT FORMULAE

1.  $\text{Gain} = (\text{S.P.}) - (\text{C.P.})$
2.  $\text{Loss} = (\text{C.P.}) - (\text{S.P.})$
3. Loss or gain is always reckoned on C.P.
4. Gain Percentage: (Gain %)

$$\text{Gain \%} = \left( \frac{\text{Gain} \times 100}{\text{C.P.}} \right)$$

5. Loss Percentage: (Loss %)

$$\text{Loss \%} = \left( \frac{\text{Loss} \times 100}{\text{C.P.}} \right)$$

6. Selling Price: (S.P.)

$$SP = \left[ \frac{(100 + Gain\%)}{100} \times C.P. \right]$$

7. Selling Price: (S.P.)

$$SP = \left[ \frac{(100 - Loss\%)}{100} \times C.P. \right]$$

8. Cost Price: (C.P.)

$$C.P. = \left[ \frac{100}{(100 + Gain\%)} \times S.P. \right]$$

9. Cost Price: (C.P.)

$$C.P. = \left[ \frac{100}{(100 - Loss\%)} \times S.P. \right]$$

10. If an article is sold at a gain of say 35%, then S.P. = 135% of C.P.

11. If an article is sold at a loss of say, 35% then S.P. = 65% of C.P.

12. When a person sells two similar items, one at a gain of say  $x\%$ , and the other at a loss of  $x\%$ , then the seller always incurs a loss given by:

$$\text{Loss \%} = \left( \frac{\text{Common Loss and Gain \%}}{10} \right)^2 = \left( \frac{x}{10} \right)^2.$$

13. If a trader professes to sell his goods at cost price, but uses false weights, then

$$\text{Gain \%} = \left[ \frac{\text{Error}}{(\text{True Value}) - (\text{Error})} \times 100 \right] \text{ \%}.$$

1. Alfred buys an old scooter for Rs. 4700 and spends Rs. 800 on its repairs. If he sells the scooter for Rs. 5800, his gain percent is:

A.  $4\frac{4}{7}\%$

B.  $5\frac{5}{11}\%$

C. 10%

D. 12%

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

Cost Price (C.P.) = Rs.  $(4700 + 800)$  = Rs. 5500.

Selling Price (S.P.) = Rs. 5800.

Gain = (S.P.) - (C.P.) = Rs.(5800 - 5500) = Rs. 300.

$$\text{Gain \%} = \left( \frac{300}{5500} \times 100 \right) \% = 5\frac{5}{11}\%$$

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- 
2. The cost price of 20 articles is the same as the selling price of  $x$  articles. If the profit is 25%, then the value of  $x$  is:

A. 15

B. 16

C. 18

D. 25

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let C.P. of each article be Re. 1 C.P. of  $x$  articles = Rs.  $x$ .

S.P. of  $x$  articles = Rs. 20.

Profit = Rs.  $(20 - x)$ .

$$\therefore \left( \frac{20 - x}{x} \times 100 = 25 \right)$$

$$\Rightarrow 2000 - 100x = 25x$$

$$125x = 2000$$

$$\Rightarrow x = 16.$$

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- 
3. If selling price is doubled, the profit triples. Find the profit percent.

A.  $66\frac{2}{3}$

B. 100

C.  $105\frac{1}{3}$

D. 120

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let C.P. be Rs.  $x$  and S.P. be Rs.  $y$ .

Then,  $3(y - x) = (2y - x) \Rightarrow y = 2x$ .

Profit = Rs.  $(y - x)$  = Rs.  $(2x - x)$  = Rs.  $x$ .

$$\therefore \text{Profit \%} = \left( \frac{x}{x} \times 100 \right) \% = 100\%$$

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- 
4. In a certain store, the profit is 320% of the cost. If the cost increases by 25% but the selling price remains constant, approximately what percentage of the selling price is the profit?

A. 30%

B. 70%

C. 100%

D. 250%

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let C.P. = Rs. 100. Then, Profit = Rs. 320, S.P. = Rs. 420.

New C.P. = 125% of Rs. 100 = Rs. 125

New S.P. = Rs. 420.

Profit = Rs.  $(420 - 125)$  = Rs. 295.

$$\therefore \text{Required percentage} = \left( \frac{295}{420} \times 100 \right) \% = \frac{1475}{21}\% = 70\% \text{ (approximately).}$$

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- 
5. A vendor bought toffees at 6 for a rupee. How many for a rupee must he sell to gain 20%?

A. 3

B. 4

C. 5

D. 6

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

C.P. of 6 toffees = Re. 1

S.P. of 6 toffees = 120% of Re. 1 = Rs.  $\frac{6}{5}$

For Rs.  $\frac{6}{5}$ , toffees sold = 6.

For Re. 1, toffees sold =  $\left(6 \times \frac{5}{6}\right) = 5$ .

- The percentage profit earned by selling an article for Rs. 1920 is equal to the percentage loss incurred by selling the same article for Rs. 1280. At what price should the article be sold to make 25% profit?

A. Rs. 2000

B. Rs. 2200

C. Rs. 2400

D. Data inadequate

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let C.P. be Rs.  $x$ .

$$\text{Then, } \frac{1920 - x}{x} \times 100 = \frac{x - 1280}{x} \times 100$$

$$\Rightarrow 1920 - x = x - 1280$$

$$\Rightarrow 2x = 3200$$

$$\Rightarrow x = 1600$$

$\therefore$  Required S.P. = 125% of Rs. 1600 = Rs.  $\left(\frac{125}{100} \times 1600\right)$  = Rs 2000.

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- 
- A shopkeeper expects a gain of 22.5% on his cost price. If in a week, his sale was of Rs. 392, what was his profit?

A. Rs. 18.20

B. Rs. 70

C. Rs. 72

D. Rs. 88.25

### **Answer & Explanation**

**Answer:** Option C

#### **Explanation:**

$$C.P. = \text{Rs.} \left( \frac{100}{122.5} \times 392 \right) = \text{Rs.} \left( \frac{1000}{1225} \times 392 \right) = \text{Rs.} 320$$

$$\therefore \text{Profit} = \text{Rs.} (392 - 320) = \text{Rs.} 72.$$

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- 
8. A man buys a cycle for Rs. 1400 and sells it at a loss of 15%. What is the selling price of the cycle?

**A.** Rs. 1090

**B.** Rs. 1160

**C.** Rs. 1190

**D.** Rs. 1202

### **Answer & Explanation**

**Answer:** Option C

#### **Explanation:**

$$S.P. = 85\% \text{ of Rs.} 1400 = \text{Rs.} \left( \frac{85}{100} \times 1400 \right) = \text{Rs.} 1190$$

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9. Sam purchased 20 dozens of toys at the rate of Rs. 375 per dozen. He sold each one of them at the rate of Rs. 33. What was his percentage profit?

**A.** 3.5

**B.** 4.5

**C.** 5.6

**D.** 6.5

### **Answer & Explanation**

**Answer:** Option C

#### **Explanation:**

$$\text{Cost Price of 1 toy} = \text{Rs.} \left( \frac{375}{12} \right) = \text{Rs.} 31.25$$

Selling Price of 1 toy = Rs. 33

So, Gain = Rs. (33 - 31.25) = Rs. 1.75

$$\therefore \text{Profit \%} = \left( \frac{1.75}{31.25} \times 100 \right) \% = \frac{28}{5}\% = 5.6\%$$

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- 
10. Some articles were bought at 6 articles for Rs. 5 and sold at 5 articles for Rs. 6. Gain percent is:

A. 30%

B.  $33\frac{1}{3}\%$

C. 35%

D. 44%

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Suppose, number of articles bought = L.C.M. of 6 and 5 = 30.

$$\text{C.P. of 30 articles} = \text{Rs. } \left( \frac{5}{6} \times 30 \right) = \text{Rs. 25.}$$

$$\text{S.P. of 30 articles} = \text{Rs. } \left( \frac{6}{5} \times 30 \right) = \text{Rs. 36.}$$

$$\therefore \text{Gain \%} = \left( \frac{11}{25} \times 100 \right) \% = 44\%.$$

11. On selling 17 balls at Rs. 720, there is a loss equal to the cost price of 5 balls. The cost price of a ball is:

A. Rs. 45

B. Rs. 50

C. Rs. 55

D. Rs. 60

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$(\text{C.P. of 17 balls}) - (\text{S.P. of 17 balls}) = (\text{C.P. of 5 balls})$$

$$\Rightarrow \text{C.P. of 12 balls} = \text{S.P. of 17 balls} = \text{Rs. 720.}$$

$$\Rightarrow \text{C.P. of 1 ball} = \text{Rs. } \left( \frac{720}{12} \right) = \text{Rs. 60.}$$

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12. When a plot is sold for Rs. 18,700, the owner loses 15%. At what price must that plot be sold in order to gain 15%?

- A. Rs. 21,000      B. Rs. 22,500  
C. Rs. 25,300      D. Rs. 25,800

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$85 : 18700 = 115 : x$$

$$\Rightarrow x = \left( \frac{18700 \times 115}{85} \right) = 25300.$$

Hence, S.P. = Rs. 25,300.

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13. 100 oranges are bought at the rate of Rs. 350 and sold at the rate of Rs. 48 per dozen. The percentage of profit or loss is:

- A.  $14\frac{2}{7}\%$  gain      B. 15% gain  
C.  $14\frac{2}{7}\%$  loss      D. 15 % loss

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$C.P. \text{ of 1 orange} = \text{Rs. } \left( \frac{350}{100} \right) = \text{Rs. } 3.50$$

$$S.P. \text{ of 1 orange} = \text{Rs. } \left( \frac{48}{12} \right) = \text{Rs. } 4$$

$$\therefore \text{Gain\%} = \left( \frac{0.50}{3.50} \times 100 \right)\% = \frac{100}{7}\% = 14\frac{2}{7}\%$$

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14. A shopkeeper sells one transistor for Rs. 840 at a gain of 20% and another for Rs. 960 at a loss of 4%. His total gain or loss percent is:

- A. 515% loss      B. 515% gain

17

17

**C.**  $6\frac{2}{3}\%$  gain

**D.** None of these

#### Answer & Explanation

**Answer:** Option **B**

#### Explanation:

$$\text{C.P. of 1}^{\text{st}} \text{ transistor} = \text{Rs. } \left( \frac{100}{120} \times 840 \right) = \text{Rs. } 700.$$

$$\text{C.P. of 2}^{\text{nd}} \text{ transistor} = \text{Rs. } \left( \frac{100}{96} \times 960 \right) = \text{Rs. } 1000$$

So, total C.P. = Rs.  $(700 + 1000)$  = Rs. 1700.

Total S.P. = Rs.  $(840 + 960)$  = Rs. 1800.

$$\therefore \text{Gain \%} = \left( \frac{100}{1700} \times 100 \right)\% = 5\frac{15}{17}\%$$

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15. A trader mixes 26 kg of rice at Rs. 20 per kg with 30 kg of rice of other variety at Rs. 36 per kg and sells the mixture at Rs. 30 per kg. His profit percent is:

**A.** No profit, no loss

**B.** 5%

**C.** 8%

**D.** 10%

**E.** None of these

#### Answer & Explanation

**Answer:** Option **B**

#### Explanation:

C.P. of 56 kg rice = Rs.  $(26 \times 20 + 30 \times 36)$  = Rs.  $(520 + 1080)$  = Rs. 1600.

S.P. of 56 kg rice = Rs.  $(56 \times 30)$  = Rs. 1680.

$$\therefore \text{Gain} = \left( \frac{80}{1600} \times 100 \right)\% = 5\%.$$

## Problems on Ages

### Formulas

#### Important Formulas on "Problems on Ages" :

1. If the current age is  $x$ , then  $n$  times the age is  $nx$ .
  2. If the current age is  $x$ , then age  $n$  years later/hence =  $x + n$ .
  3. If the current age is  $x$ , then age  $n$  years ago =  $x - n$ .
  4. The ages in a ratio  $a : b$  will be  $ax$  and  $bx$ .
  5. If the current age is  $x$ , then  $\frac{1}{n}$  of the age is  $\frac{x}{n}$ .
- 
1. Father is aged three times more than his son Ronit. After 8 years, he would be two and a half times of Ronit's age. After further 8 years, how many times would he be of Ronit's age?  

A. 2 times	B. $2\frac{1}{2}$ times
C. $2\frac{3}{4}$ times	D. 3 times

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

Let Ronit's present age be  $x$  years. Then, father's present age =  $(x + 3x)$  years =  $4x$  years.

$$\therefore (4x + 8) = \frac{5}{2}(x + 8)$$

$$\Rightarrow 8x + 16 = 5x + 40$$

$$\Rightarrow 3x = 24$$

$$\Rightarrow x = 8.$$

$$\text{Hence, required ratio} = \frac{(4x + 16)}{(x + 16)} = \frac{48}{24} = 2.$$

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- 
2. The sum of ages of 5 children born at the intervals of 3 years each is 50 years. What is the age of the youngest child?

- A. 4 years      B. 8 years  
C. 10 years      D. None of these

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

Let the ages of children be  $x$ ,  $(x + 3)$ ,  $(x + 6)$ ,  $(x + 9)$  and  $(x + 12)$  years.

$$\text{Then, } x + (x + 3) + (x + 6) + (x + 9) + (x + 12) = 50$$

$$\Rightarrow 5x = 20$$

$$\Rightarrow x = 4.$$

$\therefore$  Age of the youngest child =  $x = 4$  years.

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- 
3. A father said to his son, "I was as old as you are at the present at the time of your birth". If the father's age is 38 years now, the son's age five years back was:

- A. 14 years      B. 19 years  
C. 33 years      D. 38 years

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

Let the son's present age be  $x$  years. Then,  $(38 - x) = x$

$$\Rightarrow 2x = 38.$$

$$\Rightarrow x = 19.$$

$\therefore$  Son's age 5 years back  $(19 - 5) = 14$  years.

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- 
4. A is two years older than B who is twice as old as C. If the total of the ages of A, B and C be 27, the how old is B?

A. 7

B. 8

C. 9

D. 10

E. 11

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let C's age be  $x$  years. Then, B's age =  $2x$  years. A's age =  $(2x + 2)$  years.

$$\therefore (2x + 2) + 2x + x = 27$$

$$\Rightarrow 5x = 25$$

$$\Rightarrow x = 5.$$

Hence, B's age =  $2x = 10$  years.

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- 
5. Present ages of Sameer and Anand are in the ratio of 5 : 4 respectively. Three years hence, the ratio of their ages will become 11 : 9 respectively. What is Anand's present age in years?

A. 24

B. 27

C. 40

D. Cannot be determined

E. None of these

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

Let the present ages of Sameer and Anand be  $5x$  years and  $4x$  years respectively.

$$\text{Then, } \frac{5x + 3}{4x + 3} = \frac{11}{9}$$

$$\Rightarrow 9(5x + 3) = 11(4x + 3)$$

$$\Rightarrow 45x + 27 = 44x + 33$$

$$\Rightarrow 45x - 44x = 33 - 27$$

$$\Rightarrow x = 6.$$

$\therefore$  Anand's present age =  $4x = 24$  years.

6. A man is 24 years older than his son. In two years, his age will be twice the age of his son. The present age of his son is:

A. 14 years

B. 18 years

C. 20 years

D. 22 years

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let the son's present age be  $x$  years. Then, man's present age =  $(x + 24)$  years.

$$\therefore (x + 24) + 2 = 2(x + 2)$$

$$\Rightarrow x + 26 = 2x + 4$$

$$\Rightarrow x = 22.$$

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- 
7. Six years ago, the ratio of the ages of Kunal and Sagar was 6 : 5. Four years hence, the ratio of their ages will be 11 : 10. What is Sagar's age at present?

A. 16 years

B. 18 years

C. 20 years

D. Cannot be determined

E. None of these

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

Let the ages of Kunal and Sagar 6 years ago be  $6x$  and  $5x$  years respectively.

$$\text{Then, } \frac{(6x + 6) + 4}{(5x + 6) + 4} = \frac{11}{10}$$

$$\Rightarrow 10(6x + 10) = 11(5x + 10)$$

$$\Rightarrow 5x = 10$$

$$\Rightarrow x = 2.$$

$\therefore$  Sagar's present age =  $(5x + 6) = 16$  years.

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- 
8. The sum of the present ages of a father and his son is 60 years. Six years ago, father's age was five times the age of the son. After 6 years, son's age will be:

A. 12 years

B. 14 years

C. 18 years

D. 20 years

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Let the present ages of son and father be  $x$  and  $(60 - x)$  years respectively.

Then,  $(60 - x) - 6 = 5(x - 6)$

$$\Rightarrow 54 - x = 5x - 30$$

$$\Rightarrow 6x = 84$$

$$\Rightarrow x = 14.$$

$\therefore$  Son's age after 6 years =  $(x + 6) = 20$  years..

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- 
9. At present, the ratio between the ages of Arun and Deepak is 4 : 3. After 6 years, Arun's age will be 26 years. What is the age of Deepak at present ?

A. 12 years

B. 15 years

C. 19 and half

D. 21 years

[Answer & Explanation](#)

**Answer:** Option B

## Explanation:

Let the present ages of Arun and Deepak be  $4x$  years and  $3x$  years respectively. Then,

$$4x + 6 = 26 \quad \Leftrightarrow \quad 4x = 20$$

$$x = 5.$$

∴ Deepak's age =  $3x = 15$  years.

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10. Sachin is younger than Rahul by 7 years. If their ages are in the respective ratio of 7 : 9, how old is Sachin?

- A. 16 years
  - B. 18 years
  - C. 28 years
  - D. 24.5 years
  - E. None of these

## Answer & Explanation

**Answer:** Option D

## Explanation:

Let Rahul's age be  $x$  years.

Then, Sachin's age =  $(x - 7)$  years.

$$\therefore \frac{x-7}{x} = \frac{7}{9}$$

$$\Rightarrow 9x - 63 = 7x$$

$$\Rightarrow 2x = 63$$

$$\Rightarrow x = 31.5$$

Hence, Sachin's age  $= (x - 7) = 24.5$  years.

11. The present ages of three persons in proportions  $4 : 7 : 9$ . Eight years ago, the sum of their ages was 56. Find their present ages (in years).

- A.** 8, 20, 28      **B.** 16, 28, 36  
**C.** 20, 35, 45      **D.** None of these

## Answer & Explanation

**Answer:** Option B

**Explanation:**

Let their present ages be  $4x$ ,  $7x$  and  $9x$  years respectively.

$$\text{Then, } (4x - 8) + (7x - 8) + (9x - 8) = 56$$

$$\Rightarrow 20x = 80$$

$$\Rightarrow x = 4.$$

$\therefore$  Their present ages are  $4x = 16$  years,  $7x = 28$  years and  $9x = 36$  years respectively.

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- 
12. Ayesha's father was 38 years of age when she was born while her mother was 36 years old when her brother four years younger to her was born. What is the difference between the ages of her parents?

A. 2 years

B. 4 years

C. 6 years

D. 8 years

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Mother's age when Ayesha's brother was born = 36 years.

Father's age when Ayesha's brother was born =  $(38 + 4)$  years = 42 years.

$\therefore$  Required difference =  $(42 - 36)$  years = 6 years.

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- 
13. A person's present age is two-fifth of the age of his mother. After 8 years, he will be one-half of the age of his mother. How old is the mother at present?

A. 32 years

B. 36 years

C. 40 years

D. 48 years

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the mother's present age be  $x$  years.

Then, the person's present age =  $\left(\frac{2}{5}x\right)$  years.

$$\therefore \left(\frac{2}{5}x + 8\right) = \frac{1}{2}(x + 8)$$

$$\Rightarrow 2(2x + 40) = 5(x + 8)$$

$$\Rightarrow x = 40.$$

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- 
14. Q is as much younger than R as he is older than T. If the sum of the ages of R and T is 50 years, what is definitely the difference between R and Q's age?

A. 1 year

B. 2 years

C. 25 years

D. Data inadequate

E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

**Given that:**

1. The difference of age b/w R and Q = The difference of age b/w Q and T.
2. Sum of age of R and T is 50 i.e.  $(R + T) = 50$ .

**Question:  $R - Q = ?$ .**

Explanation:

$$R - Q = Q - T$$

$$(R + T) = 2Q$$

Now given that,  $(R + T) = 50$

So,  $50 = 2Q$  and therefore  $Q = 25$ .

Question is  $(R - Q) = ?$

Here we know the value(age) of  $Q$  (25), but we don't know the age of  $R$ .

Therefore,  $(R-Q)$  cannot be determined.

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- 
15. The age of father 10 years ago was thrice the age of his son. Ten years hence, father's age will be twice that of his son. The ratio of their present ages is:

A. 5 : 2

B. 7 : 3

C. 9 : 2

D. 13 : 4

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let the ages of father and son 10 years ago be  $3x$  and  $x$  years respectively.

$$\text{Then, } (3x + 10) + 10 = 2[(x + 10) + 10]$$

$$\Rightarrow 3x + 20 = 2x + 40$$

$$\Rightarrow x = 20.$$

$$\therefore \text{ Required ratio} = (3x + 10) : (x + 10) = 70 : 30 = 7 : 3.$$

## Average

### Formulas

#### 1. Average:

$$\text{Average} = \left( \frac{\text{Sum of observations}}{\text{Number of observations}} \right)$$

#### 2. Average Speed:

Suppose a man covers a certain distance at  $x$  kmph and an equal distance at  $y$  kmph.

Then, the average speed during the whole journey is  $\left( \frac{2xy}{x+y} \right)$  kmph.

1. In the first 10 overs of a cricket game, the run rate was only 3.2. What should be the run rate in the remaining 40 overs to reach the target of 282 runs?

A. 6.25

B. 6.5

C. 6.75

D. 7

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$\text{Required run rate} = \left( \frac{282 - (3.2 \times 10)}{40} \right) = \frac{250}{40} = 6.25$$

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- 
2. A family consists of two grandparents, two parents and three grandchildren. The average age of the grandparents is 67 years, that of the parents is 35 years and that of the grandchildren is 6 years. What is the average age of the family?

A.  $28 \frac{4}{7}$  years

B.  $31 \frac{5}{7}$  years

C.  $32 \frac{1}{7}$  years

D. None of these

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$\text{Required average} = \left( \frac{67 \times 2 + 35 \times 2 + 6 \times 3}{2 + 2 + 3} \right)$$

$$= \left( \frac{134 + 70 + 18}{7} \right)$$

$$= \frac{222}{7}$$

$$= 31 \underline{5} \text{ years.}$$

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3. A grocer has a sale of Rs. 6435, Rs. 6927, Rs. 6855, Rs. 7230 and Rs. 6562 for 5 consecutive months. How much sale must he have in the sixth month so that he gets an average sale of Rs. 6500?

- |                    |                    |
|--------------------|--------------------|
| <b>A.</b> Rs. 4991 | <b>B.</b> Rs. 5991 |
| <b>C.</b> Rs. 6001 | <b>D.</b> Rs. 6991 |

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Total sale for 5 months = Rs.  $(6435 + 6927 + 6855 + 7230 + 6562) = \text{Rs. } 34009$ .

$$\begin{aligned}\therefore \text{Required sale} &= \text{Rs. } [(6500 \times 6) - 34009] \\ &= \text{Rs. } (39000 - 34009) \\ &= \text{Rs. } 4991.\end{aligned}$$

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4. The average of 20 numbers is zero. Of them, at the most, how many may be greater than zero?

- |              |              |
|--------------|--------------|
| <b>A.</b> 0  | <b>B.</b> 1  |
| <b>C.</b> 10 | <b>D.</b> 19 |

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Average of 20 numbers = 0.

$$\therefore \text{Sum of 20 numbers } (0 \times 20) = 0.$$

It is quite possible that 19 of these numbers may be positive and if their sum is  $a$  then 20th number is  $(-a)$ .

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- 
5. The average weight of 8 person's increases by 2.5 kg when a new person comes in place of one of them weighing 65 kg. What might be the weight of the new person?
- A. 76 kg      B. 76.5 kg  
C. 85 kg      D. Data inadequate  
E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Total weight increased =  $(8 \times 2.5)$  kg = 20 kg.

Weight of new person =  $(65 + 20)$  kg = 85 kg.

6. The captain of a cricket team of 11 members is 26 years old and the wicket keeper is 3 years older. If the ages of these two are excluded, the average age of the remaining players is one year less than the average age of the whole team. What is the average age of the team?
- A. 23 years      B. 24 years  
C. 25 years      D. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let the average age of the whole team by  $x$  years.

$$\therefore 11x - (26 + 29) = 9(x - 1)$$

$$\Rightarrow 11x - 9x = 46$$

$$\Rightarrow 2x = 46$$

$$\Rightarrow x = 23.$$

So, average age of the team is 23 years.

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- 
7. The average monthly income of P and Q is Rs. 5050. The average monthly income of Q and R is Rs. 6250 and the average monthly income of P and R is Rs. 5200. The monthly income of P is:

- A. 3500      B. 4000  
C. 4050      D. 5000

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Let P, Q and R represent their respective monthly incomes. Then, we have:

$$P + Q = (5050 \times 2) = 10100 \dots \text{(i)}$$

$$Q + R = (6250 \times 2) = 12500 \dots \text{(ii)}$$

$$P + R = (5200 \times 2) = 10400 \dots \text{(iii)}$$

Adding (i), (ii) and (iii), we get:  $2(P + Q + R) = 33000$  or  $P + Q + R = 16500 \dots \text{(iv)}$

Subtracting (ii) from (iv), we get  $P = 4000$ .

$\therefore$  P's monthly income = Rs. 4000.

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- 
8. The average age of husband, wife and their child 3 years ago was 27 years and that of wife and the child 5 years ago was 20 years. The present age of the husband is:

- A. 35 years      B. 40 years  
C. 50 years      D. None of these

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Sum of the present ages of husband, wife and child =  $(27 \times 3 + 3 \times 3)$  years = 90 years.

Sum of the present ages of wife and child =  $(20 \times 2 + 5 \times 2)$  years = 50 years.

$\therefore$  Husband's present age =  $(90 - 50)$  years = 40 years.

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- 
9. A car owner buys petrol at Rs.7.50, Rs. 8 and Rs. 8.50 per litre for three successive years. What

approximately is the average cost per litre of petrol if he spends Rs. 4000 each year?

- A. Rs. 7.98      B. Rs. 8  
C. Rs. 8.50      D. Rs. 9

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\begin{aligned}\text{Total quantity of petrol consumed in 3 years} &= \left( \frac{4000}{7.50} + \frac{4000}{8} + \frac{4000}{8.50} \right) \text{ litres} \\ &= 4000 \left( \frac{2}{15} + \frac{1}{8} + \frac{2}{17} \right) \text{ litres} \\ &= \left( \frac{76700}{51} \right) \text{ litres}\end{aligned}$$

Total amount spent = Rs.  $(3 \times 4000)$  = Rs. 12000.

$$\therefore \text{Average cost} = \text{Rs. } \left( \frac{12000 \times 51}{76700} \right) = \text{Rs. } \frac{6120}{767} = \text{Rs. } 7.98$$

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- 
10. In Arun's opinion, his weight is greater than 65 kg but less than 72 kg. His brother doest not agree with Arun and he thinks that Arun's weight is greater than 60 kg but less than 70 kg. His mother's view is that his weight cannot be greater than 68 kg. If all are them are correct in their estimation, what is the average of different probable weights of Arun?

- A. 67 kg.      B. 68 kg.  
C. 69 kg.      D. Data inadequate  
E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let Arun's weight by X kg.

According to Arun,  $65 < X < 72$

According to Arun's brother,  $60 < X < 70$ .

According to Arun's mother,  $X \leq 68$

The values satisfying all the above conditions are 66, 67 and 68.

$$\therefore \text{Required average} = \left( \frac{66 + 67 + 68}{3} \right) = \left( \frac{201}{3} \right) = 67 \text{ kg.}$$

11. The average weight of A, B and C is 45 kg. If the average weight of A and B be 40 kg and that of B and C be 43 kg, then the weight of B is:

A. 17 kg

B. 20 kg

C. 26 kg

D. 31 kg

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let A, B, C represent their respective weights. Then, we have:

$$A + B + C = (45 \times 3) = 135 \dots \text{(i)}$$

$$A + B = (40 \times 2) = 80 \dots \text{(ii)}$$

$$B + C = (43 \times 2) = 86 \dots \text{(iii)}$$

$$\text{Adding (ii) and (iii), we get: } A + 2B + C = 166 \dots \text{(iv)}$$

Subtracting (i) from (iv), we get :  $B = 31$ .

$\therefore$  B's weight = 31 kg.

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- 
12. The average weight of 16 boys in a class is 50.25 kg and that of the remaining 8 boys is 45.15 kg. Find the average weights of all the boys in the class.

A. 47.55 kg

B. 48 kg

C. 48.55 kg

D. 49.25 kg

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

$$\begin{aligned}\text{Required average} &= \left( \frac{50.25 \times 16 + 45.15 \times 8}{16 + 8} \right) \\&= \left( \frac{804 + 361.20}{24} \right) \\&= \frac{1165.20}{24} \\&= 48.55\end{aligned}$$

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- 
13. A library has an average of 510 visitors on Sundays and 240 on other days. The average number of visitors per day in a month of 30 days beginning with a Sunday is:

A. 250

B. 276

C. 280

D. 285

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Since the month begins with a Sunday, there will be five Sundays in the month.

$$\begin{aligned}\text{Required average} &= \left( \frac{510 \times 5 + 240 \times 25}{30} \right) \\&= \frac{8550}{30} \\&= 285\end{aligned}$$

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- 
14. If the average marks of three batches of 55, 60 and 45 students respectively is 50, 55, 60, then the average marks of all the students is:

A. 53.33

B. 54.68

C. 55

D. None of these

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$\begin{aligned}\text{Required average} &= \left( \frac{55 \times 50 + 60 \times 55 + 45 \times 60}{55 + 60 + 45} \right) \\&= \left( \frac{2750 + 3300 + 2700}{160} \right) \\&= \frac{8750}{160} \\&= 54.68\end{aligned}$$

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- 
15. A pupil's marks were wrongly entered as 83 instead of 63. Due to that the average marks for the class got increased by half (1/2). The number of pupils in the class is:

A. 10

B. 20

C. 40

D. 73

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Let there be  $x$  pupils in the class.

$$\begin{aligned}\text{Total increase in marks} &= \left( x \times \frac{1}{2} \right) = \frac{x}{2} \\ \therefore \frac{x}{2} &= (83 - 63) \Rightarrow \frac{x}{2} = 20 \Rightarrow x = 40.\end{aligned}$$

## Permutation and Combination

### Formulas

#### 1. Factorial Notation:

Let  $n$  be a positive integer. Then, factorial  $n$ , denoted  $n!$  is defined as:

$$n! = n(n - 1)(n - 2) \dots 3.2.1.$$

**Examples:**

- i. We define  $0! = 1$ .
  - ii.  $4! = (4 \times 3 \times 2 \times 1) = 24$ .
  - iii.  $5! = (5 \times 4 \times 3 \times 2 \times 1) = 120$ .
2. **Permutations:**

The different arrangements of a given number of things by taking some or all at a time, are called permutations.

**Examples:**

- i. All permutations (or arrangements) made with the letters  $a, b, c$  by taking two at a time are ( $ab, ba, ac, ca, bc, cb$ ).
  - ii. All permutations made with the letters  $a, b, c$  taking all at a time are:  
(  $abc, acb, bac, bca, cab, cba$  )
3. **Number of Permutations:**

Number of all permutations of  $n$  things, taken  $r$  at a time, is given by:

$${}^n P_r = n(n - 1)(n - 2) \dots (n - r + 1) = \frac{n!}{(n - r)!}$$

**Examples:**

- i.  ${}^6 P_2 = (6 \times 5) = 30$ .
  - ii.  ${}^7 P_3 = (7 \times 6 \times 5) = 210$ .
  - iii. **Cor. number of all permutations of  $n$  things, taken all at a time =  $n!$ .**
4. **An Important Result:**

If there are  $n$  subjects of which  $p_1$  are alike of one kind;  $p_2$  are alike of another kind;  $p_3$  are alike of third kind and so on and  $p_r$  are alike of  $r^{\text{th}}$  kind,  
such that  $(p_1 + p_2 + \dots + p_r) = n$ .

$$\text{Then, number of permutations of these } n \text{ objects is} = \frac{n!}{(p_1!)(p_2!) \dots (p_r!)}$$

5. **Combinations:**

Each of the different groups or selections which can be formed by taking some or all of a number of objects is called a **combination**.

**Examples:**

- Suppose we want to select two out of three boys A, B, C. Then, possible selections are AB, BC and CA.

Note: AB and BA represent the same selection.

- All the combinations formed by  $a, b, c$  taking ***ab, bc, ca***.
- The only combination that can be formed of three letters  $a, b, c$  taken all at a time is ***abc***.
- Various groups of 2 out of four persons A, B, C, D are:

**AB, AC, AD, BC, BD, CD.**

- Note that  $ab$   $ba$  are two different permutations but they represent the same combination.

#### **Number of Combinations:**

The number of all combinations of  $n$  things, taken  $r$  at a time is:

$${}^nC_r = \frac{n!}{(r!)(n - r)!} = \frac{n(n - 1)(n - 2) \dots \text{to } r \text{ factors}}{r!}$$

#### **Note:**

- .  ${}^nC_n = 1$  and  ${}^nC_0 = 1$ .
- i.  ${}^nC_r = {}^nC_{(n - r)}$

#### **Examples:**

- i.  ${}^{11}C_4 = \frac{(11 \times 10 \times 9 \times 8)}{(4 \times 3 \times 2 \times 1)} = 330.$
- ii.  ${}^{16}C_{13} = {}^{16}C_{(16 - 13)} = {}^{16}C_3 = \frac{16 \times 15 \times 14}{3!} = \frac{16 \times 15 \times 14}{3 \times 2 \times 1} = 560.$

- From a group of 7 men and 6 women, five persons are to be selected to form a committee so that at least 3 men are there on the committee. In how many ways can it be done?

- |                         |               |
|-------------------------|---------------|
| <b>A.</b> 564           | <b>B.</b> 645 |
| <b>C.</b> 735           | <b>D.</b> 756 |
| <b>E.</b> None of these |               |

#### **Answer & Explanation**

**Answer:** Option **D**

**Explanation:**

We may have (3 men and 2 women) or (4 men and 1 woman) or (5 men only).

$$\therefore \text{Required number of ways} = ({}^7C_3 \times {}^6C_2) + ({}^7C_4 \times {}^6C_1) + ({}^7C_5)$$

$$= \left( \frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times \frac{6 \times 5}{2 \times 1} \right) + ({}^7C_3 \times {}^6C_1) + ({}^7C_2)$$

$$= 525 + \left( \frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times 6 \right) + \left( \frac{7 \times 6}{2 \times 1} \right)$$

$$= (525 + 210 + 21)$$

$$= 756.$$

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- 
2. In how many different ways can the letters of the word 'LEADING' be arranged in such a way that the vowels always come together?

A. 360

B. 480

C. 720

D. 5040

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

The word 'LEADING' has 7 different letters.

When the vowels EAI are always together, they can be supposed to form one letter.

Then, we have to arrange the letters LNDG (EAI).

Now, 5 (4 + 1 = 5) letters can be arranged in  $5! = 120$  ways.

The vowels (EAI) can be arranged among themselves in  $3! = 6$  ways.

$\therefore$  Required number of ways =  $(120 \times 6) = 720$ .

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3. In how many different ways can the letters of the word 'CORPORATION' be arranged so that the vowels always come together?

A. 810

B. 1440

C. 2880

D. 50400

E. 5760

#### [Answer & Explanation](#)

**Answer:** Option D

#### **Explanation:**

In the word 'CORPORATION', we treat the vowels OOAIO as one letter.

Thus, we have CRPRTN (OOAIO).

This has 7 ( $6 + 1$ ) letters of which R occurs 2 times and the rest are different.

Number of ways arranging these letters =  $\frac{7!}{2!} = 2520$ .

Now, 5 vowels in which O occurs 3 times and the rest are different, can be arranged

in  $\frac{5!}{3!} = 20$  ways.

$\therefore$  Required number of ways =  $(2520 \times 20) = 50400$ .

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4. Out of 7 consonants and 4 vowels, how many words of 3 consonants and 2 vowels can be formed?

- A. 210      B. 1050  
 C. 25200      D. 21400  
 E. None of these

#### **Answer & Explanation**

**Answer:** Option C

**Explanation:**

Number of ways of selecting (3 consonants out of 7) and (2 vowels out of 4)

$$= ({}^7C_3 \times {}^4C_2)$$

$$= \left( \frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times \frac{4 \times 3}{2 \times 1} \right)$$

$$= 210.$$

Number of groups, each having 3 consonants and 2 vowels = 210.

Each group contains 5 letters.

Number of ways of arranging 5 letters among themselves = 5!

$$= 5 \times 4 \times 3 \times 2 \times 1$$

$$= 120.$$

∴ Required number of ways =  $(210 \times 120) = 25200$ .

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5. In how many ways can the letters of the word 'LEADER' be arranged?

A. 72

B. 144

C. 360

D. 720

E. None of these

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

The word 'LEADER' contains 6 letters, namely 1L, 2E, 1A, 1D and 1R.

$$\therefore \text{Required number of ways} = \frac{6!}{(1!)(2!)(1!)(1!)(1!)} = 360.$$

6. In a group of 6 boys and 4 girls, four children are to be selected. In how many different ways can they be selected such that at least one boy should be there?

A. 159

B. 194

C. 205

D. 209

E. None of these

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

We may have (1 boy and 3 girls) or (2 boys and 2 girls) or (3 boys and 1 girl) or (4 boys).

$$\therefore \text{Required number of ways} = (^6C_1 \times ^4C_3) + (^6C_2 \times ^4C_2) + (^6C_3 \times ^4C_1) + (^6C_4)$$

$$= (^6C_1 \times ^4C_1) + (^6C_2 \times ^4C_2) + (^6C_3 \times ^4C_1) + (^6C_2)$$

$$= (6 \times 4) + \left( \frac{6 \times 5}{2 \times 1} \times \frac{4 \times 3}{2 \times 1} \right) + \left( \frac{6 \times 5 \times 4}{3 \times 2 \times 1} \times 4 \right) + \left( \frac{6 \times 5}{2 \times 1} \right)$$

$$= (24 + 90 + 80 + 15)$$

$$= 209.$$

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7. How many 3-digit numbers can be formed from the digits 2, 3, 5, 6, 7 and 9, which are divisible by 5 and none of the digits is repeated?

- A. 5  
C. 15

- B. 10  
D. 20

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Since each desired number is divisible by 5, so we must have 5 at the unit place. So, there is 1 way of doing it.

The tens place can now be filled by any of the remaining 5 digits (2, 3, 6, 7, 9). So, there are 5 ways of filling the tens place.

The hundreds place can now be filled by any of the remaining 4 digits. So, there are 4 ways of filling it.

$$\therefore \text{Required number of numbers} = (1 \times 5 \times 4) = 20.$$

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8. In how many ways a committee, consisting of 5 men and 6 women can be formed from 8 men and 10 women?

- A. 266  
C. 11760  
E. None of these

- B. 5040  
D. 86400

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\text{Required number of ways} = ({}^8C_5 \times {}^{10}C_6)$$

$$= ({}^8C_3 \times {}^{10}C_4)$$

$$= \left( \frac{8 \times 7 \times 6}{3 \times 2 \times 1} \times \frac{10 \times 9 \times 8 \times 7}{4 \times 3 \times 2 \times 1} \right) \\ = 11760.$$

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- 
9. A box contains 2 white balls, 3 black balls and 4 red balls. In how many ways can 3 balls be drawn from the box, if at least one black ball is to be included in the draw?

A. 32

B. 48

C. 64

D. 96

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

We may have(1 black and 2 non-black) or (2 black and 1 non-black) or (3 black).

$$\therefore \text{Required number of ways} = ({}^3C_1 \times {}^6C_2) + ({}^3C_2 \times {}^6C_1) + ({}^3C_3)$$

$$= \left( 3 \times \frac{6 \times 5}{2 \times 1} \right) + \left( \frac{3 \times 2}{2 \times 1} \times 6 \right) + 1 \\ = (45 + 18 + 1)$$

= 64.

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- 
10. In how many different ways can the letters of the word 'DETAIL' be arranged in such a way that the vowels occupy only the odd positions?

A. 32

B. 48

C. 36

D. 60

E. 120

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

There are 6 letters in the given word, out of which there are 3 vowels and 3 consonants.

Let us mark these positions as under:

(1) (2) (3) (4) (5) (6)

Now, 3 vowels can be placed at any of the three places out 4, marked 1, 3, 5.

Number of ways of arranging the vowels =  ${}^3P_3 = 3! = 6$ .

Also, the 3 consonants can be arranged at the remaining 3 positions.

Number of ways of these arrangements =  ${}^3P_3 = 3! = 6$ .

Total number of ways =  $(6 \times 6) = 36$

11. In how many ways can a group of 5 men and 2 women be made out of a total of 7 men and 3 women?

A. 63

B. 90

C. 126

D. 45

E. 135

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\text{Required number of ways} = ({}^7C_5 \times {}^3C_2) = ({}^7C_2 \times {}^3C_1) = \left( \frac{7 \times 6}{2 \times 1} \times 3 \right) = 63.$$

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- 
12. How many 4-letter words with or without meaning, can be formed out of the letters of the word, 'LOGARITHMS', if repetition of letters is not allowed?

A. 40

B. 400

C. 5040

D. 2520

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

'LOGARITHMS' contains 10 different letters.

Required number of words = Number of arrangements of 10 letters, taking 4 at a time.

$$= {}^{10}P_4$$

$$= (10 \times 9 \times 8 \times 7)$$

$$= 5040.$$

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- 
13. In how many different ways can the letters of the word 'MATHEMATICS' be arranged so that the vowels always come together?

A. 10080

B. 4989600

C. 120960

D. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

In the word 'MATHEMATICS', we treat the vowels AEAI as one letter.

Thus, we have MTHMTCS (AEAI).

Now, we have to arrange 8 letters, out of which M occurs twice, T occurs twice and the rest are different.

$$\therefore \text{Number of ways of arranging these letters} = \frac{8!}{(2!)(2!)} = 10080.$$

Now, AEAI has 4 letters in which A occurs 2 times and the rest are different.

$$\text{Number of ways of arranging these letters} = \frac{4!}{2!} = 12.$$

$$\therefore \text{Required number of words} = (10080 \times 12) = 120960.$$

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14. In how many different ways can the letters of the word 'OPTICAL' be arranged so that the vowels always come together?

A. 120

B. 720

C. 4320

D. 2160

E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

The word 'OPTICAL' contains 7 different letters.

When the vowels OIA are always together, they can be supposed to form one letter.

Then, we have to arrange the letters PTCL (OIA).

Now, 5 letters can be arranged in  $5! = 120$  ways.

The vowels (OIA) can be arranged among themselves in  $3! = 6$  ways.

∴ Required number of ways =  $(120 \times 6) = 720$ .

## Problems on H.C.F and L.C.M

### Formulas

#### 1. Factors and Multiples:

If number  $a$  divided another number  $b$  exactly, we say that  $a$  is a **factor** of  $b$ .

In this case,  $b$  is called a **multiple** of  $a$ .

#### 2. Highest Common Factor (H.C.F.) or Greatest Common Measure (G.C.M.) or Greatest Common Divisor (G.C.D.):

The H.C.F. of two or more than two numbers is the greatest number that divides each of them exactly.

There are two methods of finding the H.C.F. of a given set of numbers:

- I. **Factorization Method:** Express the each one of the given numbers as the product of prime factors. The product of least powers of common prime factors gives H.C.F.
- II. **Division Method:** Suppose we have to find the H.C.F. of two given numbers, divide the larger by the smaller one. Now, divide the divisor by the remainder. Repeat the process of dividing the preceding number by the remainder last obtained till zero is obtained as remainder. The last divisor is required H.C.F.

**Finding the H.C.F. of more than two numbers:** Suppose we have to find the H.C.F. of three numbers, then, H.C.F. of [(H.C.F. of any two) and (the third number)] gives the H.C.F. of three given number.

Similarly, the H.C.F. of more than three numbers may be obtained.

#### 3. Least Common Multiple (L.C.M.):

The least number which is exactly divisible by each one of the given numbers is called their L.C.M.

There are two methods of finding the L.C.M. of a given set of numbers:

- I. **Factorization Method:** Resolve each one of the given numbers into a product of prime factors. Then, L.C.M. is the product of highest powers of all the factors.
- II. **Division Method (short-cut):** Arrange the given numbers in a row in any order. Divide by a number which divides exactly at least two of the given numbers and carry forward the numbers which are not divisible. Repeat the above process till no two of the numbers are divisible by the same number except 1. The product of the divisors and the undivided numbers is the required L.C.M. of the given numbers.
4. **Product of two numbers = Product of their H.C.F. and L.C.M.**
5. **Co-primes:** Two numbers are said to be co-primes if their H.C.F. is 1.
6. **H.C.F. and L.C.M. of Fractions:**

$$1. \text{H.C.F.} = \frac{\text{H.C.F. of Numerators}}{\text{L.C.M. of Denominators}}$$

$$2. \text{L.C.M.} = \frac{\text{L.C.M. of Numerators}}{\text{H.C.F. of Denominators}}$$

#### 8. H.C.F. and L.C.M. of Decimal Fractions:

In a given numbers, make the same number of decimal places by annexing zeros in some numbers, if necessary. Considering these numbers without decimal point, find H.C.F. or L.C.M. as the case may be. Now, in the result, mark off as many decimal places as are there in each of the given numbers.

#### 9. Comparison of Fractions:

Find the L.C.M. of the denominators of the given fractions. Convert each of the fractions into an equivalent fraction with L.C.M as the denominator, by multiplying both the numerator and denominator by the same number. The resultant fraction with the greatest numerator is the greatest.

1. Find the greatest number that will divide 43, 91 and 183 so as to leave the same remainder in each case.

A. 4

B. 7

C. 9

D. 13

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

Required number = H.C.F. of (91 - 43), (183 - 91) and (183 - 43)

= H.C.F. of 48, 92 and 140 = 4.

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2. The H.C.F. of two numbers is 23 and the other two factors of their L.C.M. are 13 and 14. The larger of the two numbers is:

- A. 276      B. 299  
C. 322      D. 345

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Clearly, the numbers are  $(23 \times 13)$  and  $(23 \times 14)$ .

$\therefore$  Larger number =  $(23 \times 14) = 322$ .

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3. Six bells commence tolling together and toll at intervals of 2, 4, 6, 8, 10 and 12 seconds respectively. In 30 minutes, how many times do they toll together ?

- A. 4      B. 10  
C. 15      D. 16

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

L.C.M. of 2, 4, 6, 8, 10, 12 is 120.

So, the bells will toll together after every 120 seconds(2 minutes).

In 30 minutes, they will toll together  $\frac{30}{2} + 1 = 16$  times.

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4. Let N be the greatest number that will divide 1305, 4665 and 6905, leaving the same remainder

in each case. Then sum of the digits in N is:

A. 4

B. 5

C. 6

D. 8

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$N = \text{H.C.F. of } (4665 - 1305), (6905 - 4665) \text{ and } (6905 - 1305)$

= H.C.F. of 3360, 2240 and 5600 = 1120.

Sum of digits in N = ( 1 + 1 + 2 + 0 ) = 4

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5. The greatest number of four digits which is divisible by 15, 25, 40 and 75 is:

A. 9000

B. 9400

C. 9600

D. 9800

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Greatest number of 4-digits is 9999.

L.C.M. of 15, 25, 40 and 75 is 600.

On dividing 9999 by 600, the remainder is 399.

- ∴ Required number  $(9999 - 399) = 9600$ .
6. The product of two numbers is 4107. If the H.C.F. of these numbers is 37, then the greater number is:

A. 101

B. 107

C. 111

D. 185

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the numbers be  $37a$  and  $37b$ .

Then,  $37a \times 37b = 4107$

$$\Rightarrow ab = 3.$$

Now, co-primes with product 3 are (1, 3).

So, the required numbers are  $(37 \times 1, 37 \times 3)$  i.e., (37, 111).

$\therefore$  Greater number = 111.

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7. Three numbers are in the ratio of 3 : 4 : 5 and their L.C.M. is 2400. Their H.C.F. is:

A. 40

B. 80

C. 120

D. 200

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let the numbers be  $3x$ ,  $4x$  and  $5x$ .

Then, their L.C.M. =  $60x$ .

So,  $60x = 2400$  or  $x = 40$ .

$\therefore$  The numbers are  $(3 \times 40)$ ,  $(4 \times 40)$  and  $(5 \times 40)$ .

Hence, required H.C.F. = 40.

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8. The G.C.D. of 1.08, 0.36 and 0.9 is:

A. 0.03

B. 0.9

C. 0.18

D. 0.108

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Given numbers are 1.08, 0.36 and 0.90. H.C.F. of 108, 36 and 90 is 18,

$\therefore$  H.C.F. of given numbers = 0.18.

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9. The product of two numbers is 2028 and their H.C.F. is 13. The number of such pairs is:

A. 1

B. 2

C. 3

D. 4

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10. The least multiple of 7, which leaves a remainder of 4, when divided by 6, 9, 15 and 18 is:

A. 74

B. 94

C. 184

D. 364

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

L.C.M. of 6, 9, 15 and 18 is 90.

Let required number be  $90k + 4$ , which is multiple of 7.

Least value of  $k$  for which  $(90k + 4)$  is divisible by 7 is  $k = 4$ .

$\therefore$  Required number =  $(90 \times 4) + 4 = 364$

16. The H.C.F. of two numbers is 11 and their L.C.M. is 7700. If one of the numbers is 275, then the other is:

A. 279

B. 283

C. 308

D. 318

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

$$\text{Other number} = \left( \frac{11 \times 7700}{275} \right) = 308.$$

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17. What will be the least number which when doubled will be exactly divisible by 12, 18, 21 and 30 ?

A. 196

B. 630

C. 1260

D. 2520

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

L.C.M. of 12, 18, 21 30

$$= 2 \times 3 \times 2 \times 3 \times 7 \times 5 = 1260.$$

$$\text{Required number} = (1260 \div 2)$$

$$= 630.$$

$$\begin{array}{r} 2 \mid 12 & - & 18 & - & 21 & - & 30 \\ \hline & 3 \mid 6 & - & 9 & - & 21 & - & 15 \\ \hline & & | & 2 & - & 3 & - & 7 & - & 5 \end{array}$$

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18. The ratio of two numbers is 3 : 4 and their H.C.F. is 4. Their L.C.M. is:

A. 12

B. 16

C. 24

D. 48

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

Let the numbers be  $3x$  and  $4x$ . Then, their H.C.F. =  $x$ . So,  $x = 4$ .

So, the numbers 12 and 16.

L.C.M. of 12 and 16 = 48.

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19. The smallest number which when diminished by 7, is divisible 12, 16, 18, 21 and 28 is:

A. 1008

B. 1015

C. 1022

D. 1032

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Required number = (L.C.M. of 12,16, 18, 21, 28) + 7

$$= 1008 + 7$$

$$= 1015$$

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20. 252 can be expressed as a product of primes as:

A.  $2 \times 2 \times 3 \times 3 \times 7$

B.  $2 \times 2 \times 2 \times 3 \times 7$

C.  $3 \times 3 \times 3 \times 3 \times 7$

D.  $2 \times 3 \times 3 \times 3 \times 7$

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Clearly,  $252 = 2 \times 2 \times 3 \times 3 \times 7$ .

26. The greatest number which on dividing 1657 and 2037 leaves remainders 6 and 5 respectively, is:

A. 123

B. 127

C. 235

D. 305

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Required number = H.C.F. of (1657 - 6) and (2037 - 5)

= H.C.F. of 1651 and 2032 = 127.

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27. Which of the following has the most number of divisors?

A. 99

B. 101

C. 176

D. 182

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$99 = 1 \times 3 \times 3 \times 11$

$101 = 1 \times 101$

$176 = 1 \times 2 \times 2 \times 2 \times 2 \times 11$

$182 = 1 \times 2 \times 7 \times 13$

So, divisors of 99 are 1, 3, 9, 11, 33, .99

Divisors of 101 are 1 and 101

Divisors of 176 are 1, 2, 4, 8, 11, 16, 22, 44, 88 and 176

Divisors of 182 are 1, 2, 7, 13, 14, 26, 91 and 182.

Hence, 176 has the most number of divisors.

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28. The L.C.M. of two numbers is 48. The numbers are in the ratio 2 : 3. Then sum of the number is:

A. 28

B. 32

C. 40

D. 64

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the numbers be  $2x$  and  $3x$ .

Then, their L.C.M. =  $6x$ .

So,  $6x = 48$  or  $x = 8$ .

$\therefore$  The numbers are 16 and 24.

Hence, required sum =  $(16 + 24) = 40$ .

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29. The H.C.F. of  $\frac{9}{10}, \frac{12}{25}, \frac{18}{35}$  and  $\frac{21}{40}$  is:

A.  $\frac{3}{5}$

B.  $\frac{252}{5}$

C.  $\frac{3}{1400}$

D.  $\frac{63}{700}$

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30. If the sum of two numbers is 55 and the H.C.F. and L.C.M. of these numbers are 5 and 120 respectively, then the sum of the reciprocals of the numbers is equal to:

A.  $\frac{55}{601}$

B.  $\frac{601}{55}$

C.  $\frac{11}{120}$

D.  $\frac{120}{11}$

### Answer & Explanation

**Answer:** Option C

**Explanation:**

Let the numbers be  $a$  and  $b$ .

Then,  $a + b = 55$  and  $ab = 5 \times 120 = 600$ .

$$\therefore \text{The required sum} = \frac{1}{a} + \frac{1}{b} = \frac{a+b}{ab} = \frac{55}{600} = \frac{11}{120}$$

## Square Root and Cube Root

### Formulas

#### 1. Square Root:

If  $x^2 = y$ , we say that the square root of  $y$  is  $x$  and we write  $y = x$ .

Thus,  $4 = 2$ ,  $9 = 3$ ,  $196 = 14$ .

#### 2. Cube Root:

The cube root of a given number  $x$  is the number whose cube is  $x$ .

We, denote the cube root of  $x$  by  $x$ .

Thus,  $8 = 2 \times 2 \times 2 = 2$ ,  $343 = 7 \times 7 \times 7 = 7$  etc.

### Note:

1.  $xy = x \times y$

2.  $\frac{x}{y} = \frac{x}{y} = \frac{x}{y} \times \frac{y}{y} = \frac{xy}{y}$ .

1. The cube root of .000216 is:

A. .6

B. .06

C. 77

D. 87

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$(.000216)^{1/3} = \left( \frac{216}{10^6} \right)^{1/3}$$

$$= \left( \frac{6 \times 6 \times 6}{10^2 \times 10^2 \times 10^2} \right)^{1/3}$$

$$= \frac{6}{10^2}$$

$$= \frac{6}{100}$$

$$= 0.06$$

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2.

What should come in place of both  $x$  in the equation  $\frac{x}{128} = \frac{162}{x}$ .

A. 12

B. 14

C. 144

D. 196

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\text{Let } \frac{x}{128} = \frac{162}{x}$$

Then  $x^2 = 128 \times 162$

$$= 64 \times 2 \times 18 \times 9$$

$$= 8^2 \times 6^2 \times 3^2$$

$$= 8 \times 6 \times 3$$

$$= 144.$$

$$\therefore x = 144 = 12.$$

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3. The least perfect square, which is divisible by each of 21, 36 and 66 is:

A. 213444

B. 214344

C. 214434

D. 231444

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

L.C.M. of 21, 36, 66 = 2772.

Now,  $2772 = 2 \times 2 \times 3 \times 3 \times 7 \times 11$

To make it a perfect square, it must be multiplied by  $7 \times 11$ .

So, required number =  $2^2 \times 3^2 \times 7^2 \times 11^2 = 213444$

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4.  $1.5625 = ?$

A. 1.05

B. 1.25

C. 1.45

D. 1.55

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

$$\begin{array}{r} 1 \mid 1.5625 ( 1.25 \\ | 1 \\ | \text{-----} \\ 22 | \quad 56 \\ | \quad 44 \\ | \text{-----} \\ 245 | \quad 1225 \\ | \quad 1225 \\ | \text{-----} \\ | \quad \quad X \\ | \text{-----} \end{array}$$

$$\therefore 1.5625 = 1.25.$$

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- 
5. If  $35 + 125 = 17.88$ , then what will be the value of  $80 + 65$  ?

A. 13.41

B. 20.46

C. 21.66

D. 22.35

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

$$35 + 125 = 17.88$$

$$\Rightarrow 35 + 25 \times 5 = 17.88$$

$$\Rightarrow 35 + 55 = 17.88$$

$$\Rightarrow 85 = 17.88$$

$$\Rightarrow 5 = 2.235$$

$$\therefore 80 + 65 = 16 \times 5 + 65$$

$$= 45 + 65$$

$$= 105 = (10 \times 2.235) = 22.35$$

6. If  $a = 0.1039$ , then the value of  $4a^2 - 4a + 1 + 3a$  is:

A. 0.1039

B. 0.2078

C. 1.1039

D. 2.1039

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$4a^2 - 4a + 1 + 3a = (1)^2 + (2a)^2 - 2 \times 1 \times 2a + 3a$$

$$= (1 - 2a)^2 + 3a$$

$$= (1 - 2a) + 3a$$

$$= (1 + a)$$

$$= (1 + 0.1039)$$

$$= 1.1039$$

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- 
7. If  $x = \frac{3+1}{3-1}$  and  $y = \frac{3-1}{3+1}$ , then the value of  $(x^2 + y^2)$  is:

A. 10

B. 13

C. 14

D. 15

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$x = \frac{(3+1)}{(3-1)} \times \frac{(3+1)}{(3+1)} = \frac{(3+1)^2}{(3-1)} = \frac{3+1+23}{2} = 2+3.$$

$$y = \frac{(3 - 1)}{(3 + 1)} \times \frac{(3 - 1)}{(3 - 1)} = \frac{(3 - 1)^2}{(3 - 1)} = \frac{3 + 1 - 23}{2} = 2 - 3.$$

$$\therefore x^2 + y^2 = (2 + 3)^2 + (2 - 3)^2$$

$$= 2(4 + 3)$$

$$= 14$$

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8. A group of students decided to collect as many paise from each member of group as is the number of members. If the total collection amounts to Rs. 59.29, the number of the member is the group is:

**A.** 57

**B.** 67

**C.** 77

**D.** 87

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Money collected =  $(59.29 \times 100)$  paise = 5929 paise.

$\therefore$  Number of members = 5929 = 77.

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9. The square root of  $(7 + 35)(7 - 35)$  is

**A.** 5

**B.** 2

**C.** 4

**D.** 35

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$(7 + 35)(7 - 35) = (7)^2 - (35)^2 = 49 - 45 = 4 = 2.$$

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10.

If  $5 = 2.236$ , then the value of  $\frac{5}{2} - \frac{10}{5} + 125$  is equal to:

**A.** 5.59

**B.** 7.826

**C.** 8.944

**D.** 10.062

[Answer & Explanation](#)

**Answer:** Option **B**

**Explanation:**

$$\frac{5}{2} - \frac{10}{5} + 125 = \frac{(5)^2 - 20 + 25 \times 55}{25}$$

$$= \frac{5 - 20 + 50}{25}$$

$$= \frac{35}{25} \times \frac{5}{5}$$

$$= \frac{355}{10}$$

$$= \frac{7 \times 2.236}{2}$$

$$= 7 \times 1.118$$

$$= 7.826$$

11.  $\left( \frac{625}{11} \times \frac{14}{25} \times \frac{11}{196} \right)$  is equal to:

A. 5

B. 6

C. 8

D. 11

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$\text{Given Expression} = \frac{25}{11} \times \frac{14}{5} \times \frac{11}{14} = 5.$$

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12.  $0.0169 \times ? = 1.3$

A. 10

B. 100

C. 1000

D. None of these

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let  $0.0169 \times x = 1.3$ .

Then,  $0.0169x = (1.3)^2 = 1.69$

$$\Rightarrow x = \frac{1.69}{0.0169} = 100$$

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13.  $\left(3 - \frac{1}{3}\right)^2$  simplifies to:

A.  $\frac{3}{-}$

B.  $\frac{4}{-}$

4

3

4

C.  $\frac{1}{3}$

D. None of these

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

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

$$= 3 + \frac{1}{3} - 2$$

$$= 1 + \frac{1}{3}$$

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

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- 
14. How many two-digit numbers satisfy this property.: The last digit (unit's digit) of the square of the two-digit number is 8 ?

A. 1

B. 2

C. 3

D. None of these

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

A number ending in 8 can never be a perfect square.

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15. The square root of 64009 is:

A. 253

B. 347

C. 363

D. 803

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$\begin{array}{r} 2 | 64009 \quad ( \quad 253 \\ | 4 \\ | \hline 45 | 240 \\ | 225 \\ | \hline 503 | 1509 \\ | 1509 \\ | \hline \quad \quad x \\ | \hline \end{array}$$

$$\therefore 64009 = 253$$

## Chain Rule

Formulas

### 1. Direct Proportion:

Two quantities are said to be directly proportional, if on the increase (or decrease) of the one, the other increases (or decreases) to the same extent.

Eg. Cost is directly proportional to the number of articles.  
(More Articles, More Cost)

### 2. Indirect Proportion:

Two quantities are said to be indirectly proportional, if on the increase of the one, the other decreases to the same extent and vice-versa.

Eg. The time taken by a car is covering a certain distance is inversely proportional to the speed of the car. (More speed, Less is the time taken to cover a distance.)

**Note:** In solving problems by chain rule, we compare every item with the term to be found out.

1. 3 pumps, working 8 hours a day, can empty a tank in 2 days. How many hours a day must 4 pumps work to empty the tank in 1 day?

A. 9

B. 10

C. 11

P. 12

## Answer & Explanation

**Answer:** Option D

## Explanation:

Let the required number of working hours per day be  $x$ .

*More pumps, Less working hours per day (Indirect Proportion)*

*Less days, More working hours per day (Indirect Proportion)*

$$\left. \begin{array}{r} \text{Pumps } 4 : 3 \\ \text{Days } 1 : 2 \end{array} \right\} :: 8 : x$$

$$\therefore 4 \times 1 \times x = 3 \times 2 \times 8$$

$$\Rightarrow x = \frac{(3 \times 2 \times 8)}{(4)}$$

$$\Rightarrow x = 12.$$

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2. If the cost of  $x$  metres of wire is  $d$  rupees, then what is the cost of  $y$  metres of wire at the same rate?

A.  $\frac{xy}{d}$

**B.** Rs. ( $xd$ )

**C.** Rs. ( $yd$ )

**D.**  $\frac{y}{x}$

### Answer & Explanation

**Answer:** Option D

**Explanation:**

Cost of  $x$  metres = Rs. d.

$$\text{Cost of 1 metre} = \text{Rs. } \left( \frac{d}{x} \right)$$

$$\text{Cost of } y \text{ metres} = \text{Rs. } \left( \frac{d}{x} \cdot y \right) = \text{Rs. } \left( \frac{yd}{x} \right).$$

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- 
3. Running at the same constant rate, 6 identical machines can produce a total of 270 bottles per minute. At this rate, how many bottles could 10 such machines produce in 4 minutes?

A. 648

B. 1800

C. 2700

D. 10800

### Answer & Explanation

**Answer:** Option B

**Explanation:**

Let the required number of bottles be  $x$ .

*More machines, More bottles (Direct Proportion)*

*More minutes, More bottles (Direct Proportion)*

$$\begin{array}{lcl} \text{Machines} & 6 : 10 & \\ & & \left. \vphantom{6:10} \right\} :: 270 : x \\ \text{Time (in minutes)} & 1 : 4 & \end{array}$$

$$\therefore 6 \times 1 \times x = 10 \times 4 \times 270$$

$$\Rightarrow x = (10 \times 4 \times 270)$$

---

(6)

$$\Rightarrow x = 1800.$$

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- 
4. A fort had provision of food for 150 men for 45 days. After 10 days, 25 men left the fort. The number of days for which the remaining food will last, is:

A.  $29\frac{1}{5}$

B.  $37\frac{1}{4}$

C. 42

D. 54

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

After 10 days : 150 men had food for 35 days.

Suppose 125 men had food for  $x$  days.

Now, Less men, More days (Indirect Proportion)

$$\therefore 125 : 150 :: 35 : x \Leftrightarrow 125 \times x = 150 \times 35$$

$$\Rightarrow x = \frac{150 \times 35}{125}$$

$$\Rightarrow x = 42.$$

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- 
5. 39 persons can repair a road in 12 days, working 5 hours a day. In how many days will 30 persons, working 6 hours a day, complete the work?

A. 10

B. 13

C. 14

D. 15

### Answer & Explanation

**Answer:** Option **B**

**Explanation:**

Let the required number of days be  $x$ .

*Less persons, More days (Indirect Proportion)*

*More working hours per day, Less days (Indirect Proportion)*

$$\begin{array}{l} \text{Persons} \quad \quad \quad 30 : 39 \\ & \qquad \qquad \qquad \left. \vphantom{30:39} \right\} :: 12 : x \\ \text{Working hours/day} \quad 6 : 5 \end{array}$$

$$\therefore 30 \times 6 \times x = 39 \times 5 \times 12$$

$$\Rightarrow x = \frac{(39 \times 5 \times 12)}{(30 \times 6)}$$

$$\Rightarrow x = 13$$

6.

A man completes  $\frac{5}{8}$  of a job in 10 days. At this rate, how many more days will it takes him to finish the job?

**A.** 5

**B.** 6

**C.** 7

**D.**  $7\frac{1}{2}$

### Answer & Explanation

**Answer:** Option **B**

**Explanation:**

$$\text{Work done} = \frac{5}{8}$$

$$\text{Balance work} = \left(1 - \frac{5}{8}\right) = \frac{3}{8}$$

Let the required number of days be  $x$ .

$$\text{Then, } \frac{5}{8} : \frac{3}{8} :: 10 : x \Leftrightarrow \frac{5}{8} \times x = \frac{3}{8} \times 10$$

$$\Rightarrow x = \left(\frac{3}{8} \times 10 \times \frac{8}{5}\right)$$

$$\Rightarrow x = 6.$$

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7. If a quarter kg of potato costs 60 paise, how many paise will 200 gm cost?

**A.** 48 paise

**B.** 54 paise

**C.** 56 paise

**D.** 72 paise

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Let the required weight be  $x$  kg.

*Less weight, Less cost (Direct Proportion)*

$$\therefore 250 : 200 :: 60 : x \Leftrightarrow 250 \times x = (200 \times 60)$$

$$\Rightarrow x = \frac{(200 \times 60)}{250}$$

$$\Rightarrow x = 48.$$

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8. In a dairy farm, 40 cows eat 40 bags of husk in 40 days. In how many days one cow will eat one bag of husk?

A. 1

B.  $\frac{1}{40}$

C. 40

D. 80

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Let the required number of days be  $x$ .

*Less cows, More days (Indirect Proportion)*

*Less bags, Less days (Direct Proportion)*

$$\begin{array}{l} \text{Cows } 1 : 40 \\ \qquad\qquad\qquad\left.\right\} :: 40 : x \\ \text{Bags } 40 : 1 \end{array}$$

$$\therefore 1 \times 40 \times x = 40 \times 1 \times 40$$

$$\Rightarrow x = 40.$$

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- 
9. A wheel that has 6 cogs is meshed with a larger wheel of 14 cogs. When the smaller wheel has made 21 revolutions, then the number of revolutions mad by the larger wheel is:

A. 4

B. 9

C. 12

D. 49

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let the required number of revolutions made by larger wheel be  $x$ .

Then, *More cogs, Less revolutions (Indirect Proportion)*

$$\therefore 14 : 6 :: 21 : x \Leftrightarrow 14 \times x = 6 \times 21$$

$$\Rightarrow x = \frac{6 \times 21}{14}$$

$$\Rightarrow x = 9.$$

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10. If 7 spiders make 7 webs in 7 days, then 1 spider will make 1 web in how many days?

7

**A.** 1

**B.**  $\frac{7}{2}$

**C.** 7

**D.** 49

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Let the required number days be  $x$ .

*Less spiders, More days (Indirect Proportion)*

*Less webs, Less days (Direct Proportion)*

$$\begin{array}{l} \text{Spiders } 1 : 7 \\ \text{Webs } 7 : 1 \end{array} \left. \begin{array}{c} \\ \end{array} \right\} :: 7 : x$$

$$\therefore 1 \times 7 \times x = 7 \times 1 \times 7$$

$$\Rightarrow x = 7.$$

11. A flagstaff 17.5 m high casts a shadow of length 40.25 m. The height of the building, which casts

a shadow of length 28.75 m under similar conditions will be:

- |           |            |
|-----------|------------|
| A. 10 m   | B. 12.5 m  |
| C. 17.5 m | D. 21.25 m |

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the height of the building  $x$  metres.

*Less lengthy shadow, Less in the height (Direct Proportion)*

$$\therefore 40.25 : 28.75 :: 17.5 : x \Leftrightarrow 40.25 \times x = 28.75 \times 17.5$$

$$x = \frac{28.75 \times 17.5}{40.25}$$

$$\Rightarrow x = 12.5$$

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- 
12. In a camp, there is a meal for 120 men or 200 children. If 150 children have taken the meal, how many men will be catered to with remaining meal?

- |       |       |
|-------|-------|
| A. 20 | B. 30 |
| C. 40 | D. 50 |

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

There is a meal for 200 children. 150 children have taken the meal.

Remaining meal is to be catered to 50 children.

Now, 200 children  $\equiv$  120 men.

$$50 \text{ children} \equiv \left[ \frac{120 \times 50}{200} \right] = 30 \text{ men.}$$

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13. An industrial loom weaves 0.128 metres of cloth every second. Approximately, how many seconds will it take for the loom to weave 25 metres of cloth?

A. 178

B. 195

C. 204

D. 488

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the required time be  $x$  seconds.

*More metres, More time (Direct Proportion)*

$$\therefore 0.128 : 25 :: 1 : x \Leftrightarrow 0.128x = 25 \times 1$$

$$x = \frac{25}{0.128} = \frac{25 \times 1000}{128}$$

$$\Rightarrow x = 195.31.$$

$\therefore$  Required time = 195 sec (approximately).

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14. 36 men can complete a piece of work in 18 days. In how many days will 27 men complete the same work?

A. 12

B. 18

C. 22

D. 24

E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let the required number of days be  $x$ .

*Less men, More days (Indirect Proportion)*

$$\therefore 27 : 36 :: 18 : x \Leftrightarrow 27 \times x = 36 \times 18$$

$$\Rightarrow x = \frac{36 \times 18}{27}$$

$$\Rightarrow x = 24.$$

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- 
15. 4 mat-weavers can weave 4 mats in 4 days. At the same rate, how many mats would be woven by 8 mat-weavers in 8 days?

A. 4

B. 8

C. 12

D. 16

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let the required number of bottles be  $x$ .

*More weavers, More mats (Direct Proportion)*

*More days, More mats (Direct Proportion)*

$$\begin{array}{l} \text{Wavers } 4 : 8 \\ \qquad\qquad\qquad\left.\right\} \\ \text{Days } 4 : 8 \end{array} :: 4 : x$$

$$\therefore 4 \times 4 \times x = 8 \times 8 \times 4$$

$$\Rightarrow x = \frac{(8 \times 8 \times 4)}{(4 \times 4)}$$

$$\Rightarrow x = 16.$$

## Alligation or Mixture

### Formulas

#### 1. Alligation:

It is the rule that enables us to find the ratio in which two or more ingredients at the given price must be mixed to produce a mixture of desired price.

#### 2. Mean Price:

The cost of a unit quantity of the mixture is called the mean price.

#### 3. Rule of Alligation:

If two ingredients are mixed, then

$$\left( \frac{\text{Quantity of cheaper}}{\text{Quantity of dearer}} \right) = \left( \frac{\text{C.P. of dearer} - \text{Mean Price}}{\text{Mean price} - \text{C.P. of cheaper}} \right)$$

We present as under:

C.P. of a unit quantity of cheaper	C.P. of a unit quantity of dearer
---------------------------------------	--------------------------------------

(c)	Mean Price	(d)
(d - m)	(m)	(m - c)

$$\therefore (\text{Cheaper quantity}) : (\text{Dearer quantity}) = (d - m) : (m - c).$$

#### 4. Suppose a container contains $x$ of liquid from which $y$ units are taken out and replaced by water.

$$\text{After } n \text{ operations, the quantity of pure liquid} = \left[ x \left( 1 - \frac{y}{x} \right)^n \right] \text{ units.}$$

1. A vessel is filled with liquid, 3 parts of which are water and 5 parts syrup. How much of the mixture must be drawn off and replaced with water so that the mixture may be half water and half syrup?

- A.  $\frac{1}{3}$       B.  $\frac{1}{4}$   
C.  $\frac{1}{5}$       D.  $\frac{1}{7}$

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

Suppose the vessel initially contains 8 litres of liquid.

Let  $x$  litres of this liquid be replaced with water.

$$\text{Quantity of water in new mixture} = \left( 3 - \frac{3x}{8} + x \right) \text{ litres}$$

$$\text{Quantity of syrup in new mixture} = \left( 5 - \frac{5x}{8} \right) \text{ litres}$$

$$\therefore \left( 3 - \frac{3x}{8} + x \right) = \left( 5 - \frac{5x}{8} \right)$$

$$\Rightarrow 5x + 24 = 40 - 5x$$

$$\Rightarrow 10x = 16$$

$$\Rightarrow x = \frac{8}{5}$$

$$\text{So, part of the mixture replaced} = \left( \frac{8}{5} \times \frac{1}{8} \right) = \frac{1}{5}$$

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2. Tea worth Rs. 126 per kg and Rs. 135 per kg are mixed with a third variety in the ratio 1 : 1 : 2. If the mixture is worth Rs. 153 per kg, the price of the third variety per kg will be:

A. Rs. 169.50

B. Rs. 170

C. Rs. 175.50

D. Rs. 180

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Since first and second varieties are mixed in equal proportions.

So, their average price = Rs.  $\left( \frac{126 + 135}{2} \right)$  = Rs. 130.50

So, the mixture is formed by mixing two varieties, one at Rs. 130.50 per kg and the other at say, Rs. x per kg in the ratio 2 : 2, i.e., 1 : 1. We have to find x.

By the rule of alligation, we have:

$$\text{Cost of 1 kg of 1^{st} kind} \text{Cost of 1 kg tea of 2^{nd} kind}$$

Rs. 130.50	Mean Price	Rs. x
(x - 153)	Rs. 153	22.50

$$\therefore \frac{x - 153}{22.50} = 1$$

$$\Rightarrow x - 153 = 22.50$$

$$\Rightarrow x = 175.50$$

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3. A can contains a mixture of two liquids A and B in the ratio 7 : 5. When 9 litres of mixture are drawn off and the can is filled with B, the ratio of A and B becomes 7 : 9. How many litres of liquid A was contained by the can initially?

A. 10

B. 20

C. 21

D. 25

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Suppose the can initially contains  $7x$  and  $5x$  of mixtures A and B respectively.

$$\text{Quantity of A in mixture left} = \left( 7x - \frac{7}{12} \times 9 \right) \text{ litres} = \left( 7x - \frac{21}{4} \right) \text{ litres.}$$

$$\text{Quantity of B in mixture left} = \left( 5x - \frac{5}{12} \times 9 \right) \text{ litres} = \left( 5x - \frac{15}{4} \right) \text{ litres.}$$

$$\therefore \frac{\left( 7x - \frac{21}{4} \right)}{\left( 5x - \frac{15}{4} \right) + 9} = \frac{7}{9}$$

$$\Rightarrow \frac{28x - 21}{20x + 21} = \frac{7}{9}$$

$$\Rightarrow 252x - 189 = 140x + 147$$

$$\Rightarrow 112x = 336$$

$$\Rightarrow x = 3.$$

So, the can contained 21 litres of A.

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- 
4. A milk vendor has 2 cans of milk. The first contains 25% water and the rest milk. The second contains 50% water. How much milk should he mix from each of the containers so as to get 12 litres of milk such that the ratio of water to milk is 3 : 5?

A. 4 litres, 8 litres

B. 6 litres, 6 litres

C. 5 litres, 7 litres

D. 7 litres, 5 litres

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the cost of 1 litre milk be Re. 1

Milk in 1 litre mix. in 1<sup>st</sup> can =  $\frac{3}{4}$  litre, C.P. of 1 litre mix. in 1<sup>st</sup> can Re.  $\frac{3}{4}$

Milk in 1 litre mix. in 2<sup>nd</sup> can =  $\frac{1}{2}$  litre, C.P. of 1 litre mix. in 2<sup>nd</sup> can Re.  $\frac{1}{2}$

Milk in 1 litre of final mix. =  $\frac{5}{8}$  litre, Mean price = Re.  $\frac{5}{8}$

By the rule of alligation, we have:

C.P. of 1 litre mixture in 1<sup>st</sup> can    C.P. of 1 litre mixture in 2<sup>nd</sup> can

3	Mean Price	1
$\frac{3}{4}$		$\frac{1}{2}$
	5	
1	$\frac{1}{8}$	1
$\frac{1}{8}$		$\frac{1}{8}$

$\therefore$  Ratio of two mixtures =  $\frac{1}{8} : \frac{1}{8} = 1 : 1$ .

So, quantity of mixture taken from each can =  $\left( \frac{1}{2} \times 12 \right) = 6$  litres.

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- 
5. In what ratio must a grocer mix two varieties of pulses costing Rs. 15 and Rs. 20 per kg respectively so as to get a mixture worth Rs. 16.50 kg?

A. 3 : 7

B. 5 : 7

C. 7 : 3

D. 7 : 5

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

By the rule of alligation:

Cost of 1 kg pulses of 1<sup>st</sup> kind Cost of 1 kg pulses of 2<sup>nd</sup> kind

Rs. 15	Mean Price	Rs. 20
3.50	Rs. 16.50	1.50

∴ Required rate = 3.50 : 1.50 = 7 : 3.

6. A dishonest milkman professes to sell his milk at cost price but he mixes it with water and thereby gains 25%. The percentage of water in the mixture is:

A. 4%

B.  $6\frac{1}{4}\%$

C. 20%

D. 25%

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Let C.P. of 1 litre milk be Re. 1

Then, S.P. of 1 litre of mixture = Re. 1, Gain = 25%.

$$\text{C.P. of 1 litre mixture} = \text{Re. } \left( \frac{100}{125} \times 1 \right) = \frac{4}{5}$$

By the rule of alligation, we have:

C.P. of 1 litre of milk C.P. of 1 litre of water

Re. 1	Mean Price	0
4	4	1
—	Re. —	—
5	5	5

$$\therefore \text{Ratio of milk to water} = \frac{4}{5} : \frac{1}{5} = 4 : 1.$$

$$\text{Hence, percentage of water in the mixture} = \left( \frac{1}{5} \times 100 \right) \% = 20\%.$$

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7. How many kilogram of sugar costing Rs. 9 per kg must be mixed with 27 kg of sugar costing Rs. 7 per kg so that there may be a gain of 10% by selling the mixture at Rs. 9.24 per kg?

- |          |          |
|----------|----------|
| A. 36 kg | B. 42 kg |
| C. 54 kg | D. 63 kg |

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

S.P. of 1 kg of mixture = Rs. 9.24, Gain 10%.

$$\therefore \text{C.P. of 1 kg of mixture} = \text{Rs.} \left( \frac{100}{110} \times 9.24 \right) = \text{Rs.} 8.40$$

By the rule of alligation, we have:

C.P. of 1 kg sugar of 1<sup>st</sup> kind Cost of 1 kg sugar of 2<sup>nd</sup> kind

Rs. 9	Mean Price	Rs. 7
1.40	Rs. 8.40	0.60

$\therefore$  Ratio of quantities of 1<sup>st</sup> and 2<sup>nd</sup> kind = 14 : 6 = 7 : 3.

Let  $x$  kg of sugar of 1<sup>st</sup> be mixed with 27 kg of 2<sup>nd</sup> kind.

Then,  $7 : 3 = x : 27$

$$\Rightarrow x = \left( \frac{7 \times 27}{3} \right) = 63 \text{ kg.}$$

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8. A container contains 40 litres of milk. From this container 4 litres of milk was taken out and replaced by water. This process was repeated further two times. How much milk is now contained by the container?

- A.** 26.34 litres      **B.** 27.36 litres  
**C.** 28 litres      **D.** 29.16 litres

## Answer & Explanation

**Answer:** Option D

## Explanation:

$$\text{Amount of milk left after 3 operations} = \left[ 40 \left( 1 - \frac{4}{40} \right)^3 \right] \text{ litres}$$

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9. A jar full of whisky contains 40% alcohol. A part of this whisky is replaced by another containing 19% alcohol and now the percentage of alcohol was found to be 26%. The quantity of whisky replaced is:

- |    |               |    |               |
|----|---------------|----|---------------|
| A. | $\frac{1}{3}$ | B. | $\frac{2}{3}$ |
| C. | $\frac{2}{5}$ | D. | $\frac{3}{5}$ |

### Answer & Explanation

**Answer:** Option B

#### Explanation:

By the rule of alligation, we have:

Strength of first jar Strength of 2<sup>nd</sup> jar

40%	Mean Strength	19%
7	26%	14

So, ratio of 1<sup>st</sup> and 2<sup>nd</sup> quantities = 7 : 14 = 1 : 2

$$\therefore \text{Required quantity replaced} = \frac{2}{3}$$

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10.

In what ratio must water be mixed with milk to gain  $16\frac{2}{3}\%$  on selling the mixture at cost price?

A. 1 : 6

B. 6 : 1

C. 2 : 3

D. 4 : 3

### Answer & Explanation

**Answer:** Option A

#### Explanation:

Let C.P. of 1 litre milk be Re. 1.

$$\text{S.P. of 1 litre of mixture} = \text{Re. 1}, \text{Gain} = \frac{50}{3}\%.$$

$$\therefore \text{C.P. of 1 litre of mixture} = \left( 100 \times \frac{3}{350} \times 1 \right) = \frac{6}{7}$$

By the rule of alligation, we have:

C.P. of 1 litre of water C.P. of 1 litre of milk

0	Mean Price	Re. 1
1		6
$\frac{1}{7}$	Re. $\frac{6}{7}$	$\frac{6}{7}$

$$\therefore \text{Ratio of water and milk} = \frac{1}{7} : \frac{6}{7} = 1 : 6.$$

11. Find the ratio in which rice at Rs. 7.20 a kg be mixed with rice at Rs. 5.70 a kg to produce a mixture worth Rs. 6.30 a kg.

A. 1 : 3

B. 2 : 3

C. 3 : 4

D. 4 : 5

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

By the rule of alligation:

Cost of 1 kg of 1<sup>st</sup> kind Cost of 1 kg of 2<sup>nd</sup> kind

720 p	Mean Price	570 p
60	630 p	90

$$\therefore \text{Required ratio} = 60 : 90 = 2 : 3.$$

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- 
12. In what ratio must a grocer mix two varieties of tea worth Rs. 60 a kg and Rs. 65 a kg so that by selling the mixture at Rs. 68.20 a kg he may gain 10%?

A. 3 : 2

B. 3 : 4

C. 3 : 5

D. 4 : 5

### Answer & Explanation

**Answer:** Option A

#### Explanation:

S.P. of 1 kg of the mixture = Rs. 68.20, Gain = 10%.

$$\text{C.P. of 1 kg of the mixture} = \text{Rs. } \left( \frac{100}{110} \times 68.20 \right) = \text{Rs. } 62.$$

By the rule of alligation, we have:

Cost of 1 kg tea of 1<sup>st</sup> kind. Cost of 1 kg tea of 2<sup>nd</sup> kind.

Rs. 60	Mean Price	Rs. 65
3	Rs. 62	2

∴ Required ratio = 3 : 2.

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- 
13. The cost of Type 1 rice is Rs. 15 per kg and Type 2 rice is Rs. 20 per kg. If both Type 1 and Type 2 are mixed in the ratio of 2 : 3, then the price per kg of the mixed variety of rice is:

- |           |              |
|-----------|--------------|
| A. Rs. 18 | B. Rs. 18.50 |
| C. Rs. 19 | D. Rs. 19.50 |

### Answer & Explanation

**Answer:** Option A

#### Explanation:

Let the price of the mixed variety be Rs.  $x$  per kg.

By rule of alligation, we have:

Cost of 1 kg of Type 1 rice Cost of 1 kg of Type 2 rice

Rs. 15	Mean Price	Rs. 20
--------	------------	--------

(20 - x)

Rs. x

(x - 15)

$$\therefore \frac{(20 - x)}{(x - 15)} = \frac{2}{3}$$

$$\Rightarrow 60 - 3x = 2x - 30$$

$$\Rightarrow 5x = 90$$

$$\Rightarrow x = 18.$$

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14. 8 litres are drawn from a cask full of wine and is then filled with water. This operation is performed three more times. The ratio of the quantity of wine now left in cask to that of water is 16 : 65. How much wine did the cask hold originally?

A. 18 litres

B. 24 litres

C. 32 litres

D. 42 litres

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let the quantity of the wine in the cask originally be  $x$  litres.

Then, quantity of wine left in cask after 4 operations =  $\left[ x \left( 1 - \frac{8}{x} \right)^4 \right]$  litres.

$$\therefore \left( \frac{x(1 - (8/x))^4}{x} \right) = \frac{16}{81}$$

$$\Rightarrow \left( 1 - \frac{8}{x} \right)^4 = \left( \frac{2}{3} \right)^4$$

$$\Rightarrow \left( \frac{x - 8}{x} \right) = \frac{2}{3}$$

$$\Rightarrow 3x - 24 = 2x$$

$$\Rightarrow x = 24.$$

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15. A merchant has 1000 kg of sugar, part of which he sells at 8% profit and the rest at 18% profit. He gains 14% on the whole. The quantity sold at 18% profit is:

A. 400 kg

B. 560 kg

C. 600 kg

D. 640 kg

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

By the rule of alligation, we have:

Profit on 1<sup>st</sup> part      Profit on 2<sup>nd</sup> part

8%	Mean Profit	18%
4	14%	6

Ration of 1<sup>st</sup> and 2<sup>nd</sup> parts = 4 : 6 = 2 : 3

$$\therefore \text{Quantity of 2<sup>nd</sup> kind} = \left( \frac{3}{5} \times 1000 \right)_{\text{kg}} = 600 \text{ kg.}$$

## Stocks and Shares

### Formulas

#### 1. Stock Capital:

The total amount of money needed to run the company is called the **stock capital**.

#### 2. Shares or Stock:

The whole capital is divided into small units, called **shares** or **stock**.

For each investment, the company issues a 'share-certificate', showing the value of each share and the number of shares held by a person.

The person who subscribes in shares or stock is called a **share holder** or **stock holder**.

### 3. **Dividend:**

The annual profit distributed among share holders is called **dividend**.

Dividend is paid annually as per share or as a percentage.

### 4. **Face Value:**

The value of a share or stock printed on the share-certificate is called its **Face Value** or **Nominal Value** or **Par Value**.

### 5. **Market Value:**

The stock of different companies are sold and bought in the open market through brokers at stock-exchanges. A share or stock is said to be:

- i. **At premium or Above par**, if its market value is more than its face value.
- ii. **At par**, if its market value is the same as its face value.
- iii. **At discount or Below par**, if its market value is less than its face value.

Thus, if a Rs. 100 stock is quoted at premium of 16, then market value of the stock = Rs.(100 + 16) = Rs. 116.

Likewise, if a Rs. 100 stock is quoted at a discount of 7, then market value of the stock = Rs. (100 - 7) = 93.

### 6. **Brokerage:**

The broker's charge is called **brokerage**.

- (i) When stock is purchased, brokerage is added to the cost price.
- (ii) When stock is sold, brokerage is subtracted from the selling price.

### **Remember:**

- i. The face value of a share always remains the same.
- ii. The market value of a share changes from time to time.
- iii. Dividend is always paid on the face value of a share.
- iv. Number of shares held by a person

$$= \frac{\text{Total Investment}}{\text{Investment in 1 share}} = \frac{\text{Total Income}}{\text{Income from 1 share}} = \frac{\text{Total Face Value}}{\text{Face of 1 share}}$$

7. Thus, by a Rs. 100, 9% stock at 120, we mean that:

  - Face Value of stock = Rs. 100.
  - Market Value (M.V) of stock = Rs. 120.
  - Annual dividend on 1 share = 9% of face value = 9% of Rs. 100 = Rs. 9.
  - An investment of Rs. 120 gives an annual income of Rs. 9.
  - Rate of interest p.a = Annual income from an investment of Rs. 100

$$= \left( \frac{9}{120} \times \frac{x}{100} \right) \% = \frac{1}{72} \%.$$

1. In order to obtain an income of Rs. 650 from 10% stock at Rs. 96, one must make an investment of:

- A.** Rs. 3100                            **B.** Rs. 6240  
**C.** Rs. 6500                            **D.** Rs. 9600

## Answer & Explanation

**Answer:** Option B

## Explanation:

To obtain Rs. 10, investment = Rs. 96.

To obtain Rs. 650, investment = Rs.  $\left( \frac{96}{10} \times 650 \right)$  = Rs. 6240.

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2. A man bought 20 shares of Rs. 50 at 5 discount, the rate of dividend being  $13\frac{1}{2}$ . The rate of interest obtained is:

- A.  $12\frac{1}{2}\%$

B.  $13\frac{1}{2}\%$

C. 15%

D.  $16\frac{2}{3}\%$

## Answer & Explanation

**Answer:** Option C

## Explanation:

Investment = Rs.  $[20 \times (50 - 5)]$  = Rs. 900.

Face value = Rs.  $(50 \times 20)$  = Rs. 1000.

$$\text{Dividend} = \text{Rs. } \left( \frac{27}{2} \times \frac{1000}{100} \right) = \text{Rs. } 135.$$

$$\text{Interest obtained} = \left( \frac{135}{900} \times 100 \right) \% = 15\%$$

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3.

Which is better investment: 11% stock at 143 or  $9\frac{3}{4}\%$  stock at 117?

A. 11% stock at 143

B.  $9\frac{3}{4}\%$  stock at 117

C. Both are equally good

D. Cannot be compared, as the total amount of investment is not given.

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

Let investment in each case be Rs.  $(143 \times 117)$ .

$$\text{Income in 1<sup>st</sup> case} = \text{Rs. } \left( \frac{11}{143} \times 143 \times 117 \right) = \text{Rs. } 1287.$$

$$\text{Income in 2<sup>nd</sup> case} = \text{Rs. } \left( \frac{39}{4 \times 117} \times 143 \times 117 \right) = \text{Rs. } 1394.25$$

Clearly,  $9\frac{3}{4}\%$  stock at 117 is better.

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4. A man buys Rs. 20 shares paying 9% dividend. The man wants to have an interest of 12% on his money. The market value of each share is:

- A. Rs. 12      B. Rs. 15  
C. Rs. 18      D. Rs. 21

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5. By investing in  $16\frac{2}{3}\%$  stock at 64, one earns Rs. 1500. The investment made is:

- A. Rs. 5640      B. Rs. 5760  
C. Rs. 7500      D. Rs. 9600

#### [Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

To earn Rs.  $\frac{50}{3}$ , investment = Rs. 64.

To earn Rs. 1500, investment = Rs.  $\left( 64 \times \frac{3}{50} \times 1500 \right)$  = Rs. 5760.

6. A 6% stock yields 8%. The market value of the stock is:

- A. Rs. 48      B. Rs. 75  
C. Rs. 96      D. Rs. 133.33

#### [Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

For an income of Rs. 8, investment = Rs. 100.

For an income of Rs. 6, investment = Rs.  $\left( \frac{100}{8} \times 6 \right)$  = Rs. 75.

$\therefore$  Market value of Rs. 100 stock = Rs. 75.

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7. A man invested Rs. 4455 in Rs. 10 shares quoted at Rs. 8.25. If the rate of dividend be 12%, his annual income is:

A. Rs. 207.40

B. Rs. 534.60

C. Rs. 648

D. Rs. 655.60

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\text{Number of shares} = \left( \frac{4455}{8.25} \right) = 540.$$

Face value = Rs.  $(540 \times 10)$  = Rs. 5400.

$$\text{Annual income} = \text{Rs. } \left( \frac{12}{100} \times 5400 \right) = \text{Rs. } 648.$$

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8. Rs. 9800 are invested partly in 9% stock at 75 and 10% stock at 80 to have equal amount of incomes. The investment in 9% stock is:

A. Rs. 4800

B. Rs. 5000

C. Rs. 5400

D. Rs. 5600

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let the investment in 9% stock be Rs.  $x$ .

Then, investment in 10% stock = Rs.  $(9800 - x)$ .

$$\frac{9}{75} \times x = \frac{10}{80} \times (9800 - x)$$

$$\Rightarrow \frac{3x}{25} = \frac{9800 - x}{8}$$

$$\Rightarrow 24x = 9800 \times 25 - 25x$$

$$\Rightarrow 49x = 9800 \times 25$$

$$\Rightarrow x = 5000.$$

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9. A man invests some money partly in 9% stock at 96 and partly in 12% stock at 120. To obtain equal dividends from both, he must invest the money in the ratio:

A. 3 : 4

B. 3 : 5

C. 4 : 5

D. 16 : 15

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

For an income of Re. 1 in 9% stock at 96, investment = Rs.  $\left(\frac{96}{9}\right) = \text{Rs. } \frac{32}{3}$

For an income Re. 1 in 12% stock at 120, investment = Rs.  $\left(\frac{120}{12}\right) = \text{Rs. } 10.$

$\therefore$  Ratio of investments =  $\frac{32}{3} : 10 = 32 : 30 = 16 : 15.$

10. By investing Rs. 1620 in 8% stock, Michael earns Rs. 135. The stock is then quoted at:

A. Rs. 80

B. Rs. 96

C. Rs. 106

D. Rs. 108

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

To earn Rs. 135, investment = Rs. 1620.

$$\text{To earn Rs. 8, investment} = \text{Rs. } \left( \frac{1620}{135} \times 8 \right) = \text{Rs. 96.}$$

$\therefore$  Market value of Rs. 100 stock = Rs. 96.

11. A man invested Rs. 1552 in a stock at 97 to obtain an income of Rs. 128. The dividend from the stock is:

A. 7.5%

B. 8%

C. 9.7%

D. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

By investing Rs. 1552, income = Rs. 128.

$$\text{By investing Rs. 97, income} = \text{Rs. } \left( \frac{128}{1552} \times 97 \right) = \text{Rs. 8.}$$

$\therefore$  Dividend = 8%

12. A 12% stock yielding 10% is quoted at:

- |                            |                          |
|----------------------------|--------------------------|
| <p><b>A.</b> Rs. 83.33</p> | <p><b>B.</b> Rs. 110</p> |
| <p><b>C.</b> Rs. 112</p>   | <p><b>D.</b> Rs. 120</p> |

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

To earn Rs. 10, money invested = Rs. 100.

$$\text{To earn Rs. 12, money invested} = \text{Rs. } \left( \frac{100}{10} \times 12 \right) = \text{Rs. 120.}$$

$\therefore$  Market value of Rs. 100 stock = Rs. 120.

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13. The market value of a 10.5% stock, in which an income of Rs. 756 is derived by investing Rs. 9000, brokerage being  $\frac{1}{4}\%$ , is:

- |                             |                             |
|-----------------------------|-----------------------------|
| <p><b>A.</b> Rs. 108.25</p> | <p><b>B.</b> Rs. 112.20</p> |
| <p><b>C.</b> Rs. 124.75</p> | <p><b>D.</b> Rs. 125.25</p> |

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

For an income of Rs. 756, investment = Rs. 9000.

$$\text{For an income of Rs. } \frac{21}{2}, \text{ investment} = \text{Rs. } \left( \frac{9000}{756} \times \frac{21}{2} \right) = \text{Rs. 125.}$$

$\therefore$  For a Rs. 100 stock, investment = Rs. 125.

$$\text{Market value of Rs. 100 stock} = \text{Rs. } \left( 125 - \frac{1}{4} \right) = \text{Rs. 124.75}$$

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14.

The cost price of a Rs. 100 stock at 4 discount, when brokerage is  $\frac{1}{4}\%$  is:

A. Rs. 95.75

B. Rs. 96

C. Rs. 96.25

D. Rs. 104.25

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$C.P. = \text{Rs.} \left( 100 - 4 + \frac{1}{4} \right) = \text{Rs.} 96.25$$

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15. Sakshi invests a part of Rs. 12,000 in 12% stock at Rs. 120 and the remainder in 15% stock at Rs. 125. If his total dividend per annum is Rs. 1360, how much does he invest in 12% stock at Rs. 120?

A. Rs. 4000

B. Rs. 4500

C. Rs. 5500

D. Rs. 6000

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Let investment in 12% stock be Rs.  $x$ .

Then, investment in 15% stock = Rs.  $(12000 - x)$ .

$$\therefore \frac{12}{120} \times x + \frac{15}{125} \times (12000 - x) = 1360.$$

$$\Rightarrow x + 3(12000 - x) = 1360.$$

— —

$$\Rightarrow 5x + 72000 - 6x = 1360 \times 50$$

$$\Rightarrow x = 4000.$$

## Banker's Discount

### Formulas

#### IMPORTANT CONCEPTS

##### **Banker's Discount:**

Suppose a merchant A buys goods worth, say Rs. 10,000 from another merchant B at a credit of say 5 months. Then, B prepares a bill, called the bill of exchange. A signs this bill and allows B to withdraw the amount from his bank account after exactly 5 months.

The date exactly after 5 months is called **nominally due date**. Three days (known as grace days) are added to it get a date, known as **legally due date**.

Suppose B wants to have the money before the legally due date. Then he can have the money from the banker or a broker, who deducts S.I. on the face value (i.e., Rs. 10,000 in this case) for the period from the date on which the bill was discounted (i.e., paid by the banker) and the legally due date. This amount is known as **Banker's Discount (B.D.)**.

Thus, B.D. is the S.I. on the face value for the period from the date on which the bill was discounted and the legally due date.

**Banker's Gain (B.G.) = (B.D.) - (T.D.)** for the unexpired time.

**Note:** When the date of the bill is not given, grace days are not to be added.

#### IMPORTANT FORMULAE

1. B.D. = S.I. on bill for unexpired time.

$$2. B.G. = (B.D.) - (T.D.) = S.I. \text{ on T.D.} = \frac{(T.D.)^2}{P.W.}$$

3. T.D. P.W. x B.G.

$$4. B.D. = \left[ \frac{\text{Amount} \times \text{Rate} \times \text{Time}}{100} \right]$$

$$5. T.D. = \left[ \frac{\text{Amount} \times \text{Rate} \times \text{Time}}{\text{P.W.}} \right]$$

$$6. \text{ Amount} = \left[ \frac{100 + (\text{Rate} \times \text{Time})}{\text{B.D.} - \text{T.D.}} \right] \text{B.D.}$$

$$7. \text{ T.D.} = \left[ \frac{\text{B.G.} \times 100}{\text{Rate} \times \text{Time}} \right]$$

1. The banker's discount on a bill due 4 months hence at 15% is Rs. 420. The true discount is:

**A.** Rs. 400                                   **B.** Rs. 360

**C.** Rs. 480                                   **D.** Rs. 320

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$\text{T.D.} = \frac{\text{B.D.} \times 100}{100 + (\text{R} \times \text{T})}$$

$$= \text{Rs.} \left[ \frac{420 \times 100}{100 + \left( 15 \times \frac{1}{3} \right)} \right]$$

$$= \text{Rs.} \left( \frac{420 \times 100}{105} \right)$$

$$= \text{Rs.} 400.$$

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2. The banker's discount on Rs. 1600 at 15% per annum is the same as true discount on Rs. 1680 for the same time and at the same rate. The time is:

**A.** 3 months                                   **B.** 4 months

**C.** 6 months                                   **D.** 8 months

### Answer & Explanation

**Answer:** Option B

**Explanation:**

S.I. on Rs. 1600 = T.D. on Rs. 1680.

∴ Rs. 1600 is the P.W. of Rs. 1680, i.e., Rs. 80 is on Rs. 1600 at 15%.

$$\therefore \text{Time} = \left( \frac{100 \times 80}{1600 \times 15} \right) \text{year} = \frac{1}{3} \text{ year} = 4 \text{ months.}$$

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3. The banker's gain of a certain sum due 2 years hence at 10% per annum is Rs. 24. The present worth is:

A. Rs. 480

B. Rs. 520

C. Rs. 600

D. Rs. 960

### Answer & Explanation

**Answer:** Option C

**Explanation:**

$$\text{T.D.} = \left( \frac{\text{B.G.} \times 100}{\text{Rate} \times \text{Time}} \right) = \text{Rs.} \left( \frac{24 \times 100}{10 \times 2} \right) = \text{Rs.} 120.$$

$$\therefore \text{P.W.} = \frac{100 \times \text{T.D.}}{\text{Rate} \times \text{Time}} = \text{Rs.} \left( \frac{100 \times 120}{10 \times 2} \right) = \text{Rs.} 600.$$

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- 
4. The banker's discount on a sum of money for  $1\frac{1}{2}$  years is Rs. 558 and the true discount on the same sum for 2 years is Rs. 600. The rate percent is:

A. 10%

B. 13%

C. 12%

D. 15%

### Answer & Explanation

**Answer:** Option C

**Explanation:**

B.D. for  $\frac{3}{2}$  years = Rs. 558.

$$\begin{aligned} \text{B.D. for 2 years} &= \text{Rs.} \left( 558 \times \frac{2}{3} \times 2 \right) \\ &= \text{Rs. 744} \end{aligned}$$

T.D. for 2 years = Rs. 600.

$$\therefore \text{Sum} = \frac{\text{B.D.} \times \text{T.D.}}{\text{B.D.} - \text{T.D.}} = \text{Rs.} \left( \frac{744 \times 600}{144} \right) = \text{Rs. 3100.}$$

Thus, Rs. 744 is S.I. on Rs. 3100 for 2 years.

$$\therefore \text{Rate} = \left( \frac{100 \times 744}{3100 \times 2} \right) \% = 12\%$$

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- 
5. The banker's gain on a sum due 3 years hence at 12% per annum is Rs. 270. The banker's discount is:

A. Rs. 960

B. Rs. 840

C. Rs. 1020

D. Rs. 760

### Answer & Explanation

**Answer:** Option C

**Explanation:**

$$\text{T.D.} = \left( \frac{\text{B.G.} \times 100}{3} \right) = \text{Rs.} \left( \frac{270 \times 100}{3} \right) = \text{Rs. 750.}$$

R x T

12 x 3

- ∴ B.D. = Rs.(750 + 270) = Rs. 1020.
6. The banker's discount of a certain sum of money is Rs. 72 and the true discount on the same sum for the same time is Rs. 60. The sum due is:
- A. Rs. 360      B. Rs. 432  
C. Rs. 540      D. Rs. 1080

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\text{Sum} = \frac{\text{B.D.} \times \text{T.D.}}{\text{B.D.} - \text{T.D.}} = \text{Rs.} \left( \frac{72 \times 60}{72 - 60} \right) = \text{Rs.} \left( \frac{72 \times 60}{12} \right) = \text{Rs.} 360.$$

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- 
7. The certain worth of a certain sum due sometime hence is Rs. 1600 and the true discount is Rs. 160. The banker's gain is:
- A. Rs. 20      B. Rs. 24  
C. Rs. 16      D. Rs. 12

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\text{B.G.} = \frac{(\text{T.D.})^2}{\text{P.W.}} = \text{Rs.} \left( \frac{160 \times 160}{1600} \right) = \text{Rs.} 16.$$

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8. The present worth of a certain bill due sometime hence is Rs. 800 and the true discount is Rs. 36. The banker's discount is:
- A. Rs. 37      B. Rs. 37.62

C. Rs. 34.38

D. Rs. 38.98

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$B.G. = \frac{(T.D.)^2}{P.W.} = \text{Rs. } \left( \frac{36 \times 36}{800} \right) = \text{Rs. } 1.62$$

$$\therefore B.D. = (T.D. + B.G.) = \text{Rs. } (36 + 1.62) = \text{Rs. } 37.62$$

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9. The banker's gain on a bill due 1 year hence at 12% per annum is Rs. 6. The true discount is:

A. Rs. 72

B. Rs. 36

C. Rs. 54

D. Rs. 50

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$T.D. = \frac{B.G. \times 100}{R \times T} = \text{Rs. } \left( \frac{6 \times 100}{12 \times 1} \right) = \text{Rs. } 50.$$

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- 10.

The banker's gain on a certain sum due  $1\frac{1}{2}$  years hence is  $\frac{3}{25}$  of the banker's

discount. The rate percent is:

A.  $5\frac{1}{5}\%$

B.  $9\frac{1}{11}\%$

C.  $\frac{1}{8}\%$

D.  $\frac{1}{6}\%$

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

Let, B.D = Re. 1.

Then, B.G. = Re.  $\frac{3}{25}$ .

$$\therefore \text{T.D.} = (\text{B.D.} - \text{B.G.}) = \text{Re.} \left(1 - \frac{3}{25}\right) = \text{Re.} \frac{22}{25}.$$

$$\text{Sum} = \left(\frac{1 \times (22/25)}{1-(22/25)}\right) = \text{Rs.} \frac{22}{3}.$$

S.I. on Rs.  $\frac{22}{3}$  for  $1\frac{1}{2}$  years is Re. 1.

$$\therefore \text{Rate} = \left(\frac{100 \times 1}{\frac{22}{3}}\right)\% = \frac{100}{\frac{22}{3}} = 91\%$$

11. The present worth of a sum due sometime hence is Rs. 576 and the banker's gain is Rs. 16. The true discount is:

A. Rs. 36

B. Rs. 72

C. Rs. 48

D. Rs. 96

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

$$\text{T.D.} = \text{P.W.} \times \text{B.G.} = 576 \times 16 = 96.$$

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12. The true discount on a bill of Rs. 540 is Rs. 90. The banker's discount is:

A. Rs. 60

B. Rs. 108

C. Rs. 110

D. Rs. 112

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$P.W. = \text{Rs. } (540 - 90) = \text{Rs. } 450.$$

$$\therefore \text{S.I. on Rs. } 450 = \text{Rs. } 90.$$

$$\text{S.I. on Rs. } 540 = \text{Rs. } \left( \frac{90}{450} \times 540 \right) = \text{Rs. } 108.$$

$$\therefore \text{B.D.} = \text{Rs. } 108.$$

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13.

The banker's discount on a certain sum due 2 years hence is  $\frac{11}{10}$  of the true discount.

The rate percent is:

A. 11%

B. 10%

C. 5%

D. 5.5%

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let T.D. be Re. 1.

$$\text{Then, B.D.} = \text{Rs. } \frac{11}{10} = \text{Rs. } 1.10.$$

$$\therefore \text{Sum} = \text{Rs.} \left( \frac{1.10 \times 1}{1.10 - 1} \right) = \text{Rs.} \left( \frac{110}{10} \right) = \text{Rs.} 11.$$

$\therefore$  S.I. on Rs. 11 for 2 years is Rs. 1.10

$$\therefore \text{Rate} = \left( \frac{100 \times 1.10}{11 \times 2} \right)\% = 5\%.$$

*Gather and Edited By*

*Yasir Shahzad( Gujrat)*

*Math Book Part 2*

*Best Of Luck*

*You Can Not Help Every one But Every  
One Can Help Someone*

# 'FPSC Custom Inspectors BS16 & Preventive Officer BS16 Preparation group

## Time and Distance

### Formulas

1. Speed, Time and Distance:

$$\text{Speed} = \left( \frac{\text{Distance}}{\text{Time}} \right), \text{ Time} = \left( \frac{\text{Distance}}{\text{Speed}} \right), \text{ Distance} = (\text{Speed} \times \text{Time}).$$

2. km/hr to m/sec conversion:

$$x \text{ km/hr} = \left( x \times \frac{5}{18} \right) \text{ m/sec.}$$

3. m/sec to km/hr conversion:

$$x \text{ m/sec} = \left( x \times \frac{18}{5} \right) \text{ km/hr.}$$

4. If the ratio of the speeds of A and B is  $a : b$ , then the ratio of the

the times taken by them to cover the same distance is  $\frac{1}{a} : \frac{1}{b}$  or  $b : a$ .

5. Suppose a man covers a certain distance at  $x$  km/hr and an equal distance at  $y$  km/hr. Then,

the average speed during the whole journey is  $\left( \frac{2xy}{x+y} \right)$  km/hr.

1. A person crosses a 600 m long street in 5 minutes. What is his speed in km per hour?
- A. 3.6      B. 7.2  
C. 8.4      D. 10

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Speed} = \left( \frac{600}{5 \times 60} \right) \text{m/sec.}$$

$$= 2 \text{ m/sec.}$$

Converting m/sec to km/hr (see [important formulas](#) section)

$$= \left( 2 \times \frac{18}{5} \right) \text{km/hr}$$

$$= 7.2 \text{ km/hr.}$$

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2. An aeroplane covers a certain distance at a speed of 240 kmph in 5 hours. To cover the same distance in  $1\frac{2}{3}$  hours, it must travel at a speed of:
- A. 300 kmph      B. 360 kmph  
C. 600 kmph      D. 720 kmph

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Distance} = (240 \times 5) = 1200 \text{ km.}$$

$$\text{Speed} = \text{Distance}/\text{Time}$$

$$\text{Speed} = 1200/(5/3) \text{ km/hr.} \quad [\text{We can write } 1\frac{2}{3} \text{ hours as } 5/3 \text{ hours}]$$

$$\therefore \text{Required speed} = \left( 1200 \times \frac{3}{5} \right) \text{km/hr.} = 720 \text{ km/hr.}$$

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- 
3. If a person walks at 14 km/hr instead of 10 km/hr, he would have walked 20 km more. The actual distance travelled by him is:
- A. 50 km      B. 56 km  
C. 70 km      D. 80 km

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let the actual distance travelled be  $x$  km.

$$\text{Then, } \frac{x}{10} = \frac{x + 20}{14}$$

$$\Rightarrow 14x = 10x + 200$$

$$\Rightarrow 4x = 200$$

$$\Rightarrow x = 50 \text{ km.}$$

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- 
4. A train can travel 50% faster than a car. Both start from point A at the same time and reach point B 75 kms away from A at the same time. On the way, however, the train lost about 12.5 minutes while stopping at the stations. The speed of the car is:

- A. 100 kmph      B. 110 kmph  
C. 120 kmph      D. 130 kmph

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let speed of the car be  $x$  kmph.

$$\text{Then, speed of the train} = \frac{150}{100}x = \left(\frac{3}{2}x\right) \text{ kmph.}$$

$$\therefore \frac{75}{x} - \frac{75}{(3/2)x} = \frac{125}{10 \times 60}$$

$$\Rightarrow \frac{75}{x} - \frac{50}{x} = \frac{5}{24}$$

$$\Rightarrow x = \left( \frac{\frac{25 \times 24}{5}}{5} \right) = 120 \text{ kmph.}$$

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5. Excluding stoppages, the speed of a bus is 54 kmph and including stoppages, it is 45 kmph. For how many minutes does the bus stop per hour?

- A. 9      B. 10  
C. 12      D. 20

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Due to stoppages, it covers 9 km less.

$$\text{Time taken to cover 9 km} = \left( \frac{9}{54} \times 60 \right)_{\text{min}} = 10 \text{ min.}$$

6. In a flight of 600 km, an aircraft was slowed down due to bad weather. Its average speed for the trip was reduced by 200 km/hr and the time of flight increased by 30 minutes. The duration of the flight is:

- A. 1 hour      B. 2 hours  
C. 3 hours      D. 4 hours

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

Let the duration of the flight be  $x$  hours.

$$\text{Then, } \frac{600}{x} - \frac{600}{x + (1/2)} = 200$$

$$\Rightarrow \frac{600}{x} - \frac{1200}{2x + 1} = 200$$

$$\Rightarrow x(2x + 1) = 3$$

$$\Rightarrow 2x^2 + x - 3 = 0$$

$$\Rightarrow (2x + 3)(x - 1) = 0$$

$$\Rightarrow x = 1 \text{ hr.} \quad [\text{neglecting the -ve value of } x]$$

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7. A man complete a journey in 10 hours. He travels first half of the journey at the rate of 21 km/hr and second half at the rate of 24 km/hr. Find the total journey in km.

A. 220 km

B. 224 km

C. 230 km

D. 234 km

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\frac{(1/2)x}{21} + \frac{(1/2)x}{24} = 10$$

$$\Rightarrow \frac{x}{21} + \frac{x}{24} = 20$$

$$\Rightarrow 15x = 168 \times 20$$

$$\Rightarrow x = \left( \frac{168 \times 20}{15} \right) = 224 \text{ km.}$$

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8. The ratio between the speeds of two trains is 7 : 8. If the second train runs 400 km in 4 hours, then the speed of the first train is:

A. 70 km/hr

B. 75 km/hr

C. 84 km/hr

D. 87.5 km/hr

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let the speed of two trains be  $7x$  and  $8x$  km/hr.

$$\text{Then, } 8x = \left( \frac{400}{4} \right) = 100$$

$$\Rightarrow x = \left( \frac{100}{8} \right) = 12.5$$

$\therefore$  Speed of first train =  $(7 \times 12.5)$  km/hr = 87.5 km/hr.

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9. A man on tour travels first 160 km at 64 km/hr and the next 160 km at 80 km/hr. The average speed for the first 320 km of the tour is:

- A. 35.55 km/hr      B. 36 km/hr  
C. 71.11 km/hr      D. 71 km/hr

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\text{Total time taken} = \left( \frac{160}{64} + \frac{160}{80} \right) \text{hrs.} = \frac{9}{2} \text{ hrs.}$$

$$\therefore \text{Average speed} = \left( 320 \times \frac{2}{9} \right) \text{km/hr} = 71.11 \text{ km/hr.}$$

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10. A car travelling with  $\frac{5}{7}$  of its actual speed covers 42 km in 1 hr 40 min 48 sec. Find the actual speed of the car.

- A.  $17\frac{6}{7}$  km/hr      B. 25 km/hr  
C. 30 km/hr      D. 35 km/hr

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Time taken} = 1 \text{ hr } 40 \text{ min } 48 \text{ sec} = 1 \text{ hr } 40\frac{4}{5} \text{ min} = 1\frac{51}{75} \text{ hrs} = \frac{126}{75} \text{ hrs.}$$

Let the actual speed be  $x$  km/hr.

$$\begin{aligned} \text{Then, } \frac{5}{7}x \times \frac{126}{75} &= 42 \\ \Rightarrow x &= \left( \frac{42 \times 7 \times 75}{5 \times 126} \right) = 35 \text{ km/hr.} \end{aligned}$$

11. In covering a distance of 30 km, Abhay takes 2 hours more than Sameer. If Abhay doubles his speed, then he would take 1 hour less than Sameer. Abhay's speed is:

A. 5 kmph

B. 6 kmph

C. 6.25 kmph

D. 7.5 kmph

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let Abhay's speed be  $x$  km/hr.

$$\text{Then, } \frac{30}{x} - \frac{30}{2x} = 3$$

$$\Rightarrow 6x = 30$$

$$\Rightarrow x = 5 \text{ km/hr.}$$

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12. Robert is travelling on his cycle and has calculated to reach point A at 2 P.M. if he travels at 10 kmph, he will reach there at 12 noon if he travels at 15 kmph. At what speed must he travel to reach A at 1 P.M.?

A. 8 kmph

B. 11 kmph

C. 12 kmph

D. 14 kmph

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the distance travelled by  $x$  km.

$$\text{Then, } \frac{x}{10} - \frac{x}{15} = 2$$

$$\Rightarrow 3x - 2x = 60$$

$$\Rightarrow x = 60 \text{ km.}$$

$$\text{Time taken to travel } 60 \text{ km at } 10 \text{ km/hr} = \left( \frac{60}{10} \right)_{\text{hrs}} = 6 \text{ hrs.}$$

So, Robert started 6 hours before 2 P.M. i.e., at 8 A.M.

$$\therefore \text{Required speed} = \left( \frac{60}{5} \right)_{\text{kmph.}} = 12 \text{ kmph.}$$

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13. It takes eight hours for a 600 km journey, if 120 km is done by train and the rest by car. It takes 20 minutes more, if 200 km is done by train and the rest by car. The ratio of the speed of the train to that of the cars is:

A. 2 : 3

B. 3 : 2

C. 3 : 4

D. 4 : 3

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Let the speed of the train be  $x$  km/hr and that of the car be  $y$  km/hr.

$$\text{Then, } \frac{120}{x} + \frac{480}{y} = 8 \Rightarrow \frac{1}{x} + \frac{4}{y} = \frac{1}{15} \dots\dots(\text{i})$$

$$\text{And, } \frac{200}{x} + \frac{400}{y} = \frac{25}{3} \Rightarrow \frac{1}{x} + \frac{2}{y} = \frac{1}{24} \dots\dots(\text{ii})$$

Solving (i) and (ii), we get:  $x = 60$  and  $y = 80$ .

$$\therefore \text{Ratio of speeds} = 60 : 80 = 3 : 4.$$

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14. A farmer travelled a distance of 61 km in 9 hours. He travelled partly on foot @ 4 km/hr and partly on bicycle @ 9 km/hr. The distance travelled on foot is:

A. 14 km

B. 15 km

C. 16 km

D. 17 km

[Answer & Explanation](#)

**Answer:** Option C

### **Explanation:**

Let the distance travelled on foot be  $x$  km.

Then, distance travelled on bicycle =  $(61 - x)$  km.

$$\text{So, } \frac{x}{4} + \frac{(61 - x)}{9} = 9$$

$$\Rightarrow 9x + 4(61 - x) = 9 \times 36$$

$$\Rightarrow 5x = 80$$

$$\Rightarrow x = 16 \text{ km.}$$

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15. A man covered a certain distance at some speed. Had he moved 3 kmph faster, he would have taken 40 minutes less. If he had moved 2 kmph slower, he would have taken 40 minutes more. The distance (in km) is:

A. 35

B.  $36\frac{2}{3}$

C.  $37\frac{1}{2}$

D. 40

### **Answer & Explanation**

**Answer:** Option D

### **Explanation:**

Let distance =  $x$  km and usual rate =  $y$  kmph.

$$\text{Then, } \frac{x}{y} - \frac{x}{y+3} = \frac{40}{60} \Rightarrow 2y(y+3) = 9x \dots\dots(i)$$

$$\text{And, } \frac{x}{y-2} - \frac{x}{y} = \frac{40}{60} \Rightarrow y(y-2) = 3x \dots\dots(ii)$$

On dividing (i) by (ii), we get:  $x = 40$

## **Simple Interest**

### **Formulas**

#### **1. Principal:**

The money borrowed or lent out for a certain period is called the **principal** or the **sum**.

**2. Interest:**

Extra money paid for using other's money is called **interest**.

**3. Simple Interest (S.I.):**

If the interest on a sum borrowed for certain period is reckoned uniformly, then it is called **simple interest**.

Let Principal = P, Rate = R% per annum (p.a.) and Time = T years. Then

$$(i). \text{Simple Interest} = \left( \frac{P \times R \times T}{100} \right)$$

1.

$$(ii). P = \left( \frac{100 \times S.I.}{R \times T} \right); R = \left( \frac{100 \times S.I.}{P \times T} \right) \text{ and } T = \left( \frac{100 \times S.I.}{P \times R} \right).$$

- 
6. A sum of Rs. 12,500 amounts to Rs. 15,500 in 4 years at the rate of simple interest. What is the rate of interest?

**A.** 3%

**B.** 4%

**C.** 5%

**D.** 6%

**E.** None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

S.I. = Rs. (15500 - 12500) = Rs. 3000.

$$\text{Rate} = \left( \frac{100 \times 3000}{12500 \times 4} \right) \% = 6\%$$

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7. An automobile financier claims to be lending money at simple interest, but he includes the interest every six months for calculating the principal. If he is charging an interest of 10%, the effective rate of interest becomes:

**A.** 10%

**B.** 10.25%

C. 10.5%

D. None of these

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Let the sum be Rs. 100. Then,

$$\text{S.I. for first 6 months} = \text{Rs. } \left\{ \frac{\frac{100 \times 10 \times 1}{100 \times 2}}{} \right\} = \text{Rs. } 5$$
$$\text{S.I. for last 6 months} = \text{Rs. } \left\{ \frac{\frac{105 \times 10 \times 1}{100 \times 2}}{} \right\} = \text{Rs. } 5.25$$

So, amount at the end of 1 year = Rs.  $(100 + 5 + 5.25) = \text{Rs. } 110.25$

$\therefore$  Effective rate =  $(110.25 - 100) = 10.25\%$

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8. A lent Rs. 5000 to B for 2 years and Rs. 3000 to C for 4 years on simple interest at the same rate of interest and received Rs. 2200 in all from both of them as interest. The rate of interest per annum is:

A. 5%

B. 7%

C.  $7\frac{1}{8}\%$

D. 10%

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let the rate be R% p.a.

$$\text{Then, } \left( \frac{5000 \times R \times 2}{100} \right) + \left( \frac{3000 \times R \times 4}{100} \right) = 2200.$$

$$\Rightarrow 100R + 120R = 2200$$

$$\Rightarrow R = \left( \frac{2200}{220} \right) = 10.$$

$$\therefore \text{Rate} = 10\%.$$

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9. A sum of Rs. 725 is lent in the beginning of a year at a certain rate of interest. After 8 months, a sum of Rs. 362.50 more is lent but at the rate twice the former. At the end of the year, Rs. 33.50 is earned as interest from both the loans. What was the original rate of interest?
- A. 3.6%      B. 4.5%
- C. 5%      D. 6%
- E. None of these

**Answer & Explanation**

**Answer:** Option E

**Explanation:**

Let the original rate be R%. Then, new rate = (2R)%.

Note:

Here, original rate is for 1 year(s); the new rate is for only 4 months i.e.  $\frac{1}{3}$  year(s).

$$\therefore \left( \frac{725 \times R \times 1}{100} \right) + \left( \frac{362.50 \times 2R \times \frac{1}{3}}{100 \times 3} \right) = 33.50$$

$$\Rightarrow (2175 + 725) R = 33.50 \times 100 \times 3$$

$$\Rightarrow (2175 + 725) R = 10050$$

$$\Rightarrow (2900)R = 10050$$

$$\Rightarrow R = \frac{10050}{2900} = 3.46$$

$$\therefore \text{Original rate} = 3.46\%$$

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- 
10. A man took loan from a bank at the rate of 12% p.a. simple interest. After 3 years he had to pay Rs. 5400 interest only for the period. The principal amount borrowed by him was:
- A. Rs. 2000      B. Rs. 10,000
- C. Rs. 15,000      D. Rs. 20,000

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\text{Principal} = \text{Rs. } \left( \frac{100 \times 5400}{12 \times 3} \right) = \text{Rs. } 15000.$$

11. A sum of money amounts to Rs. 9800 after 5 years and Rs. 12005 after 8 years at the same rate of simple interest. The rate of interest per annum is:

A. 5%

B. 8%

C. 12%

D. 15%

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

S.I. for 3 years = Rs.  $(12005 - 9800)$  = Rs. 2205.

$$\text{S.I. for 5 years} = \text{Rs. } \left( \frac{2205}{3} \times 5 \right) = \text{Rs. } 3675$$

$\therefore$  Principal = Rs.  $(9800 - 3675)$  = Rs. 6125.

$$\text{Hence, rate} = \left( \frac{100 \times 3675}{6125 \times 5} \right) \% = 12\%$$

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12. What will be the ratio of simple interest earned by certain amount at the same rate of interest for 6 years and that for 9 years?

A. 1 : 3

B. 1 : 4

C. 2 : 3

D. Data inadequate

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the principal be P and rate of interest be R%.

$$\therefore \text{Required ratio} = \frac{\left( \frac{P \times R \times 6}{100} \right)}{\left( \frac{P \times R \times 9}{100} \right)} = \frac{6PR}{9PR} = \frac{6}{9} = 2 : 3.$$

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13. A certain amount earns simple interest of Rs. 1750 after 7 years. Had the interest been 2% more, how much more interest would it have earned?

- |  |   |
|--|---|
| <b>A.</b> Rs. 35<br><br><b>C.</b> Rs. 350<br><br><b>E.</b> None of these | <b>B.</b> Rs. 245<br><br><b>D.</b> Cannot be determined |
|--|---|

#### **Answer & Explanation**

**Answer:** Option D

#### **Explanation:**

We need to know the S.I., principal and time to find the rate.

Since the principal is not given, so data is inadequate.

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14. A person borrows Rs. 5000 for 2 years at 4% p.a. simple interest. He immediately lends it to another person at  $6\frac{1}{4}$  p.a for 2 years. Find his gain in the transaction per year.

- |   |   |
|---|---|
| <b>A.</b> Rs. 112.50<br><br><b>C.</b> Rs. 150 | <b>B.</b> Rs. 125<br><br><b>D.</b> Rs. 167.50 |
|---|---|

#### **Answer & Explanation**

**Answer:** Option A

#### **Explanation:**

$$\begin{aligned} \text{Gain in 2 years} &= \text{Rs.} \left[ \left( 5000 \times \frac{25}{4} \times \frac{2}{100} \right) - \left( \frac{5000 \times 4 \times 2}{100} \right) \right] \\ &= \text{Rs.} (625 - 400) \\ &= \text{Rs.} 225. \end{aligned}$$

$$\therefore \text{Gain in 1 year} = \text{Rs. } \left( \frac{225}{2} \right) = \text{Rs. } 112.50$$

## Partnership

### Formulas

#### 1. Partnership:

When two or more than two persons run a business jointly, they are called **partners** and the deal is known as **partnership**.

#### 2. Ratio of Divisions of Gains:

- I. When investments of all the partners are for the same time, the gain or loss is distributed among the partners in the ratio of their investments.

Suppose A and B invest Rs.  $x$  and Rs.  $y$  respectively for a year in a business, then at the end of the year:

$$(\text{A's share of profit}) : (\text{B's share of profit}) = x : y.$$

- II. When investments are for different time periods, then equivalent capitals are calculated for a unit of time by taking (capital  $\times$  number of units of time). Now gain or loss is divided in the ratio of these capitals.

Suppose A invests Rs.  $x$  for  $p$  months and B invests Rs.  $y$  for  $q$  months then,

$$(\text{A's share of profit}) : (\text{B's share of profit}) = xp : yq.$$

#### 3. Working and Sleeping Partners:

A partner who manages the business is known as a **working partner** and the one who simply invests the money is a **sleeping partner**.

1. A and B invest in a business in the ratio 3 : 2. If 5% of the total profit goes to charity and A's share is Rs. 855, the total profit is:

- |                       |                    |
|-----------------------|--------------------|
| <b>A.</b> Rs. 1425    | <b>B.</b> Rs. 1500 |
| <b>C.</b> Rs. 1537.50 | <b>D.</b> Rs. 1576 |

#### Answer & Explanation

**Answer:** Option **B**

**Explanation:**

Let the total profit be Rs. 100.

$$\text{After paying to charity, A's share} = \text{Rs. } \left( 95 \times \frac{3}{5} \right) = \text{Rs. } 57.$$

If A's share is Rs. 57, total profit = Rs. 100.

$$\text{If A's share Rs. } 855, \text{ total profit} = \left( \frac{100}{57} \times 855 \right) = 1500.$$

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2. A, B and C jointly thought of engaging themselves in a business venture. It was agreed that A would invest Rs. 6500 for 6 months, B, Rs. 8400 for 5 months and C, Rs. 10,000 for 3 months. A wants to be the working member for which, he was to receive 5% of the profits. The profit earned was Rs. 7400. Calculate the share of B in the profit.

A. Rs. 1900

B. Rs. 2660

C. Rs. 2800

D. Rs. 2840

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

For managing, A received = 5% of Rs. 7400 = Rs. 370.

Balance = Rs.  $(7400 - 370)$  = Rs. 7030.

Ratio of their investments =  $(6500 \times 6) : (8400 \times 5) : (10000 \times 3)$

= 39000 : 42000 : 30000

= 13 : 14 : 10

$$\therefore \text{B's share} = \text{Rs. } \left( 7030 \times \frac{14}{37} \right) = \text{Rs. } 2660.$$

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3. A, B and C enter into a partnership in the ratio  $\frac{7}{2} : \frac{4}{3} : \frac{6}{5}$ . After 4 months, A increases his share 50%. If the total profit at the end of one year be Rs. 21,600, then B's share in the profit is:

A. Rs. 2100

B. Rs. 2400

C. Rs. 3600

D. Rs. 4000

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

$$\text{Ratio of initial investments} = \left( \frac{7}{2} : \frac{4}{3} : \frac{6}{5} \right) = 105 : 40 : 36.$$

Let the initial investments be  $105x$ ,  $40x$  and  $36x$ .

$$\begin{aligned}\therefore A : B : C &= \left( 105x \times 4 + \frac{150}{100} \times 105x \times 8 \right) : (40x \times 12) : (36x \times 12) \\ &= 1680x : 480x : 432x = 35 : 10 : 9.\end{aligned}$$

$$\text{Hence, B's share} = \text{Rs. } \left( 21600 \times \frac{10}{54} \right) = \text{Rs. } 4000.$$

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4. A, B, C subscribe Rs. 50,000 for a business. A subscribes Rs. 4000 more than B and B Rs. 5000 more than C. Out of a total profit of Rs. 35,000, A receives:

A. Rs. 8400

B. Rs. 11,900

C. Rs. 13,600

D. Rs. 14,700

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let  $C = x$ .

Then,  $B = x + 5000$  and  $A = x + 5000 + 4000 = x + 9000$ .

So,  $x + x + 5000 + x + 9000 = 50000$

$$\Rightarrow 3x = 36000$$

$$\Rightarrow x = 12000$$

$$A : B : C = 21000 : 17000 : 12000 = 21 : 17 : 12.$$

$$\therefore A's \text{ share} = \text{Rs. } \left( 35000 \times \frac{21}{54} \right) = \text{Rs. } 14,700.$$

5. Three partners shared the profit in a business in the ratio 5 : 7 : 8. They had partnered for 14 months, 8 months and 7 months respectively. What was the ratio of their investments?

A. 5 : 7 : 8  
C. 38 : 28 : 21

B. 20 : 49 : 64  
D. None of these

#### **Answer & Explanation**

**Answer:** Option B

#### **Explanation:**

Let their investments be Rs.  $x$  for 14 months, Rs.  $y$  for 8 months and Rs.  $z$  for 7 months respectively.

Then,  $14x : 8y : 7z = 5 : 7 : 8$ .

$$\text{Now, } \frac{14x}{8y} = \frac{5}{7} \Leftrightarrow 98x = 40y \Leftrightarrow y = \frac{49}{20}x$$

$$\text{And, } \frac{14x}{7z} = \frac{5}{8} \Leftrightarrow 112x = 35z \Leftrightarrow z = \frac{112}{35}x = \frac{16}{5}x.$$

$$\therefore x : y : z = x : \frac{49}{20}x : \frac{16}{5}x = 20 : 49 : 64.$$

6. A starts business with Rs. 3500 and after 5 months, B joins with A as his partner. After a year, the profit is divided in the ratio 2 : 3. What is B's contribution in the capital?

A. Rs. 7500  
C. Rs. 8500

B. Rs. 8000  
D. Rs. 9000

#### **Answer & Explanation**

**Answer:** Option D

#### **Explanation:**

Let B's capital be Rs.  $x$ .

$$\text{Then, } \left( \frac{3500 \times 12}{7x} = \frac{2}{3} \right)$$

$$\Rightarrow 14x = 126000$$

$$\Rightarrow x = 9000.$$

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7. A and B entered into partnership with capitals in the ratio 4 : 5. After 3 months, A withdrew  $\frac{1}{4}$  of his capital and B withdrew  $\frac{1}{5}$  of his capital. The gain at the end of 10 months was Rs. 760. A's share in this profit is:

- A. Rs. 330      B. Rs. 360  
C. Rs. 380      D. Rs. 430

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$\begin{aligned} A : B &= \left[ 4x \times 3 + \left( 4x - \frac{1}{4} \cdot \frac{x}{4x} \right) \times \frac{x}{7} \right] : \left[ 5x \times 3 + \left( 5x - \frac{1}{5} \cdot \frac{x}{5x} \right) \times \frac{x}{7} \right] \\ &= (12x + 21x) : (15x + 28x) \\ &= 33x : 43x \\ &= 33 : 43. \end{aligned}$$

$$\therefore A's \text{ share} = \text{Rs. } \left( 760 \times \frac{33}{76} \right) = \text{Rs. } 330.$$

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8. A and B started a partnership business investing some amount in the ratio of 3 : 5. C joined then after six months with an amount equal to that of B. In what proportion should the profit at the end of one year be distributed among A, B and C?

- A. 3 : 5 : 2      B. 3 : 5 : 5  
C. 6 : 10 : 5      D. Data inadequate

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

Let the initial investments of A and B be  $3x$  and  $5x$ .

$$A : B : C = (3x \times 12) : (5x \times 12) : (5x \times 6) = 36 : 60 : 30 = 6 : 10 : 5.$$

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- 
9. A, B, C rent a pasture. A puts 10 oxen for 7 months, B puts 12 oxen for 5 months and C puts 15 oxen for 3 months for grazing. If the rent of the pasture is Rs. 175, how much must C pay as his share of rent?

- A. Rs. 45      B. Rs. 50  
C. Rs. 55      D. Rs. 60

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$A : B : C = (10 \times 7) : (12 \times 5) : (15 \times 3) = 70 : 60 : 45 = 14 : 12 : 9.$$

$$\therefore C's\ rent = \text{Rs. } \left( 175 \times \frac{9}{35} \right) = \text{Rs. } 45.$$

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- 
10. A and B started a business in partnership investing Rs. 20,000 and Rs. 15,000 respectively. After six months, C joined them with Rs. 20,000. What will be B's share in total profit of Rs. 25,000 earned at the end of 2 years from the starting of the business?

- A. Rs. 7500      B. Rs. 9000  
C. Rs. 9500      D. Rs. 10,000

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$A : B : C = (20,000 \times 24) : (15,000 \times 24) : (20,000 \times 18) = 4 : 3 : 3.$$

$$\therefore B's\ share = \text{Rs. } \left( 25000 \times \frac{3}{10} \right) = \text{Rs. } 7,500.$$

- 
11. A began a business with Rs. 85,000. He was joined afterwards by B with Rs. 42,500. For how

much period does B join, if the profits at the end of the year are divided in the ratio of 3 : 1?

- |             |             |
|-------------|-------------|
| A. 4 months | B. 5 months |
| C. 6 months | D. 8 months |

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Suppose B joined for  $x$  months. Then,

$$\text{Then, } \left( \frac{85000 \times 12}{42500 \times x} = \frac{3}{1} \right)$$
$$\Rightarrow x = \left( \frac{85000 \times 12}{42500 \times 3} \right) = 8.$$

So, B joined for 8 months.

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- 
12. Aman started a business investing Rs. 70,000. Rakhi joined him after six months with an amount of Rs. 1,05,000 and Sagar joined them with Rs. 1.4 lakhs after another six months. The amount of profit earned should be distributed in what ratio among Aman, Rakhi and Sagar respectively, 3 years after Aman started the business?

- |                 |                         |
|-----------------|-------------------------|
| A. 7 : 6 : 10   | B. 12 : 15 : 16         |
| C. 42 : 45 : 56 | D. Cannot be determined |

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Aman : Rakhi : Sagar =  $(70,000 \times 36) : (1,05,000 \times 30) : (1,40,000 \times 24) = 12 : 15 : 16$ .

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- 
13. Arun, Kamal and Vinay invested Rs. 8000, Rs. 4000 and Rs. 8000 respectively in a business. Arun left after six months. If after eight months, there was a gain of Rs. 4005, then what will be the share of Kamal?

- |            |             |
|------------|-------------|
| A. Rs. 890 | B. Rs. 1335 |
|------------|-------------|

C. Rs. 1602

D. Rs. 1780

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

$$\text{Arun : Kamal : Vinay} = (8,000 \times 6) : (4,000 \times 8) : (8,000 \times 8)$$

$$= 48 : 32 : 64$$

$$= 3 : 2 : 4.$$

$$\therefore \text{Kamal's share} = \text{Rs.} \left( 4005 \times \frac{2}{9} \right) = \text{Rs.} 890.$$

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- 
14. Simran started a software business by investing Rs. 50,000. After six months, Nanda joined her with a capital of Rs. 80,000. After 3 years, they earned a profit of Rs. 24,500. What was Simran's share in the profit?

A. Rs. 9,423

B. Rs. 10,250

C. Rs. 12,500

D. Rs. 10,500

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

$$\text{Simran : Nanda} = (50000 \times 36) : (80000 \times 30) = 3 : 4.$$

$$\therefore \text{Simran's share} = \text{Rs.} \left( 24500 \times \frac{3}{7} \right) = \text{Rs.} 10,500.$$

## Calendar

## Formulas

### 1. Odd Days:

We are supposed to find the day of the week on a given date.

For this, we use the concept of 'odd days'.

In a given period, the number of days more than the complete weeks are called **odd days**.

## 2. Leap Year:

- (i). Every year divisible by 4 is a leap year, if it is not a century.
- (ii). Every 4<sup>th</sup> century is a leap year and no other century is a leap year.

Note: A leap year has 366 days.

### Examples:

- i. Each of the years 1948, 2004, 1676 etc. is a leap year.
- ii. Each of the years 400, 800, 1200, 1600, 2000 etc. is a leap year.
- iii. None of the years 2001, 2002, 2003, 2005, 1800, 2100 is a leap year.

## 3. Ordinary Year:

The year which is not a leap year is called an **ordinary years**. An ordinary year has 365 days.

## 4. Counting of Odd Days:

$$1 \text{ ordinary year} = 365 \text{ days} = (52 \text{ weeks} + 1 \text{ day})$$

$\therefore$  1 ordinary year has 1 odd day.

$$2. 1 \text{ leap year} = 366 \text{ days} = (52 \text{ weeks} + 2 \text{ days})$$

$\therefore$  1 leap year has 2 odd days.

$$3. 100 \text{ years} = 76 \text{ ordinary years} + 24 \text{ leap years}$$

$$= (76 \times 1 + 24 \times 2) \text{ odd days} = 124 \text{ odd days.}$$

$$= (17 \text{ weeks} + \text{days}) \equiv 5 \text{ odd days.}$$

$\therefore$  Number of odd days in 100 years = 5.

$$\text{Number of odd days in 200 years} = (5 \times 2) \equiv 3 \text{ odd days.}$$

$$\text{Number of odd days in 300 years} = (5 \times 3) \equiv 1 \text{ odd day.}$$

$$\text{Number of odd days in 400 years} = (5 \times 4 + 1) \equiv 0 \text{ odd day.}$$

Similarly, each one of 800 years, 1200 years, 1600 years, 2000 years etc. has 0 odd days.

### Day of the Week Related to Odd Days:

No. of days:	0	1	2	3	4	5	6
Day:	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.

1. It was Sunday on Jan 1, 2006. What was the day of the week Jan 1, 2010?
- A. Sunday      B. Saturday  
 C. Friday      D. Wednesday

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

On 31<sup>st</sup> December, 2005 it was Saturday.

Number of odd days from the year 2006 to the year 2009 =  $(1 + 1 + 2 + 1) = 5$  days.

$\therefore$  On 31<sup>st</sup> December 2009, it was Thursday.

Thus, on 1<sup>st</sup> Jan, 2010 it is Friday.

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2. What was the day of the week on 28<sup>th</sup> May, 2006?

- A. Thursday      B. Friday  
 C. Saturday      D. Sunday

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

28 May, 2006 = (2005 years + Period from 1.1.2006 to 28.5.2006)

Odd days in 1600 years = 0

Odd days in 400 years = 0

5 years = (4 ordinary years + 1 leap year) =  $(4 \times 1 + 1 \times 2) \equiv 6$  odd days

$$\text{Jan.} \quad \text{Feb.} \quad \text{March} \quad \text{April} \quad \text{May} \\ (31 + 28 + 31 + 30 + 28) = 148 \text{ days}$$

$$\therefore 148 \text{ days} = (21 \text{ weeks} + 1 \text{ day}) \equiv 1 \text{ odd day.}$$

Total number of odd days =  $(0 + 0 + 6 + 1) = 7 \equiv 0$  odd day.

Given day is Sunday.

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3. What was the day of the week on 17<sup>th</sup> June, 1998?



## Answer & Explanation

**Answer:** Option C

## Explanation:

17<sup>th</sup> June, 1998 = (1997 years + Period from 1.1.1998 to 17.6.1998)

Odd days in 1600 years = 0

$$\text{Odd days in 300 years} = (5 \times 3) \equiv 1$$

97 years has 24 leap years + 73 ordinary years.

Number of odd days in 97 years (  $24 \times 2 + 73$  ) = 121 = 2 odd days.

$$\begin{array}{ccccccc} \text{Jan.} & \text{Feb.} & \text{March} & \text{April} & \text{May} & \text{June} \\ (31 + 28 + 31 + 30 + 31 + 17) = 168 \text{ days} \end{array}$$

∴ 168 days = 24 weeks = 0 odd day.

$$\text{Total number of odd days} = (0 + 1 + 2 + 0) = 3.$$

Given day is Wednesday.

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4. What will be the day of the week 15<sup>th</sup> August, 2010?



## Answer & Explanation

**Answer:** Option A

**Explanation:**

15<sup>th</sup> August, 2010 = (2009 years + Period 1.1.2010 to 15.8.2010)

Odd days in 1600 years = 0

Odd days in 400 years = 0

9 years = (2 leap years + 7 ordinary years) =  $(2 \times 2 + 7 \times 1) = 11$  odd days  $\equiv$  4 odd days.

Jan.      Feb.      March      April      May      June      July      Aug.  
(31 + 28 + 31 + 30 + 31 + 30 + 31 + 15) = 227 days

$\therefore$  227 days = (32 weeks + 3 days)  $\equiv$  3 odd days.

Total number of odd days =  $(0 + 0 + 4 + 3) = 7 \equiv 0$  odd days.

Given day is Sunday.

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- 
5. Today is Monday. After 61 days, it will be:

- |              |             |
|--------------|-------------|
| A. Wednesday | B. Saturday |
| C. Tuesday   | D. Thursday |

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Each day of the week is repeated after 7 days.

So, after 63 days, it will be Monday.

$\therefore$  After 61 days, it will be Saturday.

6. If 6<sup>th</sup> March, 2005 is Monday, what was the day of the week on 6<sup>th</sup> March, 2004?

- |            |              |
|------------|--------------|
| A. Sunday  | B. Saturday  |
| C. Tuesday | D. Wednesday |

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

The year 2004 is a leap year. So, it has 2 odd days.

But, Feb 2004 not included because we are calculating from March 2004 to March 2005. So it has 1 odd day only.

∴ The day on 6<sup>th</sup> March, 2005 will be 1 day beyond the day on 6<sup>th</sup> March, 2004.

Given that, 6<sup>th</sup> March, 2005 is Monday.

∴ 6<sup>th</sup> March, 2004 is Sunday (1 day before to 6<sup>th</sup> March, 2005).

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7. On what dates of April, 2001 did Wednesday fall?

A. 1<sup>st</sup>, 8<sup>th</sup>, 15<sup>th</sup>, 22<sup>nd</sup>, 29<sup>th</sup>

B. 2<sup>nd</sup>, 9<sup>th</sup>, 16<sup>th</sup>, 23<sup>rd</sup>, 30<sup>th</sup>

C. 3<sup>rd</sup>, 10<sup>th</sup>, 17<sup>th</sup>, 24<sup>th</sup>

D. 4<sup>th</sup>, 11<sup>th</sup>, 18<sup>th</sup>, 25<sup>th</sup>

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

We shall find the day on 1<sup>st</sup> April, 2001.

1<sup>st</sup> April, 2001 = (2000 years + Period from 1.1.2001 to 1.4.2001)

Odd days in 1600 years = 0

Odd days in 400 years = 0

Jan. Feb. March April  
(31 + 28 + 31 + 1) = 91 days = 0 odd days.

Total number of odd days = (0 + 0 + 0) = 0

On 1<sup>st</sup> April, 2001 it was Sunday.

In April, 2001 Wednesday falls on 4<sup>th</sup>, 11<sup>th</sup>, 18<sup>th</sup> and 25<sup>th</sup>.

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8. How many days are there in  $x$  weeks  $x$  days?

A.  $7x^2$

B.  $8x$

C.  $14x$

D. 7

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$x \text{ weeks } x \text{ days} = (7x + x) \text{ days} = 8x \text{ days.}$$

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9. The last day of a century cannot be

A. Monday

B. Wednesday

C. Tuesday

D. Friday

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

100 years contain 5 odd days.

$\therefore$  Last day of 1<sup>st</sup> century is Friday.

200 years contain  $(5 \times 2) \equiv 3$  odd days.

$\therefore$  Last day of 2<sup>nd</sup> century is Wednesday.

300 years contain  $(5 \times 3) = 15 \equiv 1$  odd day.

$\therefore$  Last day of 3<sup>rd</sup> century is Monday.

400 years contain 0 odd day.

$\therefore$  Last day of 4<sup>th</sup> century is Sunday.

This cycle is repeated.

$\therefore$  Last day of a century cannot be Tuesday or Thursday or Saturday.

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10. On 8<sup>th</sup> Feb, 2005 it was Tuesday. What was the day of the week on 8<sup>th</sup> Feb, 2004?

- |            |              |
|------------|--------------|
| A. Tuesday | B. Monday    |
| C. Sunday  | D. Wednesday |

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

The year 2004 is a leap year. It has 2 odd days.

∴ The day on 8<sup>th</sup> Feb, 2004 is 2 days before the day on 8<sup>th</sup> Feb, 2005.

Hence, this day is Sunday.

11. The calendar for the year 2007 will be the same for the year:

- |         |         |
|---------|---------|
| A. 2014 | B. 2016 |
| C. 2017 | D. 2018 |

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Count the number of odd days from the year 2007 onwards to get the sum equal to 0 odd day.

Year	:	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Odd day	:	1	2	1	1	1	2	1	1	1	2	1

Sum = 14 odd days ≡ 0 odd days.

∴ Calendar for the year 2018 will be the same as for the year 2007.

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12. Which of the following is not a leap year?

- |         |         |
|---------|---------|
| A. 700  | B. 800  |
| C. 1200 | D. 2000 |

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

The century divisible by 400 is a leap year.

∴ The year 700 is not a leap year.

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13. On 8<sup>th</sup> Dec, 2007 Saturday falls. What day of the week was it on 8<sup>th</sup> Dec, 2006?

- |            |             |
|------------|-------------|
| A. Sunday  | B. Thursday |
| C. Tuesday | D. Friday   |

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

The year 2006 is an ordinary year. So, it has 1 odd day.

So, the day on 8<sup>th</sup> Dec, 2007 will be 1 day beyond the day on 8<sup>th</sup> Dec, 2006.

But, 8<sup>th</sup> Dec, 2007 is Saturday.

∴ 8<sup>th</sup> Dec, 2006 is Friday.

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14. January 1, 2008 is Tuesday. What day of the week lies on Jan 1, 2009?

- |             |              |
|-------------|--------------|
| A. Monday   | B. Wednesday |
| C. Thursday | D. Sunday    |

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

The year 2008 is a leap year. So, it has 2 odd days.

1<sup>st</sup> day of the year 2008 is Tuesday (Given)

So, 1<sup>st</sup> day of the year 2009 is 2 days beyond Tuesday.

Hence, it will be Thursday.

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15. January 1, 2007 was Monday. What day of the week lies on Jan. 1, 2008?

- |              |            |
|--------------|------------|
| A. Monday    | B. Tuesday |
| C. Wednesday | D. Sunday  |

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

The year 2007 is an ordinary year. So, it has 1 odd day.

1<sup>st</sup> day of the year 2007 was Monday.

1<sup>st</sup> day of the year 2008 will be 1 day beyond Monday.

Hence, it will be Tuesday

## Area

## Formulas

### FUNDAMENTAL CONCEPTS

**1. Results on Triangles:**

- i. Sum of the angles of a triangle is  $180^\circ$ .
- ii. The sum of any two sides of a triangle is greater than the third side.
- iii. **Pythagoras Theorem:**

In a right-angled triangle,  $(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Height})^2$ .

- iv. The line joining the mid-point of a side of a triangle to the positive vertex is called the **median**.
- v. The point where the three medians of a triangle meet, is called **centroid**. The centroid divides each of the medians in the ratio 2 : 1.
- vi. In an isosceles triangle, the altitude from the vertex bisects the base.
- vii. The median of a triangle divides it into two triangles of the same area.

- viii. The area of the triangle formed by joining the mid-points of the sides of a given triangle is one-fourth of the area of the given triangle.

**2. Results on Quadrilaterals:**

- The diagonals of a parallelogram bisect each other.
- Each diagonal of a parallelogram divides it into triangles of the same area.
- The diagonals of a rectangle are equal and bisect each other.
- The diagonals of a square are equal and bisect each other at right angles.
- The diagonals of a rhombus are unequal and bisect each other at right angles.
- A parallelogram and a rectangle on the same base and between the same parallels are equal in area.
- Of all the parallelogram of given sides, the parallelogram which is a rectangle has the greatest area.

### **IMPORTANT FORMULAE**

- I. 1. Area of a rectangle = (Length x Breadth).

$$\therefore \text{Length} = \left( \frac{\text{Area}}{\text{Breadth}} \right) \text{ and Breadth} = \left( \frac{\text{Area}}{\text{Length}} \right).$$

- II. 2. Perimeter of a rectangle =  $2(\text{Length} + \text{Breadth})$ .

III. Area of a square =  $(\text{side})^2 = \frac{1}{2}(\text{diagonal})^2$ .

IV. Area of 4 walls of a room =  $2 (\text{Length} + \text{Breadth}) \times \text{Height}$ .

V. 1. Area of a triangle =  $\frac{1}{2} \times \text{Base} \times \text{Height}$ .

2. Area of a triangle =  $s(s-a)(s-b)(s-c)$

where  $a, b, c$  are the sides of the triangle and  $s = \frac{1}{2}(a + b + c)$ .

3. Area of an equilateral triangle =  $\frac{3}{4} \times (\text{side})^2$

4. Radius of incircle of an equilateral triangle of side  $a = \frac{a}{23}$ .

5. Radius of circumcircle of an equilateral triangle of side  $a = \frac{a}{3}$ .

6. Radius of incircle of a triangle of area  $\Delta$  and semi-perimeter  $s = \frac{\Delta}{s}$

VI. 1. Area of parallelogram = (Base x Height).

2. Area of a rhombus =  $\frac{1}{2} \times (\text{Product of diagonals})$ .

3. Area of a trapezium =  $\frac{1}{2} \times (\text{sum of parallel sides}) \times \text{distance between them}$ .

VII. 1. Area of a circle =  $\pi R^2$ , where  $R$  is the radius.

2. Circumference of a circle =  $2\pi R$ .
3. Length of an arc =  $\frac{2\pi R \theta}{360}$ , where  $\theta$  is the central angle.
4. Area of a sector =  $\frac{1}{2}(\text{arc} \times R) = \frac{\pi R^2 \theta}{360}$ .

VIII. 1. Circumference of a semi-circle =  $\pi R$ .

$$2. \text{ Area of semi-circle} = \frac{\pi R^2}{2}.$$

1. The ratio between the length and the breadth of a rectangular park is 3 : 2. If a man cycling along the boundary of the park at the speed of 12 km/hr completes one round in 8 minutes, then the area of the park (in sq. m) is:

- |                 |                  |
|-----------------|------------------|
| <b>A.</b> 15360 | <b>B.</b> 153600 |
| <b>C.</b> 30720 | <b>D.</b> 307200 |

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$\text{Perimeter} = \text{Distance covered in 8 min.} = \left( \frac{12000}{60} \times 8 \right) \text{m} = 1600 \text{ m.}$$

Let length =  $3x$  metres and breadth =  $2x$  metres.

Then,  $2(3x + 2x) = 1600$  or  $x = 160$ .

- ∴ Length = 480 m and Breadth = 320 m.
- ∴ Area =  $(480 \times 320) \text{ m}^2 = 153600 \text{ m}^2$ .

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2. An error 2% in excess is made while measuring the side of a square. The percentage of error in the calculated area of the square is:

- |              |                 |
|--------------|-----------------|
| <b>A.</b> 2% | <b>B.</b> 2.02% |
| <b>C.</b> 4% | <b>D.</b> 4.04% |

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

100 cm is read as 102 cm.

$$\therefore A_1 = (100 \times 100) \text{ cm}^2 \text{ and } A_2 = (102 \times 102) \text{ cm}^2.$$

$$(A_2 - A_1) = [(102)^2 - (100)^2]$$

$$= (102 + 100) \times (102 - 100)$$

$$= 404 \text{ cm}^2.$$

$$\therefore \text{Percentage error} = \left( \frac{404}{100 \times 100} \times 100 \right) \% = 4.04\%$$

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- 
3. The ratio between the perimeter and the breadth of a rectangle is 5 : 1. If the area of the rectangle is 216 sq. cm, what is the length of the rectangle?
- A. 16 cm      B. 18 cm  
C. 24 cm      D. Data inadequate  
E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\frac{2(l+b)}{b} = \frac{5}{1}$$

$$\Rightarrow 2l + 2b = 5b$$

$$\Rightarrow 3b = 2l$$

$$b = \frac{2}{3}l$$

Then, Area = 216 cm<sup>2</sup>

$$\Rightarrow l \times b = 216$$

$$\Rightarrow l \times \frac{2}{3}l = 216$$

$$\Rightarrow l^2 = 324$$

$$\Rightarrow l = 18 \text{ cm.}$$

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- 
4. The percentage increase in the area of a rectangle, if each of its sides is increased by 20% is:

A. 40%

B. 42%

C. 44%

D. 46%

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let original length =  $x$  metres and original breadth =  $y$  metres.

Original area =  $(xy)$  m<sup>2</sup>.

$$\text{New length} = \left( \frac{120}{100}x \right)_{\text{m}} = \left( \frac{6}{5}x \right)_{\text{m}}.$$

$$\text{New breadth} = \left( \frac{120}{100}y \right)_{\text{m}} = \left( \frac{6}{5}y \right)_{\text{m}}.$$

$$\text{New Area} = \left( \frac{6}{5}x \times \frac{6}{5}y \right)_{\text{m}^2} = \left( \frac{36}{25}xy \right)_{\text{m}^2}.$$

The difference between the original area =  $xy$  and new-area  $36/25 xy$  is

$$= (36/25)xy - xy$$

$$= xy(36/25 - 1)$$

$$= xy(11/25) \text{ or } (11/25)xy$$

$$\therefore \text{Increase \%} = \left( \frac{11}{25}xy \times \frac{1}{xy} \times 100 \right)_{\%} = 44\%.$$

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- 
5. A rectangular park 60 m long and 40 m wide has two concrete crossroads running in the middle of the park and rest of the park has been used as a lawn. If the area of the lawn is 2109 sq. m, then what is the width of the road?

A. 2.91 m

B. 3 m

C. 5.82 m

D. None of these

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Area of the park =  $(60 \times 40)$  m<sup>2</sup> = 2400 m<sup>2</sup>.

Area of the lawn = 2109 m<sup>2</sup>.

∴ Area of the crossroads =  $(2400 - 2109)$  m<sup>2</sup> = 291 m<sup>2</sup>.

Let the width of the road be  $x$  metres. Then,

$$60x + 40x - x^2 = 291$$

$$\Rightarrow x^2 - 100x + 291 = 0$$

$$\Rightarrow (x - 97)(x - 3) = 0$$

$$\Rightarrow x = 3.$$

6. The diagonal of the floor of a rectangular closet is  $7\frac{1}{2}$  feet. The shorter side of the closet is  $4\frac{1}{2}$  feet. What is the area of the closet in square feet?

A.  $5\frac{1}{4}$

B.  $13\frac{1}{2}$

C. 27

D. 37

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$$\text{Other side} = \left(\frac{15}{2}\right)^2 - \left(\frac{9}{2}\right)^2 \text{ ft}$$

$$= \frac{225}{4} - \frac{81}{4} \quad \text{ft}$$

$$= \frac{144}{4} \quad \text{ft}$$

$$= 6 \text{ ft.}$$

$\therefore$  Area of closet =  $(6 \times 4.5)$  sq. ft = 27 sq. ft.

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- 
7. A towel, when bleached, was found to have lost 20% of its length and 10% of its breadth. The percentage of decrease in area is:

A. 10%

B. 10.08%

C. 20%

D. 28%

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let original length =  $x$  and original breadth =  $y$ .

$$\text{Decrease in area} = xy - \left( \frac{80}{100}x \times \frac{90}{100}y \right)$$

$$= \left( xy - \frac{18}{25}xy \right)$$

$$= \frac{7}{25}xy.$$

$$\therefore \text{Decrease \%} = \left( \frac{7}{25}xy \times \frac{1}{xy} \times 100 \right) \% = 28\%.$$

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- 
8. A man walked diagonally across a square lot. Approximately, what was the percent saved by not walking along the edges?

A. 20

B. 24

C. 30

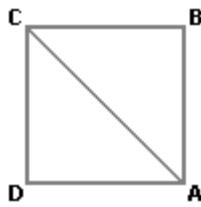
D. 33

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the side of the square(ABCD) be  $x$  metres.



Then,  $AB + BC = 2x$  metres.

$$AC = 2x = (1.41x) \text{ m.}$$

$$\text{Saving on } 2x \text{ metres} = (0.59x) \text{ m.}$$

$$\text{Saving \%} = \left( \frac{0.59x}{2x} \times 100 \right) \% = 30\% \text{ (approx.)}$$

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9. The diagonal of a rectangle is 41 cm and its area is 20 sq. cm. The perimeter of the rectangle must be:

A. 9 cm

B. 18 cm

C. 20 cm

D. 41 cm

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$l^2 + b^2 = 41.$$

$$\text{Also, } lb = 20.$$

$$(l+b)^2 = (l^2 + b^2) + 2lb = 41 + 40 = 81$$

$$\Rightarrow (l+b) = 9.$$

$$\therefore \text{Perimeter} = 2(l+b) = 18 \text{ cm.}$$

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10. What is the least number of squares tiles required to pave the floor of a room 15 m 17 cm long and 9 m 2 cm broad?

A. 814

B. 820

C. 840

D. 844

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Length of largest tile = H.C.F. of 1517 cm and 902 cm = 41 cm.

Area of each tile =  $(41 \times 41)$  cm<sup>2</sup>.

$$\therefore \text{Required number of tiles} = \left( \frac{1517 \times 902}{41 \times 41} \right) = 814.$$

11. The difference between the length and breadth of a rectangle is 23 m. If its perimeter is 206 m, then its area is:

- A. 1520 m<sup>2</sup>      B. 2420 m<sup>2</sup>  
C. 2480 m<sup>2</sup>      D. 2520 m<sup>2</sup>

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

We have:  $(l - b) = 23$  and  $2(l + b) = 206$  or  $(l + b) = 103$ .

Solving the two equations, we get:  $l = 63$  and  $b = 40$ .

$$\therefore \text{Area} = (l \times b) = (63 \times 40) \text{ m}^2 = 2520 \text{ m}^2.$$

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- 
12. The length of a rectangle is halved, while its breadth is tripled. What is the percentage change in area?

- A. 25% increase      B. 50% increase  
C. 50% decrease      D. 75% decrease

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let original length =  $x$  and original breadth =  $y$ .

Original area =  $xy$ .

$$\text{New length} = \frac{x}{2}$$

$$\text{New breadth} = 3y.$$

$$\text{New area} = \left( \frac{x}{2} \times 3y \right) = \frac{3}{2}xy.$$

$$\therefore \text{Increase \%} = \left( \frac{\frac{1}{2}xy}{xy} \times 100 \right)\% = 50\%.$$

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- 
13. The length of a rectangular plot is 20 metres more than its breadth. If the cost of fencing the plot @ 26.50 per metre is Rs. 5300, what is the length of the plot in metres?

A. 40

B. 50

C. 120

D. Data inadequate

E. None of these

**Answer & Explanation**

**Answer:** Option E

**Explanation:**

Let breadth =  $x$  metres.

Then, length =  $(x + 20)$  metres.

$$\text{Perimeter} = \left( \frac{5300}{26.50} \right) \text{ m} = 200 \text{ m.}$$

$$\therefore 2[(x + 20) + x] = 200$$

$$\Rightarrow 2x + 20 = 100$$

$$\Rightarrow 2x = 80$$

$$\Rightarrow x = 40.$$

Hence, length =  $x + 20 = 60$  m.

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- 
14. A rectangular field is to be fenced on three sides leaving a side of 20 feet uncovered. If the area of the field is 680 sq. feet, how many feet of fencing will be required?

A. 34

B. 40

C. 68

D. 88

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

We have:  $l = 20$  ft and  $lb = 680$  sq. ft.

So,  $b = 34$  ft.

$\therefore$  Length of fencing =  $(l + 2b) = (20 + 68)$  ft = 88 ft.

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- 
15. A tank is 25 m long, 12 m wide and 6 m deep. The cost of plastering its walls and bottom at 75 paise per sq. m, is:

A. Rs. 456

B. Rs. 458

C. Rs. 558

D. Rs. 568

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$$\begin{aligned}\text{Area to be plastered} &= [2(l + b) \times h] + (l \times b) \\&= \{[2(25 + 12) \times 6] + (25 \times 12)\} \text{ m}^2 \\&= (444 + 300) \text{ m}^2 \\&= 744 \text{ m}^2.\end{aligned}$$

$\therefore$  Cost of plastering = Rs.  $\left(744 \times \frac{75}{10}\right)$  = Rs. 558.

## Numbers

## Formulas

### 1. Some Basic Formulae:

i.  $(a + b)(a - b) = (a^2 - b^2)$

- ii.  $(a + b)^2 = (a^2 + b^2 + 2ab)$
- iii.  $(a - b)^2 = (a^2 + b^2 - 2ab)$
- iv.  $(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$
- v.  $(a^3 + b^3) = (a + b)(a^2 - ab + b^2)$
- vi.  $(a^3 - b^3) = (a - b)(a^2 + ab + b^2)$
- vii.  $(a^3 + b^3 + c^3 - 3abc) = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ac)$
- viii. When  $a + b + c = 0$ , then  $a^3 + b^3 + c^3 = 3abc$ .

1. Which one of the following is not a prime number?

A. 31

B. 61

C. 71

D. 91

#### [Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

91 is divisible by 7. So, it is not a prime number.

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2.  $\frac{2}{(112 \times 5^4)} = ?$

A. 67000

B. 70000

C. 76500

D. 77200

#### [Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$(112 \times 5^4) = 112 \times \left(\frac{10}{2}\right)^4 = \frac{112 \times 10^4}{2^4} = \frac{1120000}{16} = 70000$$

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3. It is being given that  $(2^{32} + 1)$  is completely divisible by a whole number. Which of the following numbers is completely divisible by this number?

A.  $(2^{16} + 1)$

B.  $(2^{16} - 1)$

C.  $(7 \times 2^{23})$

D.  $(2^{96} + 1)$

#### [Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Let  $2^{32} = x$ . Then,  $(2^{32} + 1) = (x + 1)$ .

Let  $(x + 1)$  be completely divisible by the natural number N. Then,

$(2^{96} + 1) = [(2^{32})^3 + 1] = (x^3 + 1) = (x + 1)(x^2 - x + 1)$ , which is completely divisible by N, since  $(x + 1)$  is divisible by N.

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4.

4. What least number must be added to 1056, so that the sum is completely divisible by 23 ?

A. 2

B. 3

C. 18

D. 21

E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\begin{array}{r} 23) \ 1056 \ (\text{45} \\ \quad 92 \\ \quad \text{---} \\ \quad 136 \\ \quad 115 \\ \quad \text{---} \\ \quad 21 \\ \quad \text{---} \end{array}$$

$$\begin{aligned} \text{Required number} &= (23 - 21) \\ &= 2. \end{aligned}$$

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5.

5.  $1397 \times 1397 = ?$

A. 1951609

B. 1981709

C. 18362619

D. 2031719

E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\begin{aligned}1397 \times 1397 &= (1397)^2 \\&= (1400 - 3)^2 \\&= (1400)^2 + (3)^2 - (2 \times 1400 \times 3) \\&= 1960000 + 9 - 8400 \\&= 1960009 - 8400 \\&= 1951609.\end{aligned}$$

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6. \_\_\_\_\_
6. How many of the following numbers are divisible by 132 ?  
264, 396, 462, 792, 968, 2178, 5184, 6336

A. 4

B. 5

C. 6

D. 7

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$132 = 4 \times 3 \times 11$$

So, if the number divisible by all the three number 4, 3 and 11, then the number is divisible by 132 also.

$$264 \rightarrow 11,3,4 (/)$$

$$396 \rightarrow 11,3,4 (/)$$

$$462 \rightarrow 11,3 (X)$$

$$792 \rightarrow 11,3,4 (/)$$

$$968 \rightarrow 11,4 (X)$$

$$2178 \rightarrow 11,3 (X)$$

5184 → 3,4 (X)

6336 → 11,3,4 (/)

Therefore the following numbers are divisible by 132 : 264, 396, 792 and 6336.

Required number of number = 4.

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7. \_\_\_\_\_  
7.  $(935421 \times 625) = ?$

A. 575648125

B. 584638125

C. 584649125

D. 585628125

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8. \_\_\_\_\_  
8. The largest 4 digit number exactly divisible by 88 is:

A. 9944

B. 9768

C. 9988

D. 8888

E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Largest 4-digit number = 9999

$$\begin{array}{r} 88) 9999 (113 \\ 88 \\ \hline 119 \\ 88 \\ \hline 319 \\ 264 \\ \hline 55 \\ \hline \end{array}$$

$$\begin{aligned} \text{Required number} &= (9999 - 55) \\ &= 9944. \end{aligned}$$

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9. \_\_\_\_\_

9. Which of the following is a prime number ?
- A. 33      B. 81  
C. 93      D. 97

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Clearly, 97 is a prime number.

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10. \_\_\_\_\_  
10. What is the unit digit in  $\{(6374)^{1793} \times (625)^{317} \times (341)^{491}\}$ ?
- A. 0      B. 2  
C. 3      D. 5

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Unit digit in  $(6374)^{1793}$  = Unit digit in  $(4)^{1793}$

$$= \text{Unit digit in } [(4^2)^{896} \times 4]$$

$$= \text{Unit digit in } (6 \times 4) = 4$$

Unit digit in  $(625)^{317}$  = Unit digit in  $(5)^{317}$  = 5

Unit digit in  $(341)^{491}$  = Unit digit in  $(1)^{491}$  = 1

Required digit = Unit digit in  $(4 \times 5 \times 1)$  = 0.

11.  $5358 \times 51 = ?$
- A. 273258      B. 273268  
C. 273348      D. 273358

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$\begin{aligned} 5358 \times 51 &= 5358 \times (50 + 1) \\ &= 5358 \times 50 + 5358 \times 1 \\ &= 267900 + 5358 \\ &= 273258. \end{aligned}$$

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12. The sum of first five prime numbers is:

- |       |       |
|-------|-------|
| A. 11 | B. 18 |
| C. 26 | D. 28 |

**Answer & Explanation****Answer:** Option D**Explanation:**

Required sum =  $(2 + 3 + 5 + 7 + 11) = 28$ .

Note: 1 is not a prime number.

**Definition:** A prime number (or a prime) is a natural number that has exactly two distinct natural number divisors: 1 and itself.

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13. The difference of two numbers is 1365. On dividing the larger number by the smaller, we get 6 as quotient and the 15 as remainder. What is the smaller number ?

- |        |        |
|--------|--------|
| A. 240 | B. 270 |
| C. 295 | D. 360 |

**Answer & Explanation****Answer:** Option B**Explanation:**

Let the smaller number be  $x$ . Then larger number =  $(x + 1365)$ .

$$\therefore x + 1365 = 6x + 15$$

$$\Rightarrow 5x = 1350$$

$$\Rightarrow x = 270$$

$\therefore$  Smaller number = 270.

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14.  $(12)^3 \times 6^4 \div 432 = ?$

A. 5184

B. 5060

C. 5148

D. 5084

E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\text{Given Exp.} = \frac{(12)^3 \times 6^4}{432} = \frac{(12)^3 \times 6^4}{12 \times 6^2} = (12)^2 \times 6^2 = (72)^2 = 5184$$

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15.  $72519 \times 9999 = ?$

A. 725117481

B. 674217481

C. 685126481

D. 696217481

E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$72519 \times 9999 = 72519 \times (10000 - 1)$$

$$= 72519 \times 10000 - 72519 \times 1$$

$$= 725190000 - 72519$$

$$= 725117481.$$

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16. If the number  $517^*324$  is completely divisible by 3, then the smallest whole number in the place of \* will be:

A. 0      B. 1  
C. 2      D. None of these

## Answer & Explanation

**Answer:** Option C

## Explanation:

Sum of digits =  $(5 + 1 + 7 + x + 3 + 2 + 4) = (22 + x)$ , which must be divisible by 3.

$$\therefore x = 2.$$

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17. The smallest 3 digit prime number is:

A. 101      B. 103  
C. 109      D. 113

## Answer & Explanation

**Answer:** Option A

## **Explanation:**

The smallest 3-digit number is 100, which is divisible by 2.

∴ 100 is not a prime number.

$101 < 11$  and  $101$  is not divisible by any of the prime numbers  $2, 3, 5, 7, 11$ .

∴ 101 is a prime number.

Hence 101 is the smallest 3-digit prime number.

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18. Which one of the following numbers is exactly divisible by 11?

- A. 235641      B. 245642  
C. 315624      D. 415624

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

$(4 + 5 + 2) - (1 + 6 + 3) = 1$ , not divisible by 11.

$(2 + 6 + 4) - (4 + 5 + 2) = 1$ , not divisible by 11.

$(4 + 6 + 1) - (2 + 5 + 3) = 1$ , not divisible by 11.

$(4 + 6 + 1) - (2 + 5 + 4) = 0$ , So, 415624 is divisible by 11.

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19.  $(?) - 19657 - 33994 = 9999$

- A. 63650      B. 53760  
C. 59640      D. 61560  
E. None of these

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$\begin{array}{r} 19657 \\ 33994 \\ \hline 53651 \end{array} \quad \begin{array}{l} \text{Let } x - 53651 = 9999 \\ \text{Then, } x = 9999 + 53651 = 63650 \end{array}$$

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20. The sum of first 45 natural numbers is:

- A. 1035      B. 1280  
C. 2070      D. 2140

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

Let  $S_n = (1 + 2 + 3 + \dots + 45)$ . This is an A.P. in which  $a = 1$ ,  $d = 1$ ,  $n = 45$ .

$$\begin{aligned} S_n &= \frac{n}{2} [2a + (n - 1)d] = \frac{45}{2} [2 \times 1 + (45 - 1) \times 1] = \left( \frac{45}{2} \times 46 \right) = (45 \times 23) \\ &= 45 \times (20 + 3) \\ &= 45 \times 20 + 45 \times 3 \\ &= 900 + 135 \\ &= 1035. \end{aligned}$$

**Shortcut Method:**

$$S_n = \frac{n(n + 1)}{2} = \frac{45(45 + 1)}{2} = 1035.$$

21. Which of the following number is divisible by 24 ?

A. 35718

B. 63810

C. 537804

D. 3125736

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$24 = 3 \times 8$ , where 3 and 8 co-prime.

Clearly, 35718 is not divisible by 8, as 718 is not divisible by 8.

Similarly, 63810 is not divisible by 8 and 537804 is not divisible by 8.

Consider option (D),

Sum of digits =  $(3 + 1 + 2 + 5 + 7 + 3 + 6) = 27$ , which is divisible by 3.

Also, 736 is divisible by 8.

$\therefore$  3125736 is divisible by  $(3 \times 8)$ , i.e., 24.

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22.  $\frac{753 \times 753 + 247 \times 247 - 753 \times 247}{753 \times 753 \times 753 + 247 \times 247 \times 247} = ?$

A.  $\frac{1}{1000}$

B.  $\frac{1}{506}$

C.  $\frac{253}{500}$

D. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Given Exp. =  $\frac{(a^2 + b^2 - ab)}{(a^3 + b^3)} = \frac{1}{(a+b)} = \frac{1}{(753+247)} = \frac{1}{1000}$

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23.  $(?) + 3699 + 1985 - 2047 = 31111$

A. 34748

B. 27474

C. 30154

D. 27574

E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$x + 3699 + 1985 - 2047 = 31111$$

$$\Rightarrow x + 3699 + 1985 = 31111 + 2047$$

$$\Rightarrow x + 5684 = 33158$$

$$\Rightarrow x = 33158 - 5684 = 27474.$$

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24. If the number  $481 * 673$  is completely divisible by 9, then the smallest whole number in place of \* will be:

A. 2

B. 5

C. 6

D. 7

E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Sum of digits =  $(4 + 8 + 1 + x + 6 + 7 + 3) = (29 + x)$ , which must be divisible by 9.

$$\therefore x = 7.$$

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25. The difference between the local value and the face value of 7 in the numeral 32675149 is

A. 75142

B. 64851

C. 5149

D. 69993

E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

(Local value of 7) - (Face value of 7) =  $(70000 - 7) = 69993$

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26. The difference between a positive proper fraction and its reciprocal is  $\frac{9}{20}$ . The fraction is:

A.  $\frac{3}{5}$

B.  $\frac{3}{10}$

C.  $\frac{4}{5}$

D.  $\frac{4}{3}$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the required fraction be  $x$ . Then  $\frac{1}{x} - x = \frac{9}{20}$

$$\therefore \frac{1 - x^2}{x} = \frac{9}{20}$$

$$\Rightarrow 20 - 20x^2 = 9x$$

$$\Rightarrow 20x^2 + 9x - 20 = 0$$

$$\Rightarrow 20x^2 + 25x - 16x - 20 = 0$$

$$\Rightarrow 5x(4x + 5) - 4(4x + 5) = 0$$

$$\Rightarrow (4x + 5)(5x - 4) = 0$$

$$x = \frac{4}{5}$$

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- 
27. On dividing a number by 56, we get 29 as remainder. On dividing the same number by 8, what will be the remainder ?

A. 4

B. 5

C. 6

D. 7

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

No answer description available for this question. [Let us discuss](#).

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- 
28. If  $n$  is a natural number, then  $(6n^2 + 6n)$  is always divisible by:

A. 6 only

B. 6 and 12 both

C. 12 only

D. by 18 only

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$(6n^2 + 6n) = 6n(n + 1)$ , which is always divisible by 6 and 12 both, since  $n(n + 1)$  is always even.

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29.  $107 \times 107 + 93 \times 93 = ?$

A. 19578

B. 19418

C. 20098

D. 21908

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\begin{aligned}107 \times 107 + 93 \times 93 &= (107)^2 + (93)^2 \\&= (100 + 7)^2 + (100 - 7)^2 \\&= 2 \times [(100)^2 + 7^2] \quad [\text{Ref: } (a + b)^2 + (a - b)^2 = 2(a^2 + b^2)] \\&= 20098\end{aligned}$$

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30. What will be remainder when  $(67^{67} + 67)$  is divided by 68 ?

A. 1

B. 63

C. 66

D. 67

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$(x^n + 1)$  will be divisible by  $(x + 1)$  only when  $n$  is odd.

$\therefore (67^{67} + 1)$  will be divisible by  $(67 + 1)$

$\therefore (67^{67} + 1) + 66$ , when divided by 68 will give 66 as remainder.

31. On dividing a number by 5, we get 3 as remainder. What will the remainder when the square of this number is divided by 5 ?

A. 0

B. 1

C. 2

D. 4

### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let the number be  $x$  and on dividing  $x$  by 5, we get  $k$  as quotient and 3 as remainder.

$$\therefore x = 5k + 3$$

$$\Rightarrow x^2 = (5k + 3)^2$$

$$= (25k^2 + 30k + 9)$$

$$= 5(5k^2 + 6k + 1) + 4$$

$\therefore$  On dividing  $x^2$  by 5, we get 4 as remainder.

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32. How many 3-digit numbers are completely divisible 6 ?

A. 149

B. 150

C. 151

D. 166

### Answer & Explanation

**Answer:** Option B

#### Explanation:

3-digit number divisible by 6 are: 102, 108, 114,... , 996

This is an A.P. in which  $a = 102$ ,  $d = 6$  and  $l = 996$

Let the number of terms be  $n$ . Then  $t_n = 996$ .

$$\therefore a + (n - 1)d = 996$$

$$\Rightarrow 102 + (n - 1) \times 6 = 996$$

$$\Rightarrow 6 \times (n - 1) = 894$$

$$\Rightarrow (n - 1) = 149$$

$$\Rightarrow n = 150$$

$\therefore$  Number of terms = 150.

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33. How many natural numbers are there between 23 and 100 which are exactly divisible by 6 ?

A. 8

B. 11

C. 12

D. 13

E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Required numbers are 24, 30, 36, 42, ..., 96

This is an A.P. in which  $a = 24$ ,  $d = 6$  and  $l = 96$

Let the number of terms in it be  $n$ .

Then  $t_n = 96 \Rightarrow a + (n - 1)d = 96$

$$\Rightarrow 24 + (n - 1) \times 6 = 96$$

$$\Rightarrow (n - 1) \times 6 = 72$$

$$\Rightarrow (n - 1) = 12$$

$$\Rightarrow n = 13$$

Required number of numbers = 13.

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34. How many of the following numbers are divisible by 3 but not by 9 ?

2133, 2343, 3474, 4131, 5286, 5340, 6336, 7347, 8115, 9276

A. 5

B. 6

C. 7

D. None of these

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

Marking (/) those which are divisible by 3 by not by 9 and the others by (X), by taking the sum of digits, we get:s

2133 → 9 (X)

2343 → 12 (/)

3474 → 18 (X)

4131 → 9 (X)

5286 → 21 (/)

5340 → 12 (/)

6336 → 18 (X)

7347 → 21 (/)

8115 → 15 (/)

9276 → 24 (/)

Required number of numbers = 6.

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35.  $\frac{(963 + 476)^2 + (963 - 476)^2}{(963 \times 963 + 476 \times 476)} = ?$

**A.** 1449

**B.** 497

**C.** 2

**D.** 4

**E.** None of these

**Answer & Explanation**

**Answer:** Option **C**

**Explanation:**

Given Exp. =  $\underline{(a + b)^2} + \underline{(a - b)^2} = \underline{2(a^2 + b^2)} = 2$

$$(a^2 + b^2) \quad (a^2 + b^2)$$

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56. How many 3 digit numbers are divisible by 6 in all ?

A. 149      B. 150  
C. 151      D. 166

## Answer & Explanation

**Answer:** Option B

## Explanation:

Required numbers are 102, 108, 114, ..., 996

This is an A.P. in which  $a = 102$ ,  $d = 6$  and  $l = 996$

Let the number of terms be  $n$ . Then,

$$a + (n - 1)d = 996$$

$$\Rightarrow 102 + (n - 1) \times 6 = 996$$

$$\Rightarrow 6 \times (n - 1) = 894$$

$$\Rightarrow (n - 1) = 149$$

$$\Rightarrow n = 150.$$

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37. A 3-digit number  $4a3$  is added to another 3-digit number  $984$  to give a 4-digit number  $13b7$ , which is divisible by  $11$ . Then,  $(a + b) = ?$



## Answer & Explanation

**Answer:** Option A

## Explanation:

$$\begin{array}{r} 4 \ a \ 3 \\ 9 \ 8 \ 4 \\ 13 \ b \ 7 \end{array} \quad | \quad \Rightarrow a + 8 = b \quad \Rightarrow \quad b - a = 8$$

Also, 13 b7 is divisible by 11  $\Rightarrow$   $(7 + 3) - (b + 1) = (9 - b)$

$$\Rightarrow (9 - b) = 0$$

$$\Rightarrow b = 9$$

$$\therefore (b = 9 \text{ and } a = 1) \Rightarrow (a + b) = 10.$$

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38.  $8597 - ? = 7429 - 4358$

A. 5426

B. 5706

C. 5526

D. 5476

E. None of these

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\begin{array}{r} 7429 \\ -4358 \\ \hline 3071 \end{array} \quad \begin{array}{l} \text{Let } 8597 - x = 3071 \\ \text{Then, } x = 8597 - 3071 \\ \qquad\qquad\qquad = 5526 \end{array}$$

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39. The smallest prime number is:

A. 1

B. 2

C. 3

D. 4

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

The smallest prime number is 2.

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40.  $(12345679 \times 72) = ?$

- A. 88888888      B. 888888888  
C. 898989898      D. 9999999998

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\begin{aligned}12345679 \times 72 &= 12345679 \times (70 + 2) \\&= 12345679 \times 70 + 12345679 \times 2 \\&= 864197530 + 24691358 \\&= 88888888\end{aligned}$$

41. On dividing a number by 357, we get 39 as remainder. On dividing the same number 17, what will be the remainder ?

- A. 0      B. 3  
C. 5      D. 11

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let  $x$  be the number and  $y$  be the quotient. Then,

$$\begin{aligned}x &= 357 \times y + 39 \\&= (17 \times 21 \times y) + (17 \times 2) + 5 \\&= 17 \times (21y + 2) + 5 \\&\therefore \text{Required remainder} = 5.\end{aligned}$$

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- 
42. If the product  $4864 \times 9 P 2$  is divisible by 12, then the value of  $P$  is:

- A. 2      B. 5

C. 6

D. 8

E. None of these

**Answer & Explanation**

**Answer:** Option E

**Explanation:**

Clearly, 4864 is divisible by 4.

So, 9P2 must be divisible by 3. So,  $(9 + P + 2)$  must be divisible by 3.

$$\therefore P = 1.$$

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43. Which one of the following is the common factor of  $(47^{43} + 43^{43})$  and  $(47^{47} + 43^{47})$  ?

A.  $(47 - 43)$

B.  $(47 + 43)$

C.  $(47^{43} + 43^{43})$

D. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

When  $n$  is odd,  $(x^n + a^n)$  is always divisible by  $(x + a)$ .

$\therefore$  Each one of  $(47^{43} + 43^{43})$  and  $(47^{47} + 43^{47})$  is divisible by  $(47 + 43)$ .

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44.  $-84 \times 29 + 365 = ?$

A. 2436

B. 2801

C. -2801

D. -2071

E. None of these

**Answer & Explanation**

**Answer:** Option D

## Explanation:

$$\text{Given Exp. } = -84 \times (30 - 1) + 365$$

$$\begin{aligned}
 &= -(84 \times 30) + 84 + 365 \\
 &= -2520 + 449 \\
 &= -2071
 \end{aligned}$$

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45. A number when divided by 296 leaves 75 as remainder. When the same number is divided by 37, the remainder will be:



## Answer & Explanation

**Answer:** Option A

## Explanation:

$$\text{Let } x = 296q + 75$$

$$= 37(8q + 2) + 1$$

Thus, when the number is divided by 37, the remainder is 1.

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46. In dividing a number by 585, a student employed the method of short division. He divided the number successively by 5, 9 and 13 (factors 585) and got the remainders 4, 8, 12 respectively. If he had divided the number by 585, the remainder would have been



## Answer & Explanation

**Answer:** Option D

## Explanation:

$$5 \mid x \quad z = 13 \times 1 + 12 = 25$$

$$\begin{array}{r}
 \hline
 9 | & y - 4 \\
 \hline
 13 | & z - 8 \\
 \hline
 & 1 - 12
 \end{array}
 \quad
 \begin{array}{l}
 y = 9 \times z + 8 = 9 \times 25 + 8 = 233 \\
 x = 5 \times y + 4 = 5 \times 233 + 4 = 1169
 \end{array}$$

585) 1169 (1  
 585  
 ---  
 584  
 ---

Therefore, on dividing the number by 585, remainder = 584.  
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47. In a division sum, the divisor is 10 times the quotient and 5 times the remainder. If the remainder is 46, what is the dividend ?

- |                         |                |
|-------------------------|----------------|
| <b>A.</b> 4236          | <b>B.</b> 4306 |
| <b>C.</b> 4336          | <b>D.</b> 5336 |
| <b>E.</b> None of these |                |

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Divisor} = (5 \times 46) = 230$$

$$\therefore 10 \times \text{Quotient} = 230 \Rightarrow \frac{230}{10} = 23$$

$$\text{Dividend} = (\text{Divisor} \times \text{Quotient}) + \text{Remainder}$$

$$= (230 \times 23) + 46$$

$$= 5290 + 46$$

$$= 5336.$$

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48.  $4500 \times ? = 3375$

- |                         |                         |
|-------------------------|-------------------------|
| <b>A.</b> $\frac{2}{5}$ | <b>B.</b> $\frac{3}{4}$ |
|-------------------------|-------------------------|

C.  $\frac{1}{4}$

D.  $\frac{3}{5}$

E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$4500 \times x = 3375 \Rightarrow x = \frac{3375}{4500} = \frac{3}{4}$$

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49. What smallest number should be added to 4456 so that the sum is completely divisible by 6 ?

A. 4

B. 3

C. 2

D. 1

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

6) 4456 (742

42

---

25

24

Therefore, Required number = (6 - 4) = 2.

---

16

12

---

4

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50. What least number must be subtracted from 13601, so that the remainder is divisible by 87 ?

A. 23

B. 31

C. 29

D. 37

E. 49

## Answer & Explanation

**Answer:** Option C

## Explanation:

$$\begin{array}{r}
 87) 13601 \quad (156 \\
 87 \\
 \hline
 490 \\
 435 \\
 \hline
 551 \\
 522 \\
 \hline
 29 \\
 \hline
 \end{array}$$

Therefore, the required number = 29.

51.  $476 \text{ ** } 0$  is divisible by both 3 and 11. The non-zero digits in the hundred's and ten's places are respectively:



## Answer & Explanation

**Answer:** Option C

## Explanation:

Let the given number be  $476 \text{ } xy \text{ } 0$ .

Then  $(4 + 7 + 6 + x + y + 0) = (17 + x + y)$  must be divisible by 3.

And,  $(0 + x + 7) - (y + 6 + 4) = (x - y - 3)$  must be either 0 or 11.

$$x - y - 3 = 0 \Rightarrow y = x - 3$$

$$(17 + x + y) = (17 + x + x - 3) = (2x + 14)$$

$$\Rightarrow x = 2 \text{ or } x = 8.$$

$$\therefore x = 8 \text{ and } y = 5.$$

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52. If the number  $97215 * 6$  is completely divisible by 11, then the smallest whole number in place of  $*$  will be:

- A. 3      B. 2  
C. 1      D. 5  
E. None of these

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Given number = 97215x6

$(6 + 5 + 2 + 9) - (x + 1 + 7) = (14 - x)$ , which must be divisible by 11.

$$\therefore x = 3$$

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$$53. (11^2 + 12^2 + 13^2 + \dots + 20^2) = ?$$

- A. 385      B. 2485  
C. 2870      D. 3255

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$(11^2 + 12^2 + 13^2 + \dots + 20^2) = (1^2 + 2^2 + 3^2 + \dots + 20^2) - (1^2 + 2^2 + 3^2 + \dots + 10^2)$$

$$= \left( \frac{20 \times 21 \times 41}{6} - \frac{10 \times 11 \times 21}{6} \right)$$

$$= (2870 - 385)$$

$$= 2485.$$

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$$54. \text{ If the number } 5 * 2 \text{ is divisible by 6, then } * = ?$$

A. 2

B. 3

C. 6

D. 7

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$6 = 3 \times 2$ . Clearly,  $5 * 2$  is divisible by 2. Replace \* by  $x$ .

Then,  $(5 + x + 2)$  must be divisible by 3. So,  $x = 2$ .

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55. Which of the following numbers will completely divide  $(49^{15} - 1)$  ?

A. 8

B. 14

C. 46

D. 50

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$(x^n - 1)$  will be divisible by  $(x + 1)$  only when  $n$  is even.

$(49^{15} - 1) = \{(7^2)^{15} - 1\} = (7^{30} - 1)$ , which is divisible by  $(7 + 1)$ , i.e., 8.

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56.  $9 + \frac{3}{4} + 7 + \frac{2}{17} - \left(9 + \frac{1}{15}\right) = ?$

A.  $7 + \frac{719}{1020}$

B.  $9 + \frac{817}{1020}$

C.  $9 + \frac{719}{1020}$

D.  $7 + \frac{817}{1020}$

E. None of these

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

$$\begin{aligned}\text{Given sum} &= 9 + \frac{3}{4} + 7 + \frac{2}{17} - \left(9 + \frac{1}{15}\right) \\ &= (9 + 7 - 9) + \left(\frac{3}{4} + \frac{2}{17} - \frac{1}{15}\right) \\ &= 7 + \frac{765 + 120 - 68}{1020} \\ &= 7 + \frac{817}{1020}\end{aligned}$$

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- 
57.  $\left(1 - \frac{1}{n}\right) + \left(1 - \frac{2}{n}\right) + \left(1 - \frac{3}{n}\right) + \dots \text{ up to } n \text{ terms} = ?$
- A.  $\frac{1}{2}n$       B.  $\frac{1}{2}(n - 1)$   
C.  $\frac{1}{2}n(n - 1)$       D. None of these

**Answer & Explanation****Answer:** Option B**Explanation:**

$$\begin{aligned}\text{Given sum} &= (1 + 1 + 1 + \dots \text{ to } n \text{ terms}) - \left(\frac{1}{n} + \frac{2}{n} + \frac{3}{n} + \dots \text{ to } n \text{ terms}\right) \\ &= n - \frac{n}{2} \left(\frac{1}{n} + 1\right) \quad [\text{Ref: } n\text{th terms} = (n/n) = 1] \\ &= n - \frac{n+1}{2} \\ &= \frac{1}{2} (n - 1)\end{aligned}$$

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- 
58. On dividing 2272 as well as 875 by 3-digit number N, we get the same remainder.  
The sum of the digits of N is:

- A. 10      B. 11

C. 12

D. 13

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

Clearly,  $(2272 - 875) = 1397$ , is exactly divisible by N.

Now,  $1397 = 11 \times 127$

$\therefore$  The required 3-digit number is 127, the sum of whose digits is 10.

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- 
59. A boy multiplied 987 by a certain number and obtained 559981 as his answer. If in the answer both 9 are wrong and the other digits are correct, then the correct answer would be:

A. 553681

B. 555181

C. 555681

D. 556581

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$987 = 3 \times 7 \times 47$

So, the required number must be divisible by each one of 3, 7, 47

$553681 \rightarrow$  (Sum of digits = 28, not divisible by 3)

$555181 \rightarrow$  (Sum of digits = 25, not divisible by 3)

$555681$  is divisible by 3, 7, 47.

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- 
60. How many prime numbers are less than 50 ?

A. 16

B. 15

C. 14

D. 18

### Answer & Explanation

**Answer:** Option B

#### Explanation:

Prime numbers less than 50 are:

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47

Their number is 15

61. When a number is divided by 13, the remainder is 11. When the same number is divided by 17, then remainder is 9. What is the number ?

A. 339

B. 349

C. 369

D. Data inadequate

### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$x = 13p + 11 \text{ and } x = 17q + 9$$

$$\therefore 13p + 11 = 17q + 9$$

$$\Rightarrow 17q - 13p = 2$$

$$\Rightarrow q = \frac{2 + 13p}{17}$$

The least value of  $p$  for which  $q = \frac{2 + 13p}{17}$  is a whole number is  $p = 26$

$$\therefore x = (13 \times 26 + 11)$$

$$= (338 + 11)$$

$$= 349$$

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- 
62.  $(51 + 52 + 53 + \dots + 100) = ?$

A. 2525

B. 2975

C. 3225

D. 3775

### Answer & Explanation

**Answer:** Option D

**Explanation:**

$$\begin{aligned}S_n &= (1 + 2 + 3 + \dots + 50 + 51 + 52 + \dots + 100) - (1 + 2 + 3 + \dots + 50) \\&= \frac{100}{2} \times (1 + 100) - \frac{50}{2} \times (1 + 50) \\&= (50 \times 101) - (25 \times 51) \\&= (5050 - 1275) \\&= 3775.\end{aligned}$$

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63.  $(800 \div 64) \times (1296 \div 36) = ?$

A. 420

B. 460

C. 500

D. 540

E. None of these

**Answer & Explanation**

**Answer:** Option E

**Explanation:**

Given Exp. =  $\frac{800}{64} \times \frac{1296}{36} = 450$

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64. Which natural number is nearest to 8485, which is completely divisible by 75 ?

A. 8475

B. 8500

C. 8550

D. 8525

E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

On dividing, we get

$$\begin{array}{r} 75) \ 8485 \ (113 \\ 75 \\ \hline 98 \\ 75 \\ \hline 235 \\ 225 \\ \hline 10 \\ \hline \end{array}$$

Required number =  $(8485 - 10)$  // Because  $10 < (75 - 10)$   
= 8475.

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65. If the number 42573 \* is exactly divisible by 72, then the minimum value of \* is:

- |             |             |
|-------------|-------------|
| <b>A.</b> 4 | <b>B.</b> 5 |
| <b>C.</b> 6 | <b>D.</b> 7 |
| <b>E.</b> 8 |             |

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$72 = 9 \times 8$ , where 9 and 8 are co-prime.

The minimum value of x for which  $73x$  for which  $73x$  is divisible by 8 is,  $x = 6$ .

Sum of digits in 425736 =  $(4 + 2 + 5 + 7 + 3 + 6) = 27$ , which is divisible by 9.

$\therefore$  Required value of \* is 6.

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66. Which of the following numbers is divisible by each one of 3, 7, 9 and 11 ?

- |                |                 |
|----------------|-----------------|
| <b>A.</b> 639  | <b>B.</b> 2079  |
| <b>C.</b> 3791 | <b>D.</b> 37911 |

- E.** None of these

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

639 is not divisible by 7

2079 is divisible by each of 3, 7, 9, 11.

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67. Which natural number is nearest to 9217, which is completely divisible by 88 ?

**A.** 9152

**B.** 9240

**C.** 9064

**D.** 9184

- E.** None of these

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

On dividing we get,

$$\begin{array}{r} 88) \ 9217 \ (\text{104} \\ 88 \\ \hline 417 \\ 352 \\ \hline 65 \\ \hline \end{array}$$

Therefore, Required number =  $9217 + (88 - 65)$  // Because  $(88 - 65) < 65$ .  
=  $9217 + 23$   
=  $9240$ .

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68.  $(4300731) - ? = 2535618$

**A.** 1865113

**B.** 1775123

**C.** 1765113

**D.** 1675123

- E. None of these

## Answer & Explanation

**Answer:** Option C

## Explanation:

Let  $4300731 - x = 2535618$

Then  $x_1 = 4300731 - 2535618 = 1765113$

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69.  $n$  is a whole number which when divided by 4 gives 3 as remainder. What will be the remainder when  $2n$  is divided by 4 ?

- A.** 3      **B.** 2  
**C.** 1      **D.** 0

## Answer & Explanation

**Answer:** Option B

## Explanation:

Let  $n = 4q + 3$ . Then  $2n = 8q + 6 = 4(2q + 1) + 2$ .

Thus, when  $2n$  is divided by 4, the remainder is 2.

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$$70. \frac{(489 + 375)^2 - (489 - 375)^2}{(489 \times 375)} = ?$$

- A.** 144      **B.** 864  
**C.** 2      **D.** 4  
**E.** None of these

## Answer & Explanation

**Answer:** Option D

## Explanation:

$$\text{Given Exp.} = \frac{(a+b)^2 - (a-b)^2}{ab} = \frac{4ab}{ab} = 4$$

$$71. 397 \times 397 + 104 \times 104 + 2 \times 397 \times 104 = ?$$

A. 250001      B. 251001

C. 260101      D. 261001

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$\begin{aligned}\text{Given Exp.} &= (397)^2 + (104)^2 + 2 \times 397 \times 104 \\&= (397 + 104)^2 \\&= (501)^2 = (500 + 1)^2 \\&= (500^2) + (1^2) + (2 \times 500 \times 1) \\&= 250000 + 1 + 1000 \\&= 251001\end{aligned}$$

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$$72. (35423 + 7164 + 41720) - (317 \times 89) = ?$$

A. 28213      B. 84307

C. 50694      D. 56094

E. None of these

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

$$\begin{array}{r} 35423 & 317 \times 89 = 317 \times (90 - 1) \\ + 7164 & = (317 \times 90 - 317) \\ + 41720 & = (28530 - 317) \\ \hline 84307 & = 28213 \\ - 28213 & \\ \hline 56094 & \\ \hline \end{array}$$

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73.  $(x^n - a^n)$  is completely divisible by  $(x - a)$ , when

- |  |   |
|--|---|
| <b>A.</b> $n$ is any natural number    | <b>B.</b> $n$ is an even natural number |
| <b>C.</b> $n$ is an odd natural number | <b>D.</b> $n$ is prime                  |

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

For every natural number  $n$ ,  $(x^n - a^n)$  is completely divisible by  $(x - a)$ .

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74. Which one of the following numbers is completely divisible by 45?

- |                         |                   |
|-------------------------|-------------------|
| <b>A.</b> 181560        | <b>B.</b> 331145  |
| <b>C.</b> 202860        | <b>D.</b> 2033555 |
| <b>E.</b> None of these |                   |

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$45 = 5 \times 9$ , where 5 and 9 are co-primes.

Unit digit must be 0 or 5 and sum of digits must be divisible by 9.

Among given numbers, such number is 202860.

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75. Which of the following numbers will completely divide  $(3^{25} + 3^{26} + 3^{27} + 3^{28})$  ?

- |              |              |
|--------------|--------------|
| <b>A.</b> 11 | <b>B.</b> 16 |
| <b>C.</b> 25 | <b>D.</b> 30 |

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\begin{aligned}(3^{25} + 3^{26} + 3^{27} + 3^{28}) &= 3^{25} \times (1 + 3 + 3^2 + 3^3) = 3^{25} \times 40 \\&= 3^{24} \times 3 \times 4 \times 10 \\&= (3^{24} \times 4 \times 30), \text{ which is divisible by } 30.\end{aligned}$$

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- 
76. A number when divide by 6 leaves a remainder 3. When the square of the number is divided by 6, the remainder is:

A. 0

B. 1

C. 2

D. 3

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let  $x = 6q + 3$ .

$$\begin{aligned}\text{Then, } x^2 &= (6q + 3)^2 \\&= 36q^2 + 36q + 9 \\&= 6(6q^2 + 6q + 1) + 3\end{aligned}$$

Thus, when  $x^2$  is divided by 6, then remainder = 3.

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- 
77. The sum of the two numbers is 12 and their product is 35. What is the sum of the reciprocals of these numbers ?

A.  $\frac{12}{35}$

B.  $\frac{1}{35}$

C.  $\frac{35}{8}$

D.  $\frac{7}{32}$

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let the numbers be  $a$  and  $b$ . Then,  $a + b = 12$  and  $ab = 35$ .

$$\therefore \frac{a+b}{ab} = \frac{12}{35} \Rightarrow \left( \frac{1}{b} + \frac{1}{a} \right) = \frac{12}{35}$$

$$\therefore \text{Sum of reciprocals of given numbers} = \frac{12}{35}$$

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78. What will be remainder when  $17^{200}$  is divided by 18 ?

A. 17

B. 16

C. 1

D. 2

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

When  $n$  is even.  $(x^n - a^n)$  is completely divisible by  $(x + a)$

$(17^{200} - 1^{200})$  is completely divisible by  $(17 + 1)$ , i.e., 18.

$\Rightarrow (17^{200} - 1)$  is completely divisible by 18.

$\Rightarrow$  On dividing  $17^{200}$  by 18, we get 1 as remainder.

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79. If  $1400 \times x = 1050$ . Then,  $x = ?$

A.  $\frac{1}{4}$

B.  $\frac{3}{5}$

C.  $\frac{2}{3}$

D.  $\frac{3}{4}$

E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$1400 \times x = 1050 \Rightarrow x = \frac{1050}{1400} = \frac{3}{4}$$

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80.  $(1^2 + 2^2 + 3^2 + \dots + 10^2) = ?$

**A.** 330**B.** 345**C.** 365**D.** 385**Answer & Explanation****Answer:** Option D**Explanation:**

We know that  $(1^2 + 2^2 + 3^2 + \dots + n^2) = \frac{1}{6} n(n + 1)(2n + 1)$

Putting  $n = 10$ , required sum =  $\left(\frac{1}{6} \times 10 \times 11 \times 21\right) = 385$

81. The difference of the squares of two consecutive even integers is divisible by which of the following integers ?

**A.** 3**B.** 4**C.** 6**D.** 7**Answer & Explanation****Answer:** Option B**Explanation:**

Let the two consecutive even integers be  $2n$  and  $(2n + 2)$ . Then,

$$(2n + 2)^2 = (2n + 2 + 2n)(2n + 2 - 2n)$$

$$= 2(4n + 2)$$

$$= 4(2n + 1), \text{ which is divisible by 4.}$$

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82. Which one of the following is a prime number ?

**A.** 119**B.** 187

C. 247

D. 551

E. None of these

**Answer & Explanation**

**Answer:** Option E

**Explanation:**

$$551 > 22$$

All prime numbers less than 24 are : 2, 3, 5, 7, 11, 13, 17, 19, 23.

119 is divisible by 7; 187 is divisible by 11; 247 is divisible by 13 and 551 is divisible by 19.

So, none of the given numbers is prime.

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83. The sum all even natural numbers between 1 and 31 is:

A. 16

B. 128

C. 240

D. 512

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\text{Required sum} = (2 + 4 + 6 + \dots + 30)$$

This is an A.P. in which  $a = 2$ ,  $d = (4 - 2) = 2$  and  $l = 30$ .

Let the number of terms be  $n$ . Then,

$$t_n = 30 \Rightarrow a + (n - 1)d = 30$$

$$\Rightarrow 2 + (n - 1) \times 2 = 30$$

$$\Rightarrow n - 1 = 14$$

$$\Rightarrow n = 15$$

$$\therefore S_n = \frac{n}{2}(a + l) = \frac{15}{2} \times (2 + 30) = 240.$$

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84. The difference between the place value and the face value of 6 in the numeral 856973 is

- |         |                  |
|---------|------------------|
| A. 973  | B. 6973          |
| C. 5994 | D. None of these |

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$(\text{Place value of } 6) - (\text{Face value of } 6) = (6000 - 6) = 5994$$

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85. If  $a$  and  $b$  are odd numbers, then which of the following is even ?

- |                      |                |
|----------------------|----------------|
| A. $a + b$           | B. $a + b + 1$ |
| C. $ab$              | D. $ab + 2$    |
| <br>E. None of these |                |

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

The sum of two odd number is even. So,  $a + b$  is even.

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86. Which one of the following numbers is completely divisible by 99?

- |                      |           |
|----------------------|-----------|
| A. 3572404           | B. 135792 |
| C. 913464            | D. 114345 |
| <br>E. None of these |           |

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

$99 = 11 \times 9$ , where 11 and 9 are co-prime.

By hit and trial, we find that 114345 is divisible by 11 as well as 9. So, it is divisible by 99.

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87. The sum of how many terms of the series  $6 + 12 + 18 + 24 + \dots$  is 1800 ?

A. 16

B. 24

C. 20

D. 18

E. 22

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

This is an A.P. in which  $a = 6$ ,  $d = 6$  and  $S_n = 1800$

$$\text{Then, } \frac{n}{2}[2a + (n - 1)d] = 1800$$

$$\Rightarrow \frac{n}{2}[2 \times 6 + (n - 1) \times 6] = 1800$$

$$\Rightarrow 3n(n + 1) = 1800$$

$$\Rightarrow n(n + 1) = 600$$

$$\Rightarrow n^2 + n - 600 = 0$$

$$\Rightarrow n^2 + 25n - 24n - 600 = 0$$

$$\Rightarrow n(n + 25) - 24(n + 25) = 0$$

$$\Rightarrow (n + 25)(n - 24) = 0$$

$$\Rightarrow n = 24$$

Number of terms = 24.

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88.  $(51 + 52 + 53 + \dots + 100) = ?$

- A. 2525      B. 2975  
C. 3225      D. 3775

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

This is an A.P. in which  $a = 51$ ,  $l = 100$  and  $n = 50$ .

$$\therefore \text{Sum} = \frac{n}{2}(a + l) = \frac{50}{2} \times (51 + 100) = (25 \times 151) = 3775.$$

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89.  $1904 \times 1904 = ?$

- A. 3654316      B. 3632646  
C. 3625216      D. 3623436  
E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\begin{aligned}1904 \times 1904 &= (1904)^2 \\&= (1900 + 4)^2 \\&= (1900)^2 + (4)^2 + (2 \times 1900 \times 4) \\&= 3610000 + 16 + 15200. \\&= 3625216.\end{aligned}$$

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90. What is the unit digit in  $(7^{95} - 3^{58})$ ?

- A. 0      B. 4  
C. 6      D. 7

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\begin{aligned}\text{Unit digit in } 7^{95} &= \text{Unit digit in } [(7^4)^{23} \times 7^3] \\&= \text{Unit digit in } [(\text{Unit digit in}(2401))^{23} \times (343)] \\&= \text{Unit digit in } (1^{23} \times 343) \\&= \text{Unit digit in } (343) \\&= 3\end{aligned}$$

$$\begin{aligned}\text{Unit digit in } 3^{58} &= \text{Unit digit in } [(3^4)^{14} \times 3^2] \\&= \text{Unit digit in } [\text{Unit digit in } (81)^{14} \times 3^2] \\&= \text{Unit digit in } [(1)^{14} \times 3^2] \\&= \text{Unit digit in } (1 \times 9) \\&= \text{Unit digit in } (9) \\&= 9\end{aligned}$$

$$\text{Unit digit in } (7^{95} - 3^{58}) = \text{Unit digit in } (343 - 9) = \text{Unit digit in } (334) = 4.$$

So, Option B is the answer.

91. Which one of the following is a prime number ?

A. 161

B. 221

C. 373

D. 437

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$437 > 22$$

All prime numbers less than 22 are : 2, 3, 5, 7, 11, 13, 17, 19.

161 is divisible by 7, and 221 is divisible by 13.

373 is not divisible by any of the above prime numbers.

$\therefore$  373 is prime.

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- 
92. The smallest 6 digit number exactly divisible by 111 is:

- A. 111111      B. 110011  
C. 100011      D. 110101  
E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

The smallest 6-digit number 100000.

$$\begin{array}{r} 111) \quad 100000 \quad (900 \\ \quad \quad 999 \\ \hline \quad \quad \quad 100 \\ \hline \quad \quad \quad \quad 100 \\ \hline \end{array}$$

$$\begin{aligned} \text{Required number} &= 100000 + (111 - 100) \\ &= 100011. \end{aligned}$$

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93. The largest 5 digit number exactly divisible by 91 is:

- A. 99921      B. 99918  
C. 99981      D. 99971  
E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Largest 5-digit number = 99999

$$\begin{array}{r} 91) \quad 99999 \quad (1098 \\ \quad \quad 91 \\ \hline \quad \quad \quad 899 \\ \hline \quad \quad \quad \quad 819 \\ \hline \quad \quad \quad \quad \quad 809 \\ \hline \quad \quad \quad \quad \quad \quad 728 \\ \hline \quad \quad \quad \quad \quad \quad \quad 81 \\ \hline \end{array}$$

Required number =  $(99999 - 81)$   
= 99918.

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94.  $\frac{768 \times 768 \times 768 + 232 \times 232 \times 232}{768 \times 768 - 768 \times 232 + 232 \times 232} = ?$

- A. 1000      B. 536  
C. 500      D. 268  
E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Given Exp. =  $\frac{(a^3 + b^3)}{(a^2 - ab + b^2)} = (a + b) = (768 + 232) = 1000$

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95. The smallest 5 digit number exactly divisible by 41 is:

- A. 1004      B. 10004  
C. 10045      D. 10025  
E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

The smallest 5-digit number = 10000.

41) 10000 (243

82

---

180

164

----

160

123

---

37

---

$$\begin{aligned}\text{Required number} &= 10000 + (41 - 37) \\ &= 10004.\end{aligned}$$

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96. How many terms are there in the G.P. 3, 6, 12, 24, ..., 384 ?

- A. 8  
C. 10  
E. 7

- B. 9  
D. 11

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Here  $a = 3$  and  $r = \frac{6}{3} = 2$ . Let the number of terms be  $n$ .

$$\text{Then, } t_n = 384 \Rightarrow ar^{n-1} = 384$$

$$\Rightarrow 3 \times 2^{n-1} = 384$$

$$\Rightarrow 2^{n-1} = 128 = 2^7$$

$$\Rightarrow n - 1 = 7$$

$$\Rightarrow n = 8$$

$\therefore$  Number of terms = 8.

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97. If  $x$  and  $y$  are positive integers such that  $(3x + 7y)$  is a multiple of 11, then which of the following will be divisible by 11 ?

- A.  $4x + 6y$   
C.  $9x + 4y$
- B.  $x + y + 4$   
D.  $4x - 9y$

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

By hit and trial, we put  $x = 5$  and  $y = 1$  so that  $(3x + 7y) = (3 \times 5 + 7 \times 1) = 22$ , which is divisible by 11.

$\therefore (4x + 6y) = (4 \times 5 + 6 \times 1) = 26$ , which is not divisible by 11;

$(x + y + 4) = (5 + 1 + 4) = 10$ , which is not divisible by 11;

$(9x + 4y) = (9 \times 5 + 4 \times 1) = 49$ , which is not divisible by 11;

$(4x - 9y) = (4 \times 5 - 9 \times 1) = 11$ , which is divisible by 11.

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98.  $9548 + 7314 = 8362 + (?)$

A. 8230

B. 8410

C. 8500

D. 8600

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\begin{array}{r} 9548 \\ + 7314 \\ \hline 16862 \end{array} \quad \begin{array}{r} 16862 = 8362 + x \\ x = 16862 - 8362 \\ = 8500 \end{array}$$

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99. In a division sum, the remainder is 0. A student mistook the divisor by 12 instead of 21 and obtained 35 as quotient. What is the correct quotient ?

A. 0

B. 12

C. 13

D. 20

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Number =  $(12 \times 35)$

Correct Quotient =  $420 \div 21 = 20$

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100.  $2 + 2^2 + 2^3 + \dots + 2^9 = ?$

A. 2044

B. 1022

C. 1056

D. None of these

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

This is a G.P. in which  $a = 2$ ,  $r = \frac{2^2}{2} = 2$  and  $n = 9$ .

$$\therefore S_n = \frac{a(r^n - 1)}{(r - 1)} = \frac{2 \times (2^9 - 1)}{(2 - 1)} = 2 \times (512 - 1) = 2 \times 511 = 1022.$$

101. The sum of even numbers between 1 and 31 is:

A. 6

B. 28

C. 240

D. 512

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Let  $S_n = (2 + 4 + 6 + \dots + 30)$ . This is an A.P. in which  $a = 2$ ,  $d = 2$  and  $l = 30$

Let the number of terms be  $n$ . Then,

$$a + (n - 1)d = 30$$

$$\Rightarrow 2 + (n - 1) \times 2 = 30$$

$$\Rightarrow n = 15.$$

$$\therefore S_n = \frac{n}{2} (a + l) = \frac{15}{2} \times (2 + 30) = (15 \times 16) = 240.$$

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102. If the number 91876 \* 2 is completely divisible by 8, then the smallest whole number in place of

\* will be:

A. 1

B. 2

C. 3

D. 4

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Then number  $6x2$  must be divisible by 8.

$\therefore x = 3$ , as  $632$  is divisible 8.

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103.  $2056 \times 987 = ?$

A. 1936372

B. 2029272

C. 1896172

D. 1926172

E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\begin{aligned}2056 \times 987 &= 2056 \times (1000 - 13) \\&= 2056 \times 1000 - 2056 \times 13 \\&= 2056000 - 26728 \\&= 2029272.\end{aligned}$$

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104. On multiplying a number by 7, the product is a number each of whose digits is 3. The smallest such number is:

A. 47619

B. 47719

C. 48619

D. 47649

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

By hit and trial, we find that

$$47619 \times 7 = 333333.$$

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- 
105. If  $60\%$  of  $\frac{3}{5}$  of a number is 36, then the number is:

A. 80

B. 100

C. 75

D. 90

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Let the number be  $x$ . Then

$$\begin{aligned}60\% \text{ of } \frac{3}{5} \text{ of } x &= 36 \\ \Rightarrow \frac{60}{100} \times \frac{3}{5} \times x &= 36 \\ \Rightarrow x &= \left( 36 \times \frac{25}{9} \right) = 100\end{aligned}$$

$\therefore$  Required number = 100

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- 
106. If  $x$  and  $y$  are the two digits of the number 653 $xy$  such that this number is divisible by 80, then  $x + y = ?$

A. 2 or 6

B. 4

C. 4 or 8

D. 8

- E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$80 = 2 \times 5 \times 8$$

Since  $653xy$  is divisible by 2 and 5 both, so  $y = 0$ .

Now,  $653x$  is divisible by 8, so  $13x$  should be divisible by 8.

This happens when  $x = 6$ .

$$\therefore x + y = (6 + 0) = 6.$$

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- 
107. The difference of the squares of two consecutive odd integers is divisible by which of the following integers ?

A. 3

B. 6

C. 7

D. 8

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let the two consecutive odd integers be  $(2n + 1)$  and  $(2n + 3)$ . Then,

$$(2n + 3)^2 - (2n + 1)^2 = (2n + 3 + 2n + 1)(2n + 3 - 2n - 1)$$

$$= (4n + 4) \times 2$$

$$= 8(n + 1), \text{ which is divisible by 8.}$$

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- 
108. What is the unit digit in  $(4137)^{754}$ ?

A. 1

B. 3

C. 7

D. 9

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

$$\begin{aligned}\text{Unit digit in } (4137)^{754} &= \text{Unit digit in } \{(4137)^4\}^{188} \times (4137)^2\} \\ &= \text{Unit digit in } \{ 292915317923361 \times 17114769 \} \\ &= (1 \times 9) = 9\end{aligned}$$

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109.  $587 \times 999 = ?$

A. 586413

B. 587523

C. 614823

D. 615173

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

$$\begin{aligned}587 \times 999 &= 587 \times (1000 - 1) \\ &= 587 \times 1000 - 587 \times 1 \\ &= 587000 - 587 \\ &= 586413.\end{aligned}$$

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110. A number was divided successively in order by 4, 5 and 6. The remainders were respectively 2, 3 and 4. The number is:

A. 214

B. 476

C. 954

D. 1908

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$\begin{array}{r} 4 \mid x \\ \hline 5 \mid y - 2 \\ \hline 6 \mid z - 3 \\ \hline | \quad 1 - 4 \end{array}$$
$$\begin{array}{ll} z = 6 \times 1 + 4 & = 10 \\ y = 5 \times z + 3 & = 5 \times 10 + 3 = 53 \\ x = 4 \times y + 2 & = 4 \times 53 + 2 = 214 \end{array}$$

Hence, required number = 214.

111. If  $(64)^2 - (36)^2 = 20 \times x$ , then  $x = ?$

- A. 70      B. 120  
C. 180      D. 140  
E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$20 \times x = (64 + 36)(64 - 36) = 100 \times 28$$

$$\Rightarrow x = \frac{100 \times 28}{20} = 140$$

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112. Which one of the following can't be the square of natural number ?

- A. 32761      B. 81225  
C. 42437      D. 20164  
E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

The square of a natural number never ends in 7.

$\therefore$  42437 is not the square of a natural number.

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113.  $(2^2 + 4^2 + 6^2 + \dots + 20^2) = ?$

A. 770

B. 1155

C. 1540

D.  $385 \times 385$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$(2^2 + 4^2 + 6^2 + \dots + 20^2) = (1 \times 2)^2 + (2 \times 2)^2 + (2 \times 3)^2 + \dots + (2 \times 10)^2$$

$$= (2^2 \times 1^2) + (2^2 \times 2^2) + (2^2 \times 3^2) + \dots + (2^2 \times 10^2)$$

$$= 2^2 \times [1^2 + 2^2 + 3^2 + \dots + 10^2]$$

$$\boxed{\text{Ref: } (1^2 + 2^2 + 3^2 + \dots + n^2) = \frac{1}{6} n(n + 1)(2n + 1)}$$

$$= \left( 4 \times \frac{1}{6} \times 10 \times 11 \times 21 \right)$$

$$= (4 \times 5 \times 77)$$

$$= 1540.$$

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114.  $\frac{854 \times 854 \times 854 - 276 \times 276 \times 276}{854 \times 854 + 854 \times 276 + 276 \times 276} = ?$

A. 1130

B. 578

C. 565

D. 1156

E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Given Exp.} = \frac{(a^3 - b^3)}{(a^2 + ab + b^2)} = (a - b) = (854 - 276) = 578$$

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115.  $35 + 15 \times 1.5 = ?$

- |                         |                |
|-------------------------|----------------|
| <b>A.</b> 85            | <b>B.</b> 51.5 |
| <b>C.</b> 57.5          | <b>D.</b> 5.25 |
| <b>E.</b> None of these |                |

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\text{Given Exp.} = 35 + 15 \times \frac{3}{2} = 35 + \frac{45}{2} = 35 + 22.5 = 57.5$$

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116. The sum of first 45 natural numbers is:

- |                |                |
|----------------|----------------|
| <b>A.</b> 1035 | <b>B.</b> 1280 |
| <b>C.</b> 2070 | <b>D.</b> 2140 |

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let  $S_n = (1 + 2 + 3 + \dots + 45)$

This is an A.P. in which  $a = 1$ ,  $d = 1$ ,  $n = 45$  and  $l = 45$

$$\therefore S_n = \frac{n}{2}(a + l) = \frac{45}{2} \times (1 + 45) = (45 \times 23) = 1035$$

Required sum = 1035.

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117.  $666 \div 6 \div 3 = ?$

- |              |               |
|--------------|---------------|
| <b>A.</b> 37 | <b>B.</b> 333 |
|--------------|---------------|

C. 111

D. 84

E. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Given Exp. =  $666 \times \frac{1}{6} \times \frac{1}{3} = 37$

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118. The sum of all two digit numbers divisible by 5 is:

A. 1035

B. 1245

C. 1230

D. 945

E. None of these

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119. The difference between the place values of two sevens in the numeral 69758472 is

A. 0

B. 6993

C. 699930

D. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Required difference =  $(700000 - 70) = 699930$

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120. On dividing a number by 68, we get 269 as quotient and 0 as remainder. On dividing the same number by 67, what will the remainder ?

A. 0

B. 1

C. 2

D. 3

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

$$\text{Number} = 269 \times 68 + 0 = 18292$$

$$\begin{array}{r} 67) \quad 18292 \quad (273 \\ \quad 134 \\ \hline \quad 489 \\ \quad 469 \\ \hline \quad 202 \\ \quad 201 \\ \hline \quad \quad \quad 1 \\ \hline \end{array}$$

Therefore, Required remainder = 1

121. What is the unit digit in the product  $(3^{65} \times 6^{59} \times 7^{71})$ ?

**A.** 1

**B.** 2

**C.** 4

**D.** 6

**Answer & Explanation**

**Answer:** Option **C**

**Explanation:**

Unit digit in  $3^4 = 1 \Rightarrow$  Unit digit in  $(3^4)^{16} = 1$

$\therefore$  Unit digit in  $3^{65} =$  Unit digit in  $[(3^4)^{16} \times 3] = (1 \times 3) = 3$

Unit digit in  $6^{59} = 6$

Unit digit in  $7^4 \Rightarrow$  Unit digit in  $(7^4)^{17}$  is 1.

Unit digit in  $7^{71} =$  Unit digit in  $[(7^4)^{17} \times 7^3] = (1 \times 3) = 3$

$\therefore$  Required digit = Unit digit in  $(3 \times 6 \times 3) = 4$ .

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122.  $3251 + 587 + 369 - ? = 3007$

**A.** 1250

**B.** 1300

C. 1375

D. 1200

E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\begin{array}{r} 3251 \\ + 587 \\ + 369 \\ \hline 4207 \end{array}$$

Let  $4207 - x = 3007$   
Then,  $x = 4207 - 3007 = 1200$

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123.  $7589 - ? = 3434$

A. 4242

B. 4155

C. 1123

D. 11023

E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let  $7589 - x = 3434$

Then,  $x = 7589 - 3434 = 4155$

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124.  $217 \times 217 + 183 \times 183 = ?$

A. 79698

B. 80578

C. 80698

D. 81268

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\begin{aligned}(217)^2 + (183)^2 &= (200 + 17)^2 + (200 - 17)^2 \\&= 2 \times [(200)^2 + (17)^2] \quad [\text{Ref: } (a + b)^2 + (a - b)^2 = 2(a^2 + b^2)] \\&= 2[40000 + 289] \\&= 2 \times 40289 \\&= 80578.\end{aligned}$$

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125. The unit digit in the product  $(784 \times 618 \times 917 \times 463)$  is:

**A.** 2**B.** 3**C.** 4**D.** 5**Answer & Explanation****Answer:** Option A**Explanation:**

Unit digit in the given product = Unit digit in  $(4 \times 8 \times 7 \times 3) = (672) = 2$

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126. If the number  $653xy$  is divisible by 90, then  $(x + y) = ?$

**A.** 2**B.** 3**C.** 4**D.** 6**Answer & Explanation****Answer:** Option C**Explanation:**

$$90 = 10 \times 9$$

Clearly,  $653xy$  is divisible by 10, so  $y = 0$

Now,  $653x0$  is divisible by 9.

So,  $(6 + 5 + 3 + x + 0) = (14 + x)$  is divisible by 9. So,  $x = 4$ .

Hence,  $(x + y) = (4 + 0) = 4$ .

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127.  $3897 \times 999 = ?$

- |   |                                     |
|---|-------------------------------------|
| <p>A. 3883203</p> <p>C. 3639403</p> <p>E. None of these</p> | <p>B. 3893103</p> <p>D. 3791203</p> |
|---|-------------------------------------|

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\begin{aligned}3897 \times 999 &= 3897 \times (1000 - 1) \\&= 3897 \times 1000 - 3897 \times 1 \\&= 3897000 - 3897 \\&= 3893103.\end{aligned}$$

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128. What is the unit digit in  $7^{105}$  ?

- |                         |                         |
|-------------------------|-------------------------|
| <p>A. 1</p> <p>C. 7</p> | <p>B. 5</p> <p>D. 9</p> |
|-------------------------|-------------------------|

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Unit digit in  $7^{105}$  = Unit digit in  $[ (7^4)^{26} \times 7 ]$

But, unit digit in  $(7^4)^{26} = 1$

$\therefore$  Unit digit in  $7^{105} = (1 \times 7) = 7$

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129. Which of the following numbers will completely divide  $(4^{61} + 4^{62} + 4^{63} + 4^{64})$  ?

A. 3

B. 10

C. 11

D. 13

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

$$\begin{aligned}(4^{61} + 4^{62} + 4^{63} + 4^{64}) &= 4^{61} \times (1 + 4 + 4^2 + 4^3) = 4^{61} \times 85 \\&= 4^{60} \times (4 \times 85) \\&= (4^{60} \times 340), \text{ which is divisible by 10.}\end{aligned}$$

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130.  $106 \times 106 - 94 \times 94 = ?$

A. 2400

B. 2000

C. 1904

D. 1906

E. None of these

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$\begin{aligned}106 \times 106 - 94 \times 94 &= (106)^2 - (94)^2 \\&= (106 + 94)(106 - 94) \quad [\text{Ref: } (a^2 - b^2) = (a + b)(a - b)] \\&= (200 \times 12) \\&= 2400.\end{aligned}$$

131. A number when divided successively by 4 and 5 leaves remainders 1 and 4 respectively. When it is successively divided by 5 and 4, then the respective remainders will be

A. 1, 2

B. 2, 3

C. 3, 2

D. 4, 1

#### Answer & Explanation

**Answer:** Option **B**

**Explanation:**

$$\begin{array}{r} 4 \mid x \\ \hline 5 \mid y -1 \\ \hline | 1 -4 \end{array}$$
$$y = (5 \times 1 + 4) = 9$$
$$x = (4 \times 9 + 1) = (4 \times 9 + 1) = 37$$

Now, 37 when divided successively by 5 and 4, we get

$$\begin{array}{r} 5 \mid 37 \\ \hline 4 \mid 7 - 2 \\ \hline | 1 - 3 \end{array}$$

Respective remainders are 2 and 3.

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132.  $8796 \times 223 + 8796 \times 77 = ?$

**A.** 2736900

**B.** 2638800

**C.** 2658560

**D.** 2716740

**E.** None of these

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

$$8796 \times 223 + 8796 \times 77 = 8796 \times (223 + 77) \quad [\text{Ref: By Distributive Law}]$$
$$= (8796 \times 300)$$
$$= 2638800$$

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133.  $8988 \div 8 \div 4 = ?$

**A.** 4494

**B.** 561.75

**C.** 2247

**D.** 280.875

- E.** None of these

**Answer & Explanation**

**Answer:** Option **D**

**Explanation:**

$$\text{Given Exp.} = 8988 \times \frac{1}{8} \times \frac{1}{4} = \frac{2247}{8} = 280.875$$

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$$134. 287 \times 287 + 269 \times 269 - 2 \times 287 \times 269 = ?$$

**A.** 534

**B.** 446

**C.** 354

**D.** 324

- E.** None of these

**Answer & Explanation**

**Answer:** Option **D**

**Explanation:**

Given Exp. =  $a^2 + b^2 - 2ab$ , where  $a = 287$  and  $b = 269$

$$= (a - b)^2 = (287 - 269)^2$$

$$= (18^2)$$

$$= 324$$

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$$135. 3 + 33 + 333 + 3.33 = ?$$

**A.** 362.3

**B.** 372.33

**C.** 702.33

**D.** 702

- E.** None of these

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

$$\begin{array}{r} 3 \\ + 33 \\ + 333 \\ + 3.33 \\ \hline 372.33 \end{array}$$

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136. Which one of the following can't be the square of natural number ?

- |                         |                  |
|-------------------------|------------------|
| <b>A.</b> 30976         | <b>B.</b> 75625  |
| <b>C.</b> 28561         | <b>D.</b> 143642 |
| <b>E.</b> None of these |                  |

**Answer & Explanation****Answer:** Option **D****Explanation:**

The square of a natural number never ends in 2.

∴ 143642 is not the square of natural number.

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137.  $(1000)^9 \div 10^{24} = ?$

- |                         |                |
|-------------------------|----------------|
| <b>A.</b> 10000         | <b>B.</b> 1000 |
| <b>C.</b> 100           | <b>D.</b> 10   |
| <b>E.</b> None of these |                |

**Answer & Explanation****Answer:** Option **B****Explanation:**

$$\text{Given Exp. } = \frac{(1000)^9}{10^{24}} = \frac{(10^3)^9}{10^{24}} = \frac{(10)^{27}}{10^{24}} = 10^{(27-24)} = 10^3 = 1000$$

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138.  $\{(476 + 424)^2 - 4 \times 476 \times 424\} = ?$

A. 2906

B. 3116

C. 2704

D. 2904

E. None of these

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Given Exp.  $= [(a + b)^2 - 4ab]$ , where  $a = 476$  and  $b = 424$

$$= [(476 + 424)^2 - 4 \times 476 \times 424]$$

$$= [(900)^2 - 807296]$$

$$= 810000 - 807296$$

$$= 2704.$$

## Decimal Fraction

### Formulas

#### 1. Decimal Fractions:

Fractions in which denominators are powers of 10 are known as **decimal fractions**.

Thus,  $\frac{1}{10} = 1$  tenth  $= .1$ ;  $\frac{1}{100} = 1$  hundredth  $= .01$ ;

$\frac{99}{100} = 99$  hundredths  $= .99$ ;  $\frac{7}{1000} = 7$  thousandths  $= .007$ , etc.;

#### 2. Conversion of a Decimal into Vulgar Fraction:

Put 1 in the denominator under the decimal point and annex with it as many zeros as is the number of digits after the decimal point. Now, remove the decimal point and reduce the fraction to its lowest terms.

Thus,  $0.25 = \frac{25}{100} = \frac{1}{4}$ ;  $2.008 = \frac{2008}{1000} = \frac{251}{125}$ .

#### 3. Annexing Zeros and Removing Decimal Signs:

Annexing zeros to the extreme right of a decimal fraction does not change its value. Thus,  $0.8 = 0.80 = 0.800$ , etc.

If numerator and denominator of a fraction contain the same number of decimal places, then we remove the decimal sign.

$$\text{Thus, } \frac{1.84}{2.99} = \frac{184}{299} = \frac{8}{13}.$$

#### 4. Operations on Decimal Fractions:

- i. **Addition and Subtraction of Decimal Fractions:** The given numbers are so placed under each other that the decimal points lie in one column. The numbers so arranged can now be added or subtracted in the usual way.
- ii. **Multiplication of a Decimal Fraction By a Power of 10:** Shift the decimal point to the right by as many places as is the power of 10.

Thus,  $5.9632 \times 100 = 596.32$ ;  $0.073 \times 10000 = 730$ .

- iii. **Multiplication of Decimal Fractions:** Multiply the given numbers considering them without decimal point. Now, in the product, the decimal point is marked off to obtain as many places of decimal as is the sum of the number of decimal places in the given numbers.

Suppose we have to find the product  $(.2 \times 0.02 \times .002)$ .

Now,  $2 \times 2 \times 2 = 8$ . Sum of decimal places =  $(1 + 2 + 3) = 6$ .

$$\therefore .2 \times .02 \times .002 = .000008$$

- iv. **Dividing a Decimal Fraction By a Counting Number:** Divide the given number without considering the decimal point, by the given counting number. Now, in the quotient, put the decimal point to give as many places of decimal as there are in the dividend.

Suppose we have to find the quotient  $(0.0204 \div 17)$ . Now,  $204 \div 17 = 12$ .

Dividend contains 4 places of decimal. So,  $0.0204 \div 17 = 0.0012$

- v. **Dividing a Decimal Fraction By a Decimal Fraction:** Multiply both the dividend and the divisor by a suitable power of 10 to make divisor a whole number.

Now, proceed as above.

$$\text{Thus, } \frac{0.00066}{0.11} = \frac{0.00066 \times 100}{0.11 \times 100} = \frac{0.066}{11} = .006$$

#### 5. Comparison of Fractions:

Suppose some fractions are to be arranged in ascending or descending order of magnitude, then convert each one of the given fractions in the decimal form, and arrange them accordingly.

Let us to arrange the fractions  $\frac{3}{5}$ ,  $\frac{6}{7}$  and  $\frac{7}{9}$  in descending order.

Now,  $\frac{3}{5} = 0.6$ ,  $\frac{6}{7} = 0.857$ ,  $\frac{7}{9} = 0.777\dots$

Since,  $0.857 > 0.777\dots > 0.6$ . So,  $\frac{6}{7} > \frac{7}{9} > \frac{3}{5}$ .

## 6. Recurring Decimal:

If in a decimal fraction, a figure or a set of figures is repeated continuously, then such a number is called a **recurring decimal**.

In a recurring decimal, if a single figure is repeated, then it is expressed by putting a dot on it. If a set of figures is repeated, it is expressed by putting a bar on the set.

Thus,  $\frac{1}{3} = 0.333\dots = 0.\dot{3}$ ;  $\frac{22}{7} = 3.142857142857\dots = 3.1\dot{4}285\dot{7}$ .

**Pure Recurring Decimal:** A decimal fraction, in which all the figures after the decimal point are repeated, is called a pure recurring decimal.

**Converting a Pure Recurring Decimal into Vulgar Fraction:** Write the repeated figures only once in the numerator and take as many nines in the denominator as is the number of repeating figures.

Thus,  $0.5 = \frac{5}{9}$ ;  $0.53 = \frac{53}{99}$ ;  $0.067 = \frac{67}{999}$ , etc.

**Mixed Recurring Decimal:** A decimal fraction in which some figures do not repeat and some of them are repeated, is called a mixed recurring decimal.

Eg.  $0.173333\dots = 0.1\dot{7}3$ .

**Converting a Mixed Recurring Decimal Into Vulgar Fraction:** In the numerator, take the difference between the number formed by all the digits after decimal point (taking repeated digits only once) and that formed by the digits which are not repeated. In the denominator, take the number formed by as many nines as there are repeating digits followed by as many zeros as is the number of non-repeating digits.

Thus,  $0.16 = \frac{16 - 1}{90} = \frac{15}{90} = \frac{1}{6}$ ;  $0.2273 = \frac{2273 - 22}{9900} = \frac{2251}{9900}$ .

## 7. Some Basic Formulae:

- i.  $(a + b)(a - b) = (a^2 - b^2)$
- ii.  $(a + b)^2 = (a^2 + b^2 + 2ab)$

- iii.  $(a - b)^2 = (a^2 + b^2 - 2ab)$
- iv.  $(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$
- v.  $(a^3 + b^3) = (a + b)(a^2 - ab + b^2)$
- vi.  $(a^3 - b^3) = (a - b)(a^2 + ab + b^2)$
- vii.  $(a^3 + b^3 + c^3 - 3abc) = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ac)$
- viii. When  $a + b + c = 0$ , then  $a^3 + b^3 + c^3 = 3abc$ .

1. Evaluate : 
$$\frac{(2.39)^2 - (1.61)^2}{2.39 - 1.61}$$

- A.** 2                           **B.** 4

- C.** 6                           **D.** 8

#### Answer & Explanation

**Answer:** Option **B**

#### Explanation:

Given Expression =  $\frac{a^2 - b^2}{a - b} = \frac{(a + b)(a - b)}{(a - b)} = (a + b) = (2.39 + 1.61) = 4.$

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8.  
2. What decimal of an hour is a second ?

- A.** .0025                           **B.** .0256

- C.** .00027                           **D.** .000126

#### Answer & Explanation

**Answer:** Option **C**

#### Explanation:

Required decimal =  $\frac{1}{60 \times 60} = \frac{1}{3600} = .00027$

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9.  
3. The value of  $\frac{(0.96)^3 - (0.1)^3}{(0.96)^2 + 0.096 + (0.1)^2}$  is:
- A.** 0.86                           **B.** 0.95  
**C.** 0.97                           **D.** 1.06

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$\begin{aligned}\text{Given expression} &= \frac{(0.96)^3 - (0.1)^3}{(0.96)^2 + (0.96 \times 0.1) + (0.1)^2} \\&= \left( \frac{a^3 - b^3}{a^2 + ab + b^2} \right) \\&= (a - b) \\&= (0.96 - 0.1) \\&= 0.86\end{aligned}$$

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10. \_\_\_\_\_
4. The value of  $\frac{0.1 \times 0.1 \times 0.1 + 0.02 \times 0.02 \times 0.02}{0.2 \times 0.2 \times 0.2 + 0.04 \times 0.04 \times 0.04}$  is:
- A. 0.0125      B. 0.125  
C. 0.25      D. 0.5

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$\text{Given expression} = \frac{(0.1)^3 + (0.02)^3}{2^3 [(0.1)^3 + (0.02)^3]} = \frac{1}{8} = 0.125$$

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11. \_\_\_\_\_
5. If  $2994 \div 14.5 = 172$ , then  $29.94 \div 1.45 = ?$
- A. 0.172      B. 1.72  
C. 17.2      D. 172

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\begin{aligned}
 \frac{29.94}{1.45} &= \frac{299.4}{14.5} \\
 &= \left( \frac{2994}{14.5} \times \frac{1}{10} \right) \quad [\text{Here, Substitute 172 in the place of } 2994/14.5] \\
 &= \frac{172}{10}
 \end{aligned}$$

$$= 17.2$$

6. When 0.232323..... is converted into a fraction, then the result is:

A.  $\frac{1}{5}$

B.  $\frac{2}{9}$

C.  $\frac{23}{99}$

D.  $\frac{23}{100}$

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$0.232323\dots = 0.23 = \frac{23}{99}$$

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7.  $\frac{.009}{?} = .01$

A. .0009

B. .09

C. .9

D. 9

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\text{Let } \frac{.009}{x} = .01; \quad \text{Then } x = \frac{.009}{.01} = \frac{.9}{1} = .9$$

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8. The expression  $(11.98 \times 11.98 + 11.98 \times x + 0.02 \times 0.02)$  will be a perfect square for  $x$  equal to:

A. 0.02

B. 0.2

C. 0.04

D. 0.4

[Answer & Explanation](#)

**Answer:** Option C

## Explanation:

$$\text{Given expression} = (11.98)^2 + (0.02)^2 + 11.98 \times x.$$

For the given expression to be a perfect square, we must have

$$11.98 \times x = 2 \times 11.98 \times 0.02 \text{ or } x = 0.04$$

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9.  $\frac{(0.1667)(0.8333)(0.3333)}{(0.2222)(0.6667)(0.1250)}$  is approximately equal to:



## Answer & Explanation

**Answer:** Option D

## Explanation:

61

$$\text{Given expression} = \frac{\cdot}{(0.2222)} \times \frac{\cdot}{(0.6667)(0.1250)}$$

$$= \frac{3333}{2222} \times \frac{\frac{1}{6} \times \frac{5}{6}}{\frac{2}{3} \times \frac{125}{1000}}$$

$$= \left( \frac{3}{2} \times \frac{1}{6} \times \frac{5}{6} \times \frac{3}{2} \times 8 \right)$$

$$= \frac{5}{2}$$

$$= 2.50$$

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$$10. \quad 3889 + 12.952 - ? = 3854.002$$

- A.** 47.095      **B.** 47.752

C. 47.932

D. 47.95

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let  $3889 + 12.952 - x = 3854.002$ .

Then  $x = (3889 + 12.952) - 3854.002$

$$= 3901.952 - 3854.002$$

$$= 47.95.$$

11.  $0.04 \times 0.0162$  is equal to:

A.  $6.48 \times 10^{-3}$

B.  $6.48 \times 10^{-4}$

C.  $6.48 \times 10^{-5}$

D.  $6.48 \times 10^{-6}$

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$4 \times 162 = 648$ . Sum of decimal places = 6.

So,  $0.04 \times 0.0162 = 0.000648 = 6.48 \times 10^{-4}$

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12.  $\frac{4.2 \times 4.2 - 1.9 \times 1.9}{2.3 \times 6.1}$  is equal to:

A. 0.5

B. 1.0

C. 20

D. 22

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$\text{Given Expression} = \frac{(a^2 - b^2)}{(a + b)(a - b)} = \frac{(a^2 - b^2)}{(a^2 - b^2)} = 1.$$

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- 
13. If  $\frac{144}{0.144} = \frac{14.4}{x}$ , then the value of  $x$  is:
- A. 0.0144      B. 1.44  
C. 14.4      D. 144

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$\begin{aligned}\frac{144}{0.144} &= \frac{14.4}{x} \\ \Rightarrow \frac{144 \times 1000}{144} &= \frac{14.4}{x} \\ \Rightarrow x &= \frac{14.4}{1000} = 0.0144\end{aligned}$$

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- 
14. The price of commodity X increases by 40 paise every year, while the price of commodity Y increases by 15 paise every year. If in 2001, the price of commodity X was Rs. 4.20 and that of Y was Rs. 6.30, in which year commodity X will cost 40 paise more than the commodity Y?

- A. 2010      B. 2011  
C. 2012      D. 2013

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Suppose commodity X will cost 40 paise more than Y after  $z$  years.

Then,  $(4.20 + 0.40z) - (6.30 + 0.15z) = 0.40$

$$\Rightarrow 0.25z = 0.40 + 2.10$$

$$\Rightarrow z = \frac{2.50}{0.25} = \frac{250}{25} = 10.$$

$\therefore$  X will cost 40 paise more than Y 10 years after 2001 i.e., 2011.

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- 
15. Which of the following are in descending order of their value ?

A.  $\frac{1}{3}, \frac{2}{5}, \frac{3}{7}, \frac{4}{5}, \frac{5}{6}, \frac{6}{7}$

B.  $\frac{1}{3}, \frac{2}{5}, \frac{3}{5}, \frac{4}{7}, \frac{5}{6}, \frac{6}{7}$

C.  $\frac{1}{3}, \frac{2}{5}, \frac{3}{5}, \frac{4}{6}, \frac{5}{7}, \frac{6}{7}$

D.  $\frac{6}{7}, \frac{5}{6}, \frac{4}{5}, \frac{3}{7}, \frac{2}{5}, \frac{1}{3}$

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

16. Which of the following fractions is greater than  $\frac{3}{4}$  and less than  $\frac{5}{6}$  ?

A.  $\frac{1}{2}$

B.  $\frac{2}{3}$

C.  $\frac{4}{5}$

D.  $\frac{9}{10}$

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\frac{3}{4} = 0.75, \frac{5}{6} = 0.833, \frac{1}{2} = 0.5, \frac{2}{3} = 0.66, \frac{4}{5} = 0.8, \frac{9}{10} = 0.9.$$

Clearly, 0.8 lies between 0.75 and 0.833.

$$\therefore \frac{4}{5} \text{ lies between } \frac{3}{4} \text{ and } \frac{5}{6}.$$

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- 
17. The rational number for recurring decimal 0.125125.... is:

A.  $\frac{63}{487}$

B.  $\frac{119}{993}$

C.  $\frac{125}{999}$

D. None of these

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$0.125125\dots = 0.125 = \frac{125}{999}$$

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18.  $617 + 6.017 + 0.617 + 6.0017 = ?$

- A. 6.2963      B. 62.965  
C. 629.6357      D. None of these

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\begin{array}{r} 617.00 \\ 6.017 \\ 0.617 \\ + 6.0017 \\ \hline \hline 629.6357 \\ \hline \end{array}$$

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19. The value of  $\frac{489.1375 \times 0.0483 \times 1.956}{0.0873 \times 92.581 \times 99.749}$  is closest to:

- A. 0.006      B. 0.06  
C. 0.6      D. 6

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$\begin{aligned} \frac{489.1375 \times 0.0483 \times 1.956}{0.0873 \times 92.581 \times 99.749} &\approx \frac{489 \times 0.05 \times 2}{0.09 \times 93 \times 100} \\ &= \frac{489}{9 \times 93 \times 10} \\ &= \frac{163}{279} \times \frac{1}{10} \\ &= \frac{0.58}{10} \\ &= 0.058 \approx 0.06. \end{aligned}$$

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20.  $0.002 \times 0.5 = ?$

- A. 0.0001      B. 0.001  
C. 0.01      D. 0.1

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$2 \times 5 = 10.$$

Sum of decimal places = 4

$$\therefore 0.002 \times 0.5 = 0.001$$

21.  $34.95 + 240.016 + 23.98 = ?$

- A. 298.0946      B. 298.111  
C. 298.946      D. 299.09

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\begin{array}{r} 34.95 \\ 240.016 \\ + 23.98 \\ \hline 298.946 \end{array}$$

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22. Which of the following is equal to  $3.14 \times 10^6$  ?

- A. 314      B. 3140  
C. 3140000      D. None of these

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$3.14 \times 10^6 = 3.14 \times 1000000 = 3140000.$$

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23. The least among the following is:

A.  $0.2$

B.  $1 \div 0.2$

C.  $0.2$

D.  $(0.2)^2$

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$1 \div 0.2 = \frac{1}{0.2} = \frac{10}{2} = 5;$$

$$0.2 = 0.222\dots;$$

$$(0.2)^2 = 0.04.$$

$$0.04 < 0.2 < 0.22\dots < 5.$$

Since 0.04 is the least, so  $(0.2)^2$  is the least.

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24.  $\frac{5 \times 1.6 - 2 \times 1.4}{1.3} = ?$

A.  $0.4$

B.  $1.2$

C.  $1.4$

D.  $4$

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Given Expression} = \frac{8 - 2.8}{1.3} = \frac{5.2}{1.3} = \frac{52}{13} = 4.$$

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25. How many digits will be there to the right of the decimal point in the product of 95.75 and .02554 ?

## Answer & Explanation

**Answer:** Option B

## **Explanation:**

Sum of decimal places = 7.

Since the last digit to the extreme right will be zero (since  $5 \times 4 = 20$ ), so there will be 6 significant digits to the right of the decimal point

26. The correct expression of 6.46 in the fractional form is:

- A.  $\frac{646}{99}$

B.  $\frac{64640}{1000}$

C.  $\frac{640}{100}$

D.  $\frac{640}{99}$

## Answer & Explanation

**Answer:** Option D

## Explanation:

$$6.46 = 6 + 0.46 = 6 + \frac{46}{99} = \frac{594 + 46}{99} = \frac{640}{99}.$$

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27. The fraction  $101 \frac{27}{100000}$  in decimal form is:

- A. .01027      B. .10127  
C. 101.00027      D. 101.000027

## Answer & Explanation

**Answer:** Option C

## **Explanation:**

$$101 \frac{27}{100000} = 101 + \frac{27}{100000} = 101 + .00027 = 101.00027$$

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- $$28. \quad 0.0203 \times 2.92 = ?$$

$$0.0073 \times 14.5 \times 0.7$$

A. 0.8

B. 1.45

C. 2.40

D. 3.25

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\frac{0.0203 \times 2.92}{0.0073 \times 14.5 \times 0.7} = \frac{203 \times 292}{73 \times 145 \times 7} = \frac{4}{5} = 0.8$$

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29. 4.036 divided by 0.04 gives :

A. 1.009

B. 10.09

C. 100.9

D. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\frac{4.036}{0.04} = \frac{403.6}{4} = 100.9$$

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30.  $3.87 - 2.59 = ?$

A. 1.20

B. 1.2

C. 1.27

D. 1.28

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$3.87 - 2.59 = (3 + 0.87) - (2 + 0.59)$$

$$\begin{aligned} &= \left(3 + \frac{87}{99}\right) - \left(2 + \frac{59}{99}\right) \\ &= 1 + \left(\underline{87} - \underline{59}\right) \end{aligned}$$

$$= 1 + \frac{28}{99}$$

$$= 1.28$$

## Surds and Indices

### Formulas

#### 1. Laws of Indices:

- i.  $a^m \times a^n = a^{m+n}$
- ii.

$$\frac{a^m}{a^n} = a^{m-n}$$

- iii.  $(a^m)^n = a^{mn}$
- iv.  $(ab)^n = a^n b^n$
- v.

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

$$\text{vi. } a^0 = 1$$

#### 2. Surds:

Let  $a$  be rational number and  $n$  be a positive integer such that  $a^{(1/n)} = a$

Then,  $a$  is called a surd of order  $n$ .

#### 3. Laws of Surds:

- i.  $a = a^{(1/n)}$
- ii.  $ab = a \times b$
- iii.

$$\sqrt[n]{\frac{a}{b}} = \frac{a}{b}$$

- iv.  $(a)^n = a$
- v.  $\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a}$
- vi.  $(a)^m = a^m$

1.  $(17)^{3.5} \times (17)^? = 17^8$

**A.** 2.29

**B.** 2.75

C. 4.25

D. 4.5

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let  $(17)^{3.5} \times (17)^x = 17^8$ .

Then,  $(17)^{3.5+x} = 17^8$ .

$$\therefore 3.5 + x = 8$$

$$\Rightarrow x = (8 - 3.5)$$

$$\Rightarrow x = 4.5$$

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4.  
2. If  $\left(\frac{a}{b}\right)^{x-1} = \left(\frac{b}{a}\right)^{x-3}$ , then the value of  $x$  is:
- A.  $\frac{1}{2}$       B. 1  
C. 2      D.  $\frac{7}{2}$

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Given  $\left(\frac{a}{b}\right)^{x-1} = \left(\frac{b}{a}\right)^{x-3}$   
 $\Rightarrow \left(\frac{a}{b}\right)^{x-1} = \left(\frac{a}{b}\right)^{-(x-3)} = \left(\frac{a}{b}\right)^{(3-x)}$

$$\Rightarrow x-1 = 3-x$$

$$\Rightarrow 2x = 4$$

$$\Rightarrow x = 2.$$

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5. \_\_\_\_\_

3. Given that  $10^{0.48} = x$ ,  $10^{0.70} = y$  and  $x^z = y^2$ , then the value of  $z$  is close to:

- A. 1.45      B. 1.88

- C. 2.9      D. 3.7

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$x^z = y^2 \Leftrightarrow 10^{(0.48z)} = 10^{(2 \times 0.70)} = 10^{1.40}$$

$$\Rightarrow 0.48z = 1.40$$

$$\Rightarrow z = \frac{140}{48} = \frac{35}{12} = 2.9 \text{ (approx.)}$$

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6.  
4. If  $5^a = 3125$ , then the value of  $5^{(a - 3)}$  is:

- A. 25      B. 125

- C. 625      D. 1625

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$5^a = 3125 \Leftrightarrow 5^a = 5^5$$

$$\Rightarrow a = 5.$$

$$\therefore 5^{(a - 3)} = 5^{(5 - 3)} = 5^2 = 25.$$

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7.  
5. If  $3^{(x - y)} = 27$  and  $3^{(x + y)} = 243$ , then  $x$  is equal to:

- A. 0      B. 2

- C. 4      D. 6

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$3^{x-y} = 27 = 3^3 \Leftrightarrow x - y = 3 \dots \text{(i)}$$

$$3^{x+y} = 243 = 3^5 \Leftrightarrow x + y = 5 \dots \text{(ii)}$$

On solving (i) and (ii), we get  $x = 4$ .

6.  $(256)^{0.16} \times (256)^{0.09} = ?$

A. 4

B. 16

C. 64

D. 256.25

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$(256)^{0.16} \times (256)^{0.09} = (256)^{(0.16 + 0.09)}$$

$$= (256)^{0.25}$$

$$= (256)^{(25/100)}$$

$$= (256)^{(1/4)}$$

$$= (4^4)^{(1/4)}$$

$$= 4^{4(1/4)}$$

$$= 4^1$$

$$= 4$$

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- 
7. The value of  $[(10)^{150} \div (10)^{146}]$

A. 1000

B. 10000

C. 100000

D.  $10^6$

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$(10)^{150} \div (10)^{146} = \frac{10^{150}}{10^{146}}$$

$$= 10^{150 - 146}$$

$$= 10^4$$

$$= 10000.$$

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$$8. \frac{1}{1 + x^{(b-a)} + x^{(c-a)}} + \frac{1}{1 + x^{(a-b)} + x^{(c-b)}} + \frac{1}{1 + x^{(b-c)} + x^{(a-c)}} = ?$$

A. 0

B. 1

C.  $x^{a-b-c}$

D. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Given Exp.} = \frac{1}{\left(1 + \frac{x^b}{x^a} + \frac{x^c}{x^a}\right)} + \frac{1}{\left(1 + \frac{x^a}{x^b} + \frac{x^c}{x^b}\right)} + \frac{1}{\left(1 + \frac{x^b}{x^c} + \frac{x^a}{x^c}\right)}$$
$$= \frac{x^a}{(x^a + x^b + x^c)} + \frac{x^b}{(x^a + x^b + x^c)} + \frac{x^c}{(x^a + x^b + x^c)}$$
$$= \frac{(x^a + x^b + x^c)}{(x^a + x^b + x^c)}$$
$$= 1.$$

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$$9. (25)^{7.5} \times (5)^{2.5} \div (125)^{1.5} = 5^?$$

A. 8.5

B. 13

C. 16

D. 17.5

**E.** None of these

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

Let  $(25)^{7.5} \times (5)^{2.5} \div (125)^{1.5} = 5^x$ .

$$\begin{aligned}\text{Then, } & \frac{(5^2)^{7.5} \times (5)^{2.5}}{(5^3)^{1.5}} = 5^x \\ \Rightarrow & \frac{5^{(2 \times 7.5)} \times 5^{2.5}}{5^{(3 \times 1.5)}} = 5^x \\ \Rightarrow & \frac{5^{15} \times 5^{2.5}}{5^{4.5}} = 5^x\end{aligned}$$

$$\Rightarrow 5^x = 5^{(15 + 2.5 - 4.5)}$$

$$\Rightarrow 5^x = 5^{13}$$

$$\therefore x = 13.$$

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10.  $(0.04)^{-1.5} = ?$

**A.** 25

**B.** 125

**C.** 250

**D.** 625

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

$$\begin{aligned}(0.04)^{-1.5} &= \left(\frac{4}{100}\right)^{-1.5} \\ &= \left(\frac{1}{25}\right)^{-(3/2)} \\ &= (25)^{(3/2)} \\ &= (5^2)^{(3/2)} \\ &= (5)^{2 \times (3/2)}\end{aligned}$$

$$= 5^3$$

$$11. \frac{= 125}{\frac{(243)^{n/5} \times 3^{2n+1}}{9^n \times 3^{n-1}}} = ?$$

A. 1

B. 2

C. 9

D.  $3^n$

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

$$\text{Given Expression} = \frac{(243)^{(n/5)} \times 3^{2n+1}}{9^n \times 3^{n-1}}$$

$$= \frac{(3^5)^{(n/5)} \times 3^{2n+1}}{(3^2)^n \times 3^{n-1}}$$

$$= \frac{(3^{5 \times (n/5)}) \times 3^{2n+1}}{(3^{2n}) \times 3^{n-1})}$$

$$= \frac{3^n \times 3^{2n+1}}{3^{2n} \times 3^{n-1}}$$

$$= \frac{3^{(n+2n+1)}}{3^{(2n+n-1)}}$$

$$= \frac{3^{3n+1}}{3^{3n-1}}$$

$$= 3^{(3n+1-3n+1)} = 3^2 = 9.$$

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$$12. \frac{1}{1+a^{(n-m)}} + \frac{1}{1+a^{(m-n)}} = ?$$

A. 0

B.  $\frac{1}{2}$

C. 1

D.  $a^{m+n}$

#### Answer & Explanation

**Answer:** Option C

## Explanation:

$$\begin{aligned} \frac{1}{1+a^{(n-m)}} + \frac{1}{1+a^{(m-n)}} &= \frac{1}{\left(1+\frac{a^n}{a^m}\right)} + \frac{1}{\left(1+\frac{a^m}{a^n}\right)} \\ &= \frac{a^m}{(a^m+a^n)} + \frac{a^n}{(a^m+a^n)} \\ &= \frac{(a^m+a^n)}{(a^m+a^n)} \\ &= 1. \end{aligned}$$

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13. If  $m$  and  $n$  are whole numbers such that  $m^n = 121$ , the value of  $(m - 1)^{n+1}$  is:

- |               |                |
|---------------|----------------|
| <b>A.</b> 1   | <b>B.</b> 10   |
| <b>C.</b> 121 | <b>D.</b> 1000 |

## Answer & Explanation

**Answer:** Option D

## Explanation:

We know that  $11^2 = 121$ .

Putting  $m = 11$  and  $n = 2$ , we get:

$$(m - 1)^{n + 1} = (11 - 1)^{(2 + 1)} = 10^3 = 1000.$$

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- $$14. \left( \frac{x^b}{x^c} \right) (b + c - a) \cdot \left( \frac{x^c}{x^a} \right) (c + a - b) \cdot \left( \frac{x^a}{x^b} \right) (a + b - c) = ?$$

- A.**  $x^{abc}$       **B.**  $1$   
**C.**  $x^{ab + bc + ca}$       **D.**  $x^{a + b + c}$

## Answer & Explanation

**Answer:** Option **B**

**Explanation:**

$$\begin{aligned}\text{Given Exp. } &= x^{(b-c)(b+c-a)} \cdot x^{(c-a)(c+a-b)} \cdot x^{(a-b)(a+b-c)} \\&= x^{(b-c)(b+c) - a(b-c)} \cdot x^{(c-a)(c+a) - b(c-a)} \\&\quad \cdot x^{(a-b)(a+b) - c(a-b)} \\&= x^{(b^2 - c^2 + c^2 - a^2 + a^2 - b^2)} \cdot x^{-a(b-c) - b(c-a) - c(a-b)} \\&= (x^0 \times x^0) \\&= (1 \times 1) = 1.\end{aligned}$$

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15. If  $x = 3 + 22$ , then the value of  $\left(x - \frac{1}{x}\right)$  is:

**A.** 1

**B.** 2

**C.** 22

**D.** 33

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

$$\begin{aligned}\left(x - \frac{1}{x}\right)^2 &= x + \frac{1}{x} - 2 \\&= (3 + 22) + \frac{1}{(3 + 22)} - 2 \\&= (3 + 22) + \frac{1}{(3 + 22)} \times \frac{(3 - 22)}{(3 - 22)} - 2 \\&= (3 + 22) + (3 - 22) - 2 \\&= 4.\end{aligned}$$

$$\therefore \left(x - \frac{1}{x}\right) = 2.$$

## Pipes and Cistern

### Formulas

#### 1. Inlet:

A pipe connected with a tank or a cistern or a reservoir, that fills it, is known as an inlet.

#### Outlet:

A pipe connected with a tank or cistern or reservoir, emptying it, is known as an outlet.

#### 2. If a pipe can fill a tank in $x$ hours, then:

$$\text{part filled in 1 hour} = \frac{1}{x}.$$

#### 3. If a pipe can empty a tank in $y$ hours, then:

$$\text{part emptied in 1 hour} = \frac{1}{y}.$$

#### 4. If a pipe can fill a tank in $x$ hours and another pipe can empty the full tank in $y$ hours (where $y > x$ ), then on opening both the pipes, then

$$\text{the net part filled in 1 hour} = \left( \frac{1}{x} - \frac{1}{y} \right).$$

#### 5. If a pipe can fill a tank in $x$ hours and another pipe can empty the full tank in $y$ hours (where $x > y$ ), then on opening both the pipes, then

$$\text{the net part emptied in 1 hour} = \left( \frac{1}{y} - \frac{1}{x} \right).$$

#### 1. Three pipes A, B and C can fill a tank from empty to full in 30 minutes, 20 minutes, and 10 minutes respectively. When the tank is empty, all the three pipes are opened. A, B and C discharge chemical solutions P, Q and R respectively. What is the proportion of the solution R in the liquid in the tank after 3 minutes?

A.  $\frac{5}{11}$

B.  $\frac{6}{11}$

C.  $\frac{7}{11}$

D.  $\frac{8}{11}$

### Answer & Explanation

**Answer:** Option B

**Explanation:**

$$\text{Part filled by } (A + B + C) \text{ in 3 minutes} = 3 \left( \frac{1}{30} + \frac{1}{20} + \frac{1}{10} \right) = \left( 3 \times \frac{11}{60} \right) = \frac{11}{20}.$$

$$\text{Part filled by } C \text{ in 3 minutes} = \frac{3}{10}.$$

$$\therefore \text{Required ratio} = \left( \frac{3}{10} \times \frac{20}{11} \right) = \frac{6}{11}.$$

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2. Pipes A and B can fill a tank in 5 and 6 hours respectively. Pipe C can empty it in 12 hours. If all the three pipes are opened together, then the tank will be filled in:

A.  $1\frac{13}{17}$  hours

B.  $2\frac{8}{11}$  hours

C.  $3\frac{9}{17}$  hours

D.  $4\frac{1}{2}$  hours

**Answer & Explanation****Answer:** Option C**Explanation:**

$$\text{Net part filled in 1 hour} \left( \frac{1}{5} + \frac{1}{6} - \frac{1}{12} \right) = \frac{17}{60}.$$

$$\therefore \text{The tank will be full in } \frac{60}{17} \text{ hours i.e., } 3\frac{9}{17} \text{ hours.}$$

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3. A pump can fill a tank with water in 2 hours. Because of a leak, it took  $2\frac{1}{3}$  hours to fill the tank. The leak can drain all the water of the tank in:

A.  $4\frac{1}{3}$  hours

B. 7 hours

C. 8 hours

D. 14 hours

**Answer & Explanation****Answer:** Option D**Explanation:**

$$\text{Work done by the leak in 1 hour} = \left( \frac{1}{2} - \frac{3}{7} \right) = \frac{1}{14}.$$

- Leak will empty the tank in 14 hrs.

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4. Two pipes A and B can fill a cistern in  $37\frac{1}{2}$  minutes and 45 minutes respectively. Both pipes are opened. The cistern will be filled in just half an hour, if the B is turned off after:

- |                   |                   |
|-------------------|-------------------|
| <b>A.</b> 5 min.  | <b>B.</b> 9 min.  |
| <b>C.</b> 10 min. | <b>D.</b> 15 min. |

#### **Answer & Explanation**

**Answer:** Option B

#### **Explanation:**

Let B be turned off after  $x$  minutes. Then,

Part filled by  $(A + B)$  in  $x$  min. + Part filled by A in  $(30 - x)$  min. = 1.

$$\begin{aligned} \therefore x \left( \frac{2}{75} + \frac{1}{45} \right) + (30 - x) \cdot \frac{2}{75} &= 1 \\ \Rightarrow \frac{11x}{225} + \frac{(60 - 2x)}{75} &= 1 \\ \Rightarrow 11x + 180 - 6x &= 225. \\ \Rightarrow x &= 9. \end{aligned}$$

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5. A tank is filled by three pipes with uniform flow. The first two pipes operating simultaneously fill the tank in the same time during which the tank is filled by the third pipe alone. The second pipe fills the tank 5 hours faster than the first pipe and 4 hours slower than the third pipe. The time required by the first pipe is:

- |                    |                    |
|--------------------|--------------------|
| <b>A.</b> 6 hours  | <b>B.</b> 10 hours |
| <b>C.</b> 15 hours | <b>D.</b> 30 hours |

#### **Answer & Explanation**

**Answer:** Option C

#### **Explanation:**

Suppose, first pipe alone takes  $x$  hours to fill the tank .

Then, second and third pipes will take  $(x - 5)$  and  $(x - 9)$  hours respectively to fill the tank.

$$\therefore \frac{1}{x} + \frac{1}{(x - 5)} = \frac{1}{(x - 9)}$$
$$\Rightarrow \frac{x - 5 + x}{x(x - 5)} = \frac{1}{(x - 9)}$$

$$\Rightarrow (2x - 5)(x - 9) = x(x - 5)$$

$$\Rightarrow x^2 - 18x + 45 = 0$$

$$(x - 15)(x - 3) = 0$$

$$\Rightarrow x = 15. \quad [\text{neglecting } x = 3]$$

6. Two pipes can fill a tank in 20 and 24 minutes respectively and a waste pipe can empty 3 gallons per minute. All the three pipes working together can fill the tank in 15 minutes. The capacity of the tank is:

A. 60 gallons      B. 100 gallons

C. 120 gallons      D. 180 gallons

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$$\begin{aligned}\text{Work done by the waste pipe in 1 minute} &= \frac{1}{15} - \left( \frac{1}{20} + \frac{1}{24} \right) \\ &= \left( \frac{1}{15} - \frac{11}{120} \right) \\ &= -\frac{1}{40}. \quad [-\text{ve sign means emptying}] \\ \therefore \text{Volume of } \frac{1}{40} \text{ part} &= 3 \text{ gallons.}\end{aligned}$$

Volume of whole =  $(3 \times 40)$  gallons = 120 gallons.

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- 
7. A tank is filled in 5 hours by three pipes A, B and C. The pipe C is twice as fast as B and B is twice as fast as A. How much time will pipe A alone take to fill the tank?

- A. 20 hours      B. 25 hours
- C. 35 hours      D. Cannot be determined
- E. None of these

#### **Answer & Explanation**

**Answer:** Option C

#### **Explanation:**

Suppose pipe A alone takes  $x$  hours to fill the tank.

Then, pipes B and C will take  $\frac{x}{2}$  and  $\frac{x}{4}$  hours respectively to fill the tank.

$$\begin{aligned}\therefore \frac{1}{x} + \frac{2}{x} + \frac{4}{x} &= \frac{1}{5} \\ \Rightarrow \frac{7}{x} &= \frac{1}{5}\end{aligned}$$

$$\Rightarrow x = 35 \text{ hrs.}$$

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8. Two pipes A and B together can fill a cistern in 4 hours. Had they been opened separately, then B would have taken 6 hours more than A to fill the cistern. How much time will be taken by A to fill the cistern separately?

- A. 1 hour      B. 2 hours
- C. 6 hours      D. 8 hours

#### **Answer & Explanation**

**Answer:** Option C

#### **Explanation:**

Let the cistern be filled by pipe A alone in  $x$  hours.

Then, pipe B will fill it in  $(x + 6)$  hours.

$$\begin{aligned}\therefore \frac{1}{x} + \frac{1}{(x+6)} &= \frac{1}{4} \\ \Rightarrow \frac{x+6+x}{x(x+6)} &= \frac{1}{4}\end{aligned}$$

$$\Rightarrow x^2 - 2x - 24 = 0$$

$$\Rightarrow (x - 6)(x + 4) = 0$$

$$\Rightarrow x = 6. \quad [\text{neglecting the negative value of } x]$$

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9. Two pipes A and B can fill a tank in 20 and 30 minutes respectively. If both the pipes are used together, then how long will it take to fill the tank?

A. 12 min      B. 15 min

C. 25 min      D. 50 min

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\text{Part filled by A in 1 min} = \frac{1}{20}.$$

$$\text{Part filled by B in 1 min} = \frac{1}{30}.$$

$$\text{Part filled by (A + B) in 1 min} = \left( \frac{1}{20} + \frac{1}{30} \right) = \frac{1}{12}.$$

∴ Both pipes can fill the tank in 12 minutes.

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- 
10. Two pipes A and B can fill a tank in 15 minutes and 20 minutes respectively. Both the pipes are opened together but after 4 minutes, pipe A is turned off. What is the total time required to fill the tank?

A. 10 min. 20 sec.      B. 11 min. 45 sec.

C. 12 min. 30 sec.      D. 14 min. 40 sec.

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Part filled in 4 minutes} = 4 \left( \frac{1}{15} + \frac{1}{20} \right) = \frac{7}{12}.$$

$$\text{Remaining part} = \left(1 - \frac{7}{15}\right) = \frac{8}{15}$$

$$\text{Part filled by B in 1 minute} = \frac{1}{20}$$

$$\therefore \frac{1}{20} : \frac{8}{15} :: 1 : x$$

$$x = \left(\frac{8}{15} \times 1 \times 20\right) = 10\frac{2}{3} \text{ min} = 10 \text{ min. } 40 \text{ sec.}$$

- $\therefore$  The tank will be full in (4 min. + 10 min. + 40 sec.) = 14 min. 40 sec.
11. One pipe can fill a tank three times as fast as another pipe. If together the two pipes can fill the tank in 36 minutes, then the slower pipe alone will be able to fill the tank in:

A. 81 min.

B. 108 min.

C. 144 min.

D. 192 min.

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Let the slower pipe alone fill the tank in  $x$  minutes.

Then, faster pipe will fill it in  $\frac{x}{3}$  minutes.

$$\therefore \frac{1}{x} + \frac{3}{x} = \frac{1}{36}$$

$$\Rightarrow \frac{4}{x} = \frac{1}{36}$$

$$\Rightarrow x = 144 \text{ min.}$$

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12. A large tanker can be filled by two pipes A and B in 60 minutes and 40 minutes respectively. How many minutes will it take to fill the tanker from empty state if B is used for half the time and A and B fill it together for the other half?

A. 15 min

B. 20 min

C. 27.5 min

D. 30 min

#### Answer & Explanation

**Answer:** Option D

**Explanation:**

$$\text{Part filled by } (A + B) \text{ in 1 minute} = \left( \frac{1}{60} + \frac{1}{40} \right) = \frac{1}{24}.$$

Suppose the tank is filled in  $x$  minutes.

$$\text{Then, } \frac{x}{2} \left( \frac{1}{24} + \frac{1}{40} \right) = 1$$

$$\Rightarrow \frac{x}{2} \times \frac{1}{15} = 1$$

$$\Rightarrow x = 30 \text{ min.}$$

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13. A tap can fill a tank in 6 hours. After half the tank is filled, three more similar taps are opened. What is the total time taken to fill the tank completely?

A. 3 hrs 15 min

B. 3 hrs 45 min

C. 4 hrs

D. 4 hrs 15 min

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Time taken by one tap to fill **half of the tank** = 3 hrs.

$$\text{Part filled by the four taps in 1 hour} = \left( 4 \times \frac{1}{6} \right) = \frac{2}{3}.$$

$$\text{Remaining part} = \left( 1 - \frac{1}{2} \right) = \frac{1}{2}.$$

$$\therefore \frac{2}{3} : \frac{1}{2} :: 1 : x$$

$$\Rightarrow x = \left( \frac{1}{2} \times 1 \times \frac{3}{2} \right) = \frac{3}{4} \text{ hours i.e., 45 mins.}$$

So, total time taken = 3 hrs. 45 mins.

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14. Three taps A, B and C can fill a tank in 12, 15 and 20 hours respectively. If A is open all the time and B and C are open for one hour each alternately, the tank will be full in:

A. 6 hours

B.  $6\frac{2}{3}$  hours

C. 7 hours

D.  $7\frac{1}{2}$  hours

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$$(A + B)'s \text{ 1 hour's work} = \left( \frac{1}{12} + \frac{1}{15} \right) = \frac{9}{60} = \frac{3}{20}.$$

$$(A + C)'s \text{ hour's work} = \left( \frac{1}{12} + \frac{1}{20} \right) = \frac{8}{60} = \frac{2}{15}.$$

$$\text{Part filled in 2 hrs} = \left( \frac{3}{20} + \frac{2}{15} \right) = \frac{17}{60}.$$

$$\text{Part filled in 6 hrs} = \left( 3 \times \frac{17}{60} \right) = \frac{17}{20}.$$

$$\text{Remaining part} = \left( 1 - \frac{17}{20} \right) = \frac{3}{20}.$$

Now, it is the turn of A and B and  $\frac{3}{20}$  part is filled by A and B in 1 hour.

$\therefore$  Total time taken to fill the tank = (6 + 1) hrs = 7 hrs.

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15. Three pipes A, B and C can fill a tank in 6 hours. After working at it together for 2 hours, C is closed and A and B can fill the remaining part in 7 hours. The number of hours taken by C alone to fill the tank is:

A. 10

B. 12

C. 14

D. 16

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

$$\text{Part filled in 2 hours} = \frac{2}{6} = \frac{1}{3}$$

$$\text{Remaining part} = \left( 1 - \frac{1}{3} \right) = \frac{2}{3}.$$

$$\therefore (A + B)'s \text{ 7 hour's work} = \frac{2}{3}$$

$$(A + B)'s \text{ 1 hour's work} = \frac{2}{21}$$

$\therefore C'$ 's 1 hour's work = { (A + B + C)'s 1 hour's work } - { (A + B)'s 1 hour's work }

$$= \left( \frac{1}{6} - \frac{2}{21} \right) = \frac{1}{14}$$

$\therefore C$  alone can fill the tank in 14 hours.

## Logarithm

### Formulas

#### 1. Logarithm:

If  $a$  is a positive real number, other than 1 and  $a^m = x$ , then we write:  
 $m = \log_a x$  and we say that the value of  $\log x$  to the base  $a$  is  $m$ .

#### Examples:

$$(i). 10^3 = 1000 \Rightarrow \log_{10} 1000 = 3.$$

$$(ii). 3^4 = 81 \Rightarrow \log_3 81 = 4.$$

$$(iii). 2^{-3} = \frac{1}{8} \Rightarrow \log_2 \frac{1}{8} = -3.$$

$$(iv). (.1)^2 = .01 \Rightarrow \log_{(.1)} .01 = 2.$$

#### 2. Properties of Logarithms:

$$1. \log_a (xy) = \log_a x + \log_a y$$

$$2. \log_a \left( \frac{x}{y} \right) = \log_a x - \log_a y$$

$$3. \log_x x = 1$$

$$4. \log_a 1 = 0$$

$$5. \log_a (x^n) = n(\log_a x)$$

$$6. \log_a x = \frac{1}{\log_x a}$$

$$7. \log_a x = \frac{\log_b x}{\log_b a} = \frac{\log x}{\log a}.$$

### 3. Common Logarithms:

Logarithms to the base 10 are known as common logarithms.

4. The logarithm of a number contains two parts, namely 'characteristic' and 'mantissa'.

**Characteristic:** The integral part of the logarithm of a number is called its**characteristic**.

Case I: When the number is greater than 1.

In this case, the characteristic is one less than the number of digits in the left of the decimal point in the given number.

Case II: When the number is less than 1.

In this case, the characteristic is one more than the number of zeros between the decimal point and the first significant digit of the number and it is negative.

Instead of -1, -2 etc. we write 1 (one bar), 2 (two bar), etc.

Examples:-

Number	Characteristic	Number	Characteristic
654.24	2	0.6453	1
26.649	1	0.06134	2
8.3547	0	0.00123	3

### Mantissa:

The decimal part of the logarithm of a number is known as its **mantissa**. For mantissa, we look through log table.

- 
1. Which of the following statements is not correct?

- A.  $\log_{10} 10 = 1$
- B.  $\log (2 + 3) = \log (2 \times 3)$
- C.  $\log_{10} 1 = 0$
- D.  $\log (1 + 2 + 3) = \log 1 + \log 2 + \log 3$

### Answer & Explanation

**Answer:** Option B

## Explanation:

- (a) Since  $\log_a a = 1$ , so  $\log_{10} 10 = 1$ .

(b)  $\log (2 + 3) = \log 5$  and  $\log (2 \times 3) = \log 6 = \log 2 + \log 3$

$\therefore \log (2 + 3) \neq \log (2 \times 3)$

(c) Since  $\log_a 1 = 0$ , so  $\log_{10} 1 = 0$ .

(d)  $\log (1 + 2 + 3) = \log 6 = \log (1 \times 2 \times 3) = \log 1 + \log 2 + \log 3$ .

So, (b) is incorrect.

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2. If  $\log 2 = 0.3010$  and  $\log 3 = 0.4771$ , the value of  $\log_5 512$  is:

- A.** 2.870      **B.** 2.967  
**C.** 3.876      **D.** 3.912

## Answer & Explanation

**Answer:** Option C

## Explanation:

$$\begin{aligned}
 \log_5 512 &= \frac{\log 512}{\log 5} \\
 &= \frac{\log 2^9}{\log (10/2)} \\
 &= \frac{9 \log 2}{\log 10 - \log 2} \\
 &= \frac{(9 \times 0.3010)}{1 - 0.3010} \\
 &= \frac{2.709}{0.699} \\
 &= \frac{2709}{699}
 \end{aligned}$$

$$= 3.876$$

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- 
3.  $\frac{\log 8}{\log 8}$  is equal to:

A.  $\frac{1}{8}$

B.  $\frac{1}{4}$

C.  $\frac{1}{2}$

D.  $\frac{1}{8}$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\frac{\log 8}{\log 8} = \frac{\log (8)^{1/2}}{\log 8} = \frac{\frac{1}{2}\log 8}{\log 8} = \frac{1}{2}.$$

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- 
4. If  $\log 27 = 1.431$ , then the value of  $\log 9$  is:

A. 0.934

B. 0.945

C. 0.954

D. 0.958

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\log 27 = 1.431$$

$$\Rightarrow \log (3^3) = 1.431$$

$$\Rightarrow 3 \log 3 = 1.431$$

$$\Rightarrow \log 3 = 0.477$$

$$\therefore \log 9 = \log(3^2) = 2 \log 3 = (2 \times 0.477) = 0.954.$$

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- 
5. If  $\log \frac{a}{b} + \log \frac{b}{a} = \log (a + b)$ , then:

A.  $a + b = 1$

B.  $a - b = 1$

C.  $a = b$

D.  $a^2 - b^2 = 1$

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\begin{aligned}\log \frac{a}{b} + \log \frac{b}{a} &= \log (a + b) \\ \Rightarrow \log (a + b) &= \log \left( \frac{a}{b} \times \frac{b}{a} \right) = \log 1.\end{aligned}$$

So,  $a + b = 1$ .

6. If  $\log_{10} 7 = a$ , then  $\log_{10} \left( \frac{1}{70} \right)$  is equal to:

A.  $-(1 + a)$

B.  $(1 + a)^{-1}$

C.  $\frac{a}{10}$

D.  $\frac{1}{10a}$

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\begin{aligned}\log_{10} \left( \frac{1}{70} \right) &= \log_{10} 1 - \log_{10} 70 \\ &= -\log_{10} (7 \times 10) \\ &= -(\log_{10} 7 + \log_{10} 10) \\ &= -(a + 1).\end{aligned}$$

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7. If  $\log_{10} 2 = 0.3010$ , then  $\log_2 10$  is equal to:

A.  $\frac{699}{301}$

B.  $\frac{1000}{301}$

C. 0.3010

D. 0.6990

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\log_2 10 = \frac{1}{\log_{10} 2} = \frac{1}{0.3010} = \frac{10000}{3010} = \frac{1000}{301}.$$

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8. If  $\log_{10} 2 = 0.3010$ , the value of  $\log_{10} 80$  is:

- A. 1.6020      B. 1.9030  
C. 3.9030      D. None of these

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$\begin{aligned}\log_{10} 80 &= \log_{10} (8 \times 10) \\&= \log_{10} 8 + \log_{10} 10 \\&= \log_{10} (2^3) + 1 \\&= 3 \log_{10} 2 + 1 \\&= (3 \times 0.3010) + 1 \\&= 1.9030.\end{aligned}$$

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- 
9. If  $\log_{10} 5 + \log_{10} (5x + 1) = \log_{10} (x + 5) + 1$ , then  $x$  is equal to:

- A. 1      B. 3  
C. 5      D. 10

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$\log_{10} 5 + \log_{10} (5x + 1) = \log_{10} (x + 5) + 1$$

$$\Rightarrow \log_{10} 5 + \log_{10} (5x + 1) = \log_{10} (x + 5) + \log_{10} 10$$

$$\Rightarrow \log_{10} [5(5x + 1)] = \log_{10} [10(x + 5)]$$

$$\Rightarrow 5(5x + 1) = 10(x + 5)$$

$$\Rightarrow 5x + 1 = 2x + 10$$

$$\Rightarrow 3x = 9$$

$$\Rightarrow x = 3.$$

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10. The value of  $\left( \frac{1}{\log_3 60} + \frac{1}{\log_4 60} + \frac{1}{\log_5 60} \right)$  is:

A. 0

B. 1

C. 5

D. 60

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

$$\text{Given expression} = \log_{60} 3 + \log_{60} 4 + \log_{60} 5$$

$$= \log_{60} (3 \times 4 \times 5)$$

$$= \log_{60} 60$$

$$= 1$$

11. If  $\log 2 = 0.30103$ , the number of digits in  $2^{64}$  is:

A. 18

B. 19

C. 20

D. 21

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\log (2^{64}) = 64 \times \log 2$$

$$= (64 \times 0.30103)$$

$$= 19.26592$$

Its characteristic is 19.

Hence, then number of digits in  $2^{64}$  is 20.

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12. If  $\log_x \left( \frac{9}{16} \right) = -\frac{1}{2}$ , then  $x$  is equal to:

A.  $-\frac{3}{4}$

B.  $\frac{3}{4}$

C.  $\frac{81}{256}$

D.  $\frac{256}{81}$

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

$$\log_x \left( \frac{9}{16} \right) = -\frac{1}{2}$$

$$\Rightarrow x^{-1/2} = \frac{9}{16}$$

$$\Rightarrow \frac{1}{x} = \frac{9}{16}$$

$$\Rightarrow x = \frac{16}{9}$$

$$\Rightarrow x = \left( \frac{16}{9} \right)^2$$

$$\Rightarrow x = \frac{256}{81}$$

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13. If  $a^x = b^y$ , then:

A.  $\log \frac{a}{b} = \frac{x}{y}$

B.  $\frac{\log a}{\log b} = \frac{x}{y}$

C.  $\frac{\log a}{\log b} = \frac{y}{x}$

D. None of these

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$a^x = b^y$$

$$\Rightarrow \log a^x = \log b^y$$

$$\Rightarrow x \log a = y \log b$$

$$\Rightarrow \frac{\log a}{\log b} = \frac{y}{x}$$

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14. If  $\log_x y = 100$  and  $\log_2 x = 10$ , then the value of  $y$  is:

A.  $2^{10}$

B.  $2^{100}$

C.  $2^{1000}$

D.  $2^{10000}$

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\log_2 x = 10 \Rightarrow x = 2^{10}.$$

$$\therefore \log_x y = 100$$

$$\Rightarrow y = x^{100}$$

$$\Rightarrow y = (2^{10})^{100} \quad [\text{put value of } x]$$

$$\Rightarrow y = 2^{1000}.$$

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15. The value of  $\log_2 16$  is:

A.  $\frac{1}{8}$

B. 4

C. 8

D. 16

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let  $\log_2 16 = n$ .

$$\text{Then, } 2^n = 16 = 2^4 \Rightarrow n = 4.$$

$$\therefore \log_2 16 = 4.$$

## Probability

### Formulas

#### 1. Experiment:

An operation which can produce some well-defined outcomes is called an experiment.

#### 2. Random Experiment:

An experiment in which all possible outcomes are known and the exact output cannot be predicted in advance, is called a random experiment.

### Examples:

- i. Rolling an unbiased dice.
- ii. Tossing a fair coin.
- iii. Drawing a card from a pack of well-shuffled cards.
- iv. Picking up a ball of certain colour from a bag containing balls of different colours.

### Details:

- v. When we throw a coin, then either a Head (H) or a Tail (T) appears.
- vi. A dice is a solid cube, having 6 faces, marked 1, 2, 3, 4, 5, 6 respectively. When we throw a die, the outcome is the number that appears on its upper face.
- vii. A pack of cards has 52 cards.

It has 13 cards of each suit, name **Spades, Clubs, Hearts and Diamonds**.

Cards of spades and clubs are **black cards**.

Cards of hearts and diamonds are **red cards**.

There are 4 honours of each unit.

There are **Kings, Queens and Jacks**. These are all called **face cards**.

### 3. Sample Space:

When we perform an experiment, then the set  $S$  of all possible outcomes is called the **sample space**.

#### Examples:

1. In tossing a coin,  $S = \{H, T\}$
2. If two coins are tossed, the  $S = \{HH, HT, TH, TT\}$ .
3. In rolling a dice, we have,  $S = \{1, 2, 3, 4, 5, 6\}$ .

#### Event:

Any subset of a sample space is called an **event**.

#### Probability of Occurrence of an Event:

Let  $S$  be the sample and let  $E$  be an event.

Then,  $E \subseteq S$ .

$$\therefore P(E) = \frac{n(E)}{n(S)}.$$

#### Results on Probability:

- .  $P(S) = 1$
- i.  $0 \leq P(E) \leq 1$
- ii.  $P(\emptyset) = 0$
- iii. For any events  $A$  and  $B$  we have :  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- iv. If  $A$  denotes (not- $A$ ), then  $P(A) = 1 - P(A)$ .

1. Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5?

A.  $\frac{1}{2}$

B.  $\frac{2}{5}$

C.  $\frac{8}{15}$

D.  $\frac{9}{20}$

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Here,  $S = \{1, 2, 3, 4, \dots, 19, 20\}$ .

Let  $E$  = event of getting a multiple of 3 or 5 =  $\{3, 6, 9, 12, 15, 18, 5, 10, 20\}$ .

$$\therefore P(E) = \underline{n(E)} = \underline{9}.$$

$n(S) = 20$   
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2. A bag contains 2 red, 3 green and 2 blue balls. Two balls are drawn at random. What is the probability that none of the balls drawn is blue?

A.  $\frac{10}{21}$

B.  $\frac{11}{21}$

C.  $\frac{2}{7}$

D.  $\frac{5}{7}$

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Total number of balls =  $(2 + 3 + 2) = 7$ .

Let S be the sample space.

Then,  $n(S)$  = Number of ways of drawing 2 balls out of 7

$$= {}^7C_2$$

$$= \frac{(7 \times 6)}{(2 \times 1)}$$

$$= 21.$$

Let E = Event of drawing 2 balls, none of which is blue.

$\therefore n(E)$  = Number of ways of drawing 2 balls out of  $(2 + 3)$  balls.

$$= {}^5C_2$$

$$= \frac{(5 \times 4)}{(2 \times 1)}$$

$$= 10.$$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{10}{21}.$$

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- 
3. In a box, there are 8 red, 7 blue and 6 green balls. One ball is picked up randomly. What is the probability that it is neither red nor green?

A.  $\frac{1}{1}$

B.  $\frac{3}{1}$

- 3  
**C.**  $\frac{7}{19}$   
**E.**  $\frac{9}{21}$

- 4  
**D.**  $\frac{8}{21}$

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Total number of balls =  $(8 + 7 + 6) = 21$ .

Let E = event that the ball drawn is neither red nor green

= event that the ball drawn is blue.

$$\therefore n(E) = 7.$$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{7}{21} = \frac{1}{3}.$$

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- 
4. What is the probability of getting a sum 9 from two throws of a dice?

- A.**  $\frac{1}{6}$   
**C.**  $\frac{1}{9}$

- B.**  $\frac{1}{8}$   
**D.**  $\frac{1}{12}$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

In two throws of a die,  $n(S) = (6 \times 6) = 36$ .

Let E = event of getting a sum = $\{(3, 6), (4, 5), (5, 4), (6, 3)\}$ .

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{4}{36} = \frac{1}{9}.$$

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- 
5. Three unbiased coins are tossed. What is the probability of getting at most two heads?

A.  $\frac{3}{4}$

B.  $\frac{1}{4}$

C.  $\frac{3}{8}$

D.  $\frac{7}{8}$

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Here  $S = \{\text{TTT}, \text{TTH}, \text{THT}, \text{HTT}, \text{THH}, \text{HTH}, \text{HHT}, \text{HHH}\}$

Let  $E$  = event of getting at most two heads.

Then  $E = \{\text{TTT}, \text{TTH}, \text{THT}, \text{HTT}, \text{THH}, \text{HTH}, \text{HHT}\}$ .

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{7}{8}.$$

6. Two dice are thrown simultaneously. What is the probability of getting two numbers whose product is even?

A.  $\frac{1}{2}$

B.  $\frac{3}{4}$

C.  $\frac{3}{8}$

D.  $\frac{5}{16}$

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

In a simultaneous throw of two dice, we have  $n(S) = (6 \times 6) = 36$ .

Then,  $E = \{(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)\}$

$$\therefore n(E) = 27.$$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{27}{36} = \frac{3}{4}.$$

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7. In a class, there are 15 boys and 10 girls. Three students are selected at random. The probability that 1 girl and 2 boys are selected, is:

A.  $\frac{21}{46}$

B.  $\frac{25}{117}$

C.  $\frac{1}{50}$

D.  $\frac{3}{25}$

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let S be the sample space and E be the event of selecting 1 girl and 2 boys.

Then,  $n(S)$  = Number ways of selecting 3 students out of 25

$$\begin{aligned} &= {}^{25}C_3 \\ &= \frac{(25 \times 24 \times 23)}{(3 \times 2 \times 1)} \\ &= 2300. \end{aligned}$$

$$n(E) = ({}^{10}C_1 \times {}^{15}C_2)$$

$$\begin{aligned} &= \left[ 10 \times \frac{(15 \times 14)}{(2 \times 1)} \right] \\ &= 1050. \end{aligned}$$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{1050}{2300} = \frac{21}{46}.$$

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- 
8. In a lottery, there are 10 prizes and 25 blanks. A lottery is drawn at random. What is the probability of getting a prize?

A.  $\frac{1}{10}$

B.  $\frac{2}{5}$

C.  $\frac{2}{7}$

D.  $\frac{5}{7}$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$P(\text{getting a prize}) = \frac{10}{(10 + 25)} = \frac{10}{35} = \frac{2}{7}.$$

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- 
9. From a pack of 52 cards, two cards are drawn together at random. What is the probability of both the cards being kings?

A.  $\frac{1}{15}$

B.  $\frac{25}{57}$

C.  $\frac{35}{256}$

D.  $\frac{1}{221}$

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let S be the sample space.

$$\text{Then, } n(S) = {}^{52}C_2 = \frac{(52 \times 51)}{(2 \times 1)} = 1326.$$

Let E = event of getting 2 kings out of 4.

$$\therefore n(E) = {}^4C_2 = \frac{(4 \times 3)}{(2 \times 1)} = 6.$$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{6}{1326} = \frac{1}{221}.$$

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- 
10. Two dice are tossed. The probability that the total score is a prime number is:

A.  $\frac{1}{6}$

B.  $\frac{5}{12}$

C.  $\frac{1}{2}$

D.  $\frac{7}{9}$

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Clearly,  $n(S) = (6 \times 6) = 36$ .

Let E = Event that the sum is a prime number.

Then E = { (1, 1), (1, 2), (1, 4), (1, 6), (2, 1), (2, 3), (2, 5), (3, 2), (3, 4), (4, 1), (4, 3), (5, 2), (5, 6), (6, 1), (6, 5) }

$$\therefore n(E) = 15.$$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{15}{36} = \frac{5}{12}.$$

11. A card is drawn from a pack of 52 cards. The probability of getting a queen of club or a king of heart is:

A.  $\frac{1}{13}$

B.  $\frac{2}{13}$

C.  $\frac{1}{26}$

D.  $\frac{1}{52}$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Here,  $n(S) = 52$ .

Let E = event of getting a queen of club or a king of heart.

Then,  $n(E) = 2$ .

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{2}{52} = \frac{1}{26}.$$

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- 
12. A bag contains 4 white, 5 red and 6 blue balls. Three balls are drawn at random from the bag. The probability that all of them are red, is:

A.  $\frac{1}{22}$

B.  $\frac{3}{22}$

C.  $\frac{2}{91}$

D.  $\frac{2}{77}$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let S be the sample space.

Then,  $n(S)$  = number of ways of drawing 3 balls out of 15

$$= {}^{15}C_3$$

$$= \frac{(15 \times 14 \times 13)}{(3 \times 2 \times 1)}$$

$$= 455.$$

Let E = event of getting all the 3 red balls.

$$\therefore n(E) = {}^5C_3 = {}^5C_2 = \frac{(5 \times 4)}{(2 \times 1)} = 10.$$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{10}{455} = \frac{2}{91}.$$

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- 
13. Two cards are drawn together from a pack of 52 cards. The probability that one is a spade and one is a heart, is:

A.  $\frac{3}{20}$

B.  $\frac{29}{34}$

C.  $\frac{47}{100}$

D.  $\frac{13}{102}$

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Let S be the sample space.

$$\text{Then, } n(S) = {}^{52}C_2 = \frac{(52 \times 51)}{(2 \times 1)} = 1326.$$

Let E = event of getting 1 spade and 1 heart.

$\therefore n(E) = \text{number of ways of choosing 1 spade out of 13 and 1 heart out of 13}$

$$= ({}^{13}C_1 \times {}^{13}C_1)$$

$$= (13 \times 13)$$

$$= 169.$$

$$\therefore P(E) = \frac{n(E)}{n(S)} = \frac{169}{1326} = \frac{13}{102}.$$

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- 
14. One card is drawn at random from a pack of 52 cards. What is the probability that the card drawn is a face card (Jack, Queen and King only)?

A.  $\frac{1}{13}$

B.  $\frac{3}{13}$

C.  $\frac{1}{4}$

D.  $\frac{9}{52}$

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Clearly, there are 52 cards, out of which there are 12 face cards.

$$\therefore P(\text{getting a face card}) = \frac{12}{52} = \frac{3}{13}.$$

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- 
15. A bag contains 6 black and 8 white balls. One ball is drawn at random. What is the probability that the ball drawn is white?

A.  $\frac{3}{4}$

B.  $\frac{4}{7}$

C.  $\frac{1}{8}$

D.  $\frac{3}{7}$

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let number of balls =  $(6 + 8) = 14$ .

Number of white balls = 8.

$$P(\text{drawing a white ball}) = \frac{8}{14} = \frac{4}{7}.$$

## Odd Man Out and Series

Find the odd man out.

1. 3, 5, 11, 14, 17, 21

A. 21

B. 17

C. 14

D. 3

**Answer & Explanation**

**Answer:** Option C

## **Explanation:**

Each of the numbers except 14 is an odd number.

The number '14' is the only EVEN number.

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2.  $8, 27, 64, 100, 125, 216, 343$

A. 27      B. 100  
C. 125      D. 343

## Answer & Explanation

**Answer:** Option B

## Explanation:

The pattern is  $2^3, 3^3, 4^3, 5^3, 6^3, 7^3$ . But, 100 is not a perfect cube.

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3.  $10, 25, 45, 54, 60, 75, 80$

A. 10      B. 45  
C. 54      D. 75

## Answer & Explanation

**Answer:** Option C

## Explanation:

Each of the numbers except 54 is multiple of 5.

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4. 396, 462, 572, 427, 671, 264

A. 396      B. 427

C. 671

D. 264

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

In each number except 427, the middle digit is the sum of other two.

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- 
5. 6, 9, 15, 21, 24, 28, 30

A. 28

B. 21

C. 24

D. 30

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Each of the numbers except 28, is a multiple of 3.  
Find the odd man out.

6. 1, 4, 9, 16, 23, 25, 36

A. 9

B. 23

C. 25

D. 36

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Each of the numbers except 23, is perfect square.

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- 
7. 1, 4, 9, 16, 20, 36, 49

A. 1

B. 9

C. 20

D. 49

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

The pattern is  $1^2$ ,  $2^2$ ,  $3^2$ ,  $4^2$ ,  $5^2$ ,  $6^2$ ,  $7^2$ . But, instead of  $5^2$ , it is 20 which to be turned out.

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- 
8. 2, 5, 10, 17, 26, 37, 50, 64

**A.** 50                   **B.** 26  
**C.** 37                   **D.** 64

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

$(1*1)+1$ ,  $(2*2)+1$ ,  $(3*3)+1$ ,  $(4*4)+1$ ,  $(5*5)+1$ ,  $(6*6)+1$ ,  $(7*7)+1$ ,  $(8*8)+1$

But, 64 is out of pattern.

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- 
9. 10, 14, 16, 18, 21, 24, 26

**A.** 26                   **B.** 24  
**C.** 21                   **D.** 18

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Each of the numbers except 21 is an even number.

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- 
10. 16, 25, 36, 72, 144, 196, 225

**A.** 36                   **B.** 72

**C.** 196

**D.** 225

[\*\*Answer & Explanation\*\*](#)

**Answer:** Option **B**

**Explanation:**

Each of the numbers except 72 is a perfect square

Find the odd man out.

11. 331, 482, 551, 263, 383, 362, 284

**A.** 263

**B.** 383

**C.** 331

**D.** 551

[\*\*Answer & Explanation\*\*](#)

**Answer:** Option **B**

**Explanation:**

In each number except 383, the product of first and third digits is the middle one.

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- 
12. 835, 734, 642, 751, 853, 981, 532

**A.** 751

**B.** 853

**C.** 981

**D.** 532

[\*\*Answer & Explanation\*\*](#)

**Answer:** Option **A**

**Explanation:**

In each number except 751, the difference of third and first digit is the middle one.

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- 
13. 41, 43, 47, 53, 61, 71, 73, 81

**A.** 61

**B.** 71

C. 73

D. 81

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Each of the numbers except 81 is a prime number.

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- 
14. 3, 5, 7, 12, 17, 19

A. 19

B. 17

C. 5

D. 12

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Each of the numbers is a prime number except 12.

Find out the wrong number in the given sequence of numbers.

1. 582, 605, 588, 611, 634, 617, 600

A. 634

B. 611

C. 605

D. 600

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Alternatively 23 is added and 17 is subtracted from the terms. So, 634 is wrong.

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- 
2. 22, 33, 66, 99, 121, 279, 594

A. 33

B. 121

C. 279

D. 594

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Each of the number except 279 is a multiple of 11.

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- 
3. 8, 13, 21, 32, 47, 63, 83

**A.** 47

**B.** 63

**C.** 32

**D.** 83

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Go on adding 5, 8, 11, 14, 17, 20.

So, the number 47 is wrong and must be replaced by 46.

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- 
4. 1, 8, 27, 64, 124, 216, 343

**A.** 8

**B.** 27

**C.** 64

**D.** 124

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

The numbers are  $1^3$ ,  $2^3$ ,  $3^3$ ,  $4^3$  etc. So, 124 is wrong; it must have been  $5^3$  i.e., 125.

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- 
5. 1, 2, 6, 15, 31, 56, 91

**A.** 31

**B.** 91

C. 56

D. 15

[Answer & Explanation](#)

**Answer:** Option **B**

**Explanation:**

$$1, 1 + 1^2 = 2, 2 + 2^2 = 6, 6 + 3^2 = 15, 15 + 4^2 = 31, 31 + 5^2 = 56, 56 + 6^2 = 92$$

Last number of given series must be 92 not 91.

Find out the wrong number in the given sequence of numbers.

6. 52, 51, 48, 43, 34, 27, 16

A. 27

B. 34

C. 43

D. 48

[Answer & Explanation](#)

**Answer:** Option **B**

**Explanation:**

Subtract 1, 3, 5, 7, 9, 11 from successive numbers.

So, 34 is wrong.

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- 
7. 4, 6, 8, 9, 10, 11, 12

A. 10

B. 11

C. 12

D. 9

[Answer & Explanation](#)

**Answer:** Option **B**

**Explanation:**

Each number is a composite number except 11.

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- 
8. 105, 85, 60, 30, 0, -45, -90

A. 0

B. 85

C. -45

D. 60

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Subtract 20, 25, 30, 35, 40, 45 from successive numbers.

So, 0 is wrong.

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9. 5, 16, 6, 16, 7, 16, 9

A. 9

B. 7

C. 6

D. None of these

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Terms at odd places are 5, 6, 7, 8 etc. and each term at even place is 16.

So, 9 is wrong.

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10. 125, 127, 130, 135, 142, 153, 165

A. 130

B. 142

C. 153

D. 165

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Prime numbers 2, 3, 5, 7, 11, 13 are to be added successively.

So, 165 is wrong  
Find out the wrong number in the given sequence of numbers.  
11. 46080, 3840, 384, 48, 24, 2, 1

A. 1

B. 2

C. 24

D. 384

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

The terms are successively divided by 12, 10, 8, 6, ...etc.

So, 24 is wrong, it should be 8 ( $48/6 = 8$ ).

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12. 6, 13, 18, 25, 30, 37, 40

A. 25

B. 30

C. 37

D. 40

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

The differences between two successive terms from the beginning are 7, 5, 7, 5, 7, 5.

So, 40 is wrong.

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13. 36, 54, 18, 27, 9, 18.5, 4.5

A. 4.5

B. 18.5

C. 54

D. 18

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

The terms are alternatively multiplied by 1.5 and divided by 3. However, 18.5 does not satisfy it.

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14. 56, 72, 90, 110, 132, 150

**A.** 72                           **B.** 110

**C.** 132                           **D.** 150

**[Answer & Explanation](#)**

**Answer:** Option D

**Explanation:**

The numbers are  $7 \times 8$ ,  $8 \times 9$ ,  $9 \times 10$ ,  $10 \times 11$ ,  $11 \times 12$ ,  $12 \times 13$ .

So, 150 is wrong.

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15. 25, 36, 49, 81, 121, 169, 225

**A.** 36                           **B.** 49

**C.** 121                           **D.** 169

**[Answer & Explanation](#)**

**Answer:** Option A

**Explanation:**

The numbers are squares of odd natural numbers, starting from 5 up to 15.

So, 36 is wrong.

Insert the missing number.

1. 16, 33, 65, 131, 261, (...)

**A.** 523                           **B.** 521

**C.** 613                           **D.** 721

## Answer & Explanation

**Answer:** Option A

## Explanation:

Each number is twice the preceding one with 1 added or subtracted alternatively.

So, the next number is  $(2 \times 261 + 1) = 523$ .

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2.  $10, 5, 13, 10, 16, 20, 19, (\dots)$

A. 22      B. 40  
C. 38      D. 23

## Answer & Explanation

**Answer:** Option B

## Explanation:

There are two series (10, 13, 16, 19) and (5, 10, 20, 40), one increasing by 3 and the other multiplied by 2.

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3.  $1, 4, 9, 16, 25, 36, 49, (\dots)$

A. 54      B. 56  
C. 64      D. 81

## Answer & Explanation

**Answer:** Option C

## Explanation:

Numbers are  $1^2, 2^2, 3^2, 4^2, 5^2, 6^2, 7^2$ .

So, the next number is  $8^2 = 64$ .

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4.  $2, 4, 12, 48, 240, (\dots)$

A. 960

B. 1440

C. 1080

D. 1920

#### **[Answer & Explanation](#)**

**Answer:** Option B

#### **Explanation:**

Go on multiplying the given numbers by 2, 3, 4, 5, 6.

So, the correct next number is 1440.

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- 
5. 8, 7, 11, 12, 14, 17, 17, 22, (....)

A. 27

B. 20

C. 22

D. 24

#### **[Answer & Explanation](#)**

**Answer:** Option B

#### **Explanation:**

There are two series (8, 11, 14, 17, 20) and (7, 12, 17, 22) increasing by 3 and 5 respectively.

Insert the missing number.

6. 11, 13, 17, 19, 23, 29, 31, 37, 41, (....)

A. 43

B. 47

C. 53

D. 51

#### **[Answer & Explanation](#)**

**Answer:** Option A

#### **Explanation:**

Numbers are all primes. The next prime is 43.

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- 
7. 8, 24, 12, 36, 18, 54, (....)

A. 27

B. 108

C. 68

D. 72

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Numbers are alternatively multiplied by 3 and divided by 2.

So, the next number =  $54 \div 2 = 27$ .

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- 
8. 2, 6, 12, 20, 30, 42, 56, (....)

A. 61

B. 64

C. 72

D. 70

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

The pattern is  $1 \times 2$ ,  $2 \times 3$ ,  $3 \times 4$ ,  $4 \times 5$ ,  $5 \times 6$ ,  $6 \times 7$ ,  $7 \times 8$ .

So, the next number is  $8 \times 9 = 72$ .

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- 
9. 4, -8, 16, -32, 64, (....)

A. 128

B. -128

C. 192

D. -192

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Each number is the proceeding number multiplied by -2.

So, the required number is -128.

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10. 7, 26, 63, 124, 215, 342, (....)

A. 481

B. 511

C. 391

D. 421

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Numbers are  $(2^3 - 1)$ ,  $(3^3 - 1)$ ,  $(4^3 - 1)$ ,  $(5^3 - 1)$ ,  $(6^3 - 1)$ ,  $(7^3 - 1)$  etc.

So, the next number is  $(8^3 - 1) = (512 - 1) = 511$ .

Insert the missing number.

11. 5, 10, 13, 26, 29, 58, 61, (....)

A. 122

B. 64

C. 125

D. 128

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Numbers are alternatively multiplied by 2 and increased by 3.

So, the missing number =  $61 \times 2 = 122$ .

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12. 15, 31, 63, 127, 255, (....)

A. 513

B. 511

C. 517

D. 523

[Answer & Explanation](#)

**Answer:** Option **B**

**Explanation:**

Each number is double the preceding one plus 1.

So, the next number is  $(255 \times 2) + 1 = 511$ .

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13. 1, 8, 27, 64, 125, 216, (....)

**A.** 354

**B.** 343

**C.** 392

**D.** 245

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

Numbers are  $1^3, 2^3, 3^3, 4^3, 5^3, 6^3$ .

So, the missing number is  $7^3 = 343$ .

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14. 3, 7, 6, 5, 9, 3, 12, 1, 15, (....)

**A.** 18

**B.** 13

**C.** -1

**D.** 3

**Answer & Explanation**

**Answer:** Option **C**

**Explanation:**

There are two series, beginning respectively with 3 and 7. In one 3 is added and in another 2 is subtracted.

The next number is  $1 - 2 = -1$ .

Find out the wrong number in the series.

1. 7, 8, 18, 57, 228, 1165, 6996

A. 8

B. 18

C. 57

D. 228

E. 1165

[Answer & Explanation](#)

**Answer:** Option **D**

**Explanation:**

Let the given numbers be A, B, C, D, E, F, G.

Then,  $A, A \times 1 + 1, B \times 2 + 2, C \times 3 + 3, D \times 4 + 4, E \times 5 + 5, F \times 6 + 6$  are the required numbers.

Clearly, 228 is wrong.

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2. 1, 1, 2, 6, 24, 96, 720

A. 720

B. 96

C. 24

D. 6

E. 2

[Answer & Explanation](#)

**Answer:** Option **B**

**Explanation:**

Go on multiplying with 1, 2, 3, 4, 5, 6 to get next number.

So, 96 is wrong.

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---

3. 196, 169, 144, 121, 100, 80, 64

A. 169

B. 144

C. 121

D. 100

**E.** 80

[Answer & Explanation](#)

**Answer:** Option E

**Explanation:**

Numbers must be  $(14)^2$ ,  $(13)^2$ ,  $(12)^2$ ,  $(11)^2$ ,  $(10)^2$ ,  $(9)^2$ ,  $(8)^2$ .

So, 80 is wrong.

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- 
4. 445, 221, 109, 46, 25, 11, 4

**A.** 221

**B.** 109

**C.** 46

**D.** 25

**E.** 11

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Go on subtracting 3 and dividing the result by 2 to obtain the next number.

Clearly, 46 is wrong.

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- 
5. 190, 166, 145, 128, 112, 100, 91

**A.** 100

**B.** 166

**C.** 145

**D.** 128

**E.** 112

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Go on subtracting 24, 21, 18, 15, 12, 9 from the numbers to get the next number.

190 - 24 = 166  
166 - 21 = 145  
145 - 18 = 127 [Here, 128 is placed instead of 127]  
127 - 15 = 112  
112 - 12 = 100 ... and so on.

Therefore, 128 is wrong.

Find out the wrong number in the series.

6. 19, 26, 33, 46, 59, 74, 91

- |              |              |
|--------------|--------------|
| <b>A.</b> 26 | <b>B.</b> 33 |
| <b>C.</b> 46 | <b>D.</b> 59 |
| <b>E.</b> 74 |              |

[\*\*Answer & Explanation\*\*](#)

**Answer:** Option **B**

**Explanation:**

Go on adding 7, 9, 11, 13, 15, 17 respectively to obtain the next number.

So, 33 is wrong. It must be 35

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- 
7. 1, 3, 10, 21, 64, 129, 356, 777

- |               |               |
|---------------|---------------|
| <b>A.</b> 10  | <b>B.</b> 21  |
| <b>C.</b> 64  | <b>D.</b> 129 |
| <b>E.</b> 356 |               |

[\*\*Answer & Explanation\*\*](#)

**Answer:** Option **E**

**Explanation:**

$A \times 2 + 1$ ,  $B \times 3 + 1$ ,  $C \times 2 + 1$ ,  $D \times 3 + 1$  and so on.

So, 356 is wrong.

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8. 6, 12, 48, 100, 384, 768, 3072

**A.** 768

**B.** 384

**C.** 100

**D.** 48

**E.** 12

[\*\*Answer & Explanation\*\*](#)

**Answer:** Option C

**Explanation:**

Each even term of the series is obtained by multiplying the previous term by 2.

$$2^{\text{nd}} \text{ term} = (1^{\text{st}} \text{ term}) \times 2 = 6 \times 2 = 12$$

$$4^{\text{th}} \text{ term} = (3^{\text{rd}} \text{ term}) \times 2 = 48 \times 2 = 96.$$

$$6^{\text{th}} \text{ term} = (5^{\text{th}} \text{ term}) \times 2 = 384 \times 2 = 768.$$

$\therefore$  4<sup>th</sup> term should be 96 instead of 100.

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9. 40960, 10240, 2560, 640, 200, 40, 10

**A.** 640

**B.** 40

**C.** 200

**D.** 2560

**E.** 10240

[\*\*Answer & Explanation\*\*](#)

**Answer:** Option C

**Explanation:**

Go on dividing by 4 to get the next number.

So, 200 is wrong.

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10. 3, 7, 15, 39, 63, 127, 255, 511

A. 7

B. 15

C. 39

D. 63

E. 127

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Go on multiplying 2 and adding 1 to get the next number.

So, 39 is wrong.

Find out the wrong number in the series.

11. 64, 71, 80, 91, 104, 119, 135, 155

A. 71

B. 80

C. 104

D. 119

E. 135

[Answer & Explanation](#)

**Answer:** Option E

**Explanation:**

Go on adding 7, 9, 11, 13, 15, 17, 19 respectively to obtain the next number.

So, 135 is wrong.

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12. 15, 16, 34, 105, 424, 2124, 12756

A. 16

B. 34

C. 105

D. 424

E. 2124

[Answer & Explanation](#)

**Answer:** Option E

**Explanation:**

$$2^{\text{nd}} \text{ term} = (1^{\text{st}} \text{ term}) \times 1 + 1 = 15 \times 1 + 1 = 16.$$

$$3^{\text{rd}} \text{ term} = (2^{\text{nd}} \text{ term}) \times 2 + 2 = 16 \times 2 + 2 = 34.$$

$$4^{\text{th}} \text{ term} = (3^{\text{th}} \text{ term}) \times 3 + 3 = 34 \times 3 + 3 = 105.$$

$$5^{\text{th}} \text{ term} = (4^{\text{th}} \text{ term}) \times 4 + 4 = 105 \times 4 + 4 = 424$$

$$6^{\text{th}} \text{ term} = (5^{\text{th}} \text{ term}) \times 5 + 5 = 424 \times 5 + 5 = 2125$$

$\therefore 6^{\text{th}}$  term should 2125 instead of 2124.

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13. 10, 26, 74, 218, 654, 1946, 5834

**A.** 26

**B.** 74

**C.** 218

**D.** 654

**E.** 1946

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

$$2^{\text{nd}} \text{ term} = (1^{\text{st}} \text{ term}) \times 3 - 4 = 10 \times 3 - 4 = 26.$$

$$3^{\text{rd}} \text{ term} = (2^{\text{nd}} \text{ term}) \times 3 - 4 = 26 \times 3 - 4 = 74.$$

$$4^{\text{th}} \text{ term} = (3^{\text{th}} \text{ term}) \times 3 - 4 = 74 \times 3 - 4 = 218.$$

$$5^{\text{th}} \text{ term} = (4^{\text{th}} \text{ term}) \times 3 - 4 = 218 \times 3 - 4 = 650.$$

$\therefore 5^{\text{th}}$  term must be 650 instead of 654.

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14. 2880, 480, 92, 24, 8, 4, 4

**A.** 480

**B.** 92

**C.** 24

**D.** 8

E. 4

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Go on dividing by 6, 5, 4, 3, 2, 1 respectively to obtain the next number.

Clearly, 92 is wrong.

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15. 3, 7, 15, 27, 63, 127, 255

A. 7

B. 15

C. 27

D. 63

E. 127

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Go on multiplying the number by 2 and adding 1 to it to get the next number.

So, 27 is wrong.

*Gather and Edited By*

*Yasir Shahzad( Gujrat)*

*Math Book Part 3*

*Best Of Luck*

*You Can Not Help Every one But Every  
One Can Help Someone*

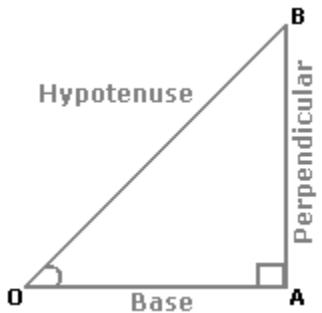
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## Height and Distance

### Formulas

#### 1. Trigonometry:

In a right angled  $\triangle OAB$ , where  $\angle BOA = \theta$ ,



- i.  $\sin \theta = \frac{\text{Perpendicular}}{\text{Hypotenuse}} = \frac{AB}{OB};$
- ii.  $\cos \theta = \frac{\text{Base}}{\text{Hypotenuse}} = \frac{OA}{OB};$
- iii.  $\tan \theta = \frac{\text{Perpendicular}}{\text{Base}} = \frac{AB}{OA};$
- iv.  $\operatorname{cosec} \theta = \frac{1}{\sin \theta} = \frac{OB}{AB};$
- v.  $\sec \theta = \frac{1}{\cos \theta} = \frac{OB}{OA};$
- vi.  $\cot \theta = \frac{1}{\tan \theta} = \frac{OA}{AB};$

#### 2. Trigonometrical Identities:

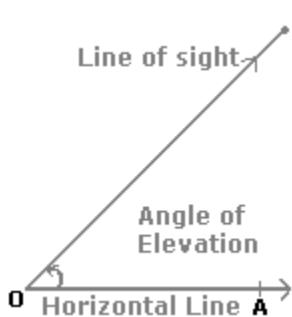
- i.  $\sin^2 \theta + \cos^2 \theta = 1.$
- ii.  $1 + \tan^2 \theta = \sec^2 \theta.$
- iii.  $1 + \cot^2 \theta = \operatorname{cosec}^2 \theta.$

#### 3. Values of T-ratios:

$\theta$	$0^\circ$	$(\pi/6)$	$(\pi/4)$	$(\pi/3)$	$(\pi/2)$
$\sin \theta$	0	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{2}$	1
$\cos \theta$	1	$\frac{3}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	0

$\tan \theta$	0	$\frac{1}{3}$	1	3	not defined
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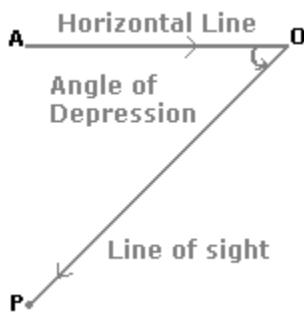
#### **4. Angle of Elevation:**



Suppose a man from a point O looks up at an object P, placed above the level of his eye. Then, the angle which the line of sight makes with the horizontal through O, is called the **angle of elevation** of P as seen from O.

$\therefore$  Angle of elevation of P from O =  $\angle AOP$ .

### **5. Angle of Depression:**



Suppose a man from a point O looks down at an object P, placed below the level of his eye, then the angle which the line of sight makes with the horizontal through O, is called the **angle of depression** of P as seen from O.

1. Two ships are sailing in the sea on the two sides of a lighthouse. The angle of elevation of the top of the lighthouse is observed from the ships are  $30^\circ$  and  $45^\circ$  respectively. If the lighthouse is 100 m high, the distance between the two ships is:



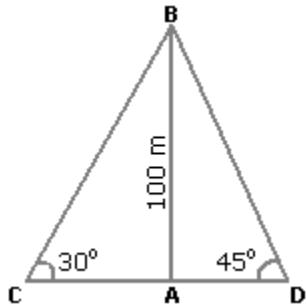
- C. 273 m D. 300 m

## Answer & Explanation

**Answer:** Option C

**Explanation:**

Let AB be the lighthouse and C and D be the positions of the ships.



Then,  $AB = 100 \text{ m}$ ,  $\angle ACB = 30^\circ$  and  $\angle ADB = 45^\circ$ .

$$\frac{AB}{AC} = \tan 30^\circ = \frac{1}{3} \Rightarrow AC = AB \times 3 = 100 \times 3 = 300 \text{ m.}$$

$$\frac{AB}{AD} = \tan 45^\circ = 1 \Rightarrow AD = AB = 100 \text{ m.}$$

$$\therefore CD = (AC + AD) = (300 + 100) \text{ m}$$

$$= 100(3 + 1)$$

$$= (100 \times 2.73) \text{ m}$$

$$= 273 \text{ m.}$$

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- 
2. A man standing at a point P is watching the top of a tower, which makes an angle of elevation of  $30^\circ$  with the man's eye. The man walks some distance towards the tower to watch its top and the angle of the elevation becomes  $60^\circ$ . What is the distance between the base of the tower and the point P?

A. 43 units

B. 8 units

C. 12 units

D. Data inadequate

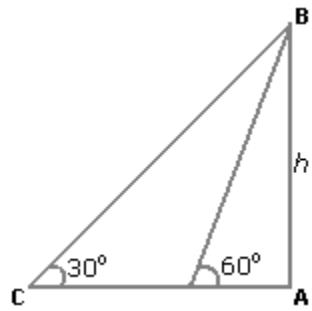
E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

One of AB, AD and CD must have given.



So, the data is inadequate.

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3. The angle of elevation of a ladder leaning against a wall is  $60^\circ$  and the foot of the ladder is 4.6 m away from the wall. The length of the ladder is:



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4. An observer 1.6 m tall is 203 away from a tower. The angle of elevation from his eye to the top of the tower is  $30^\circ$ . The heights of the tower is:

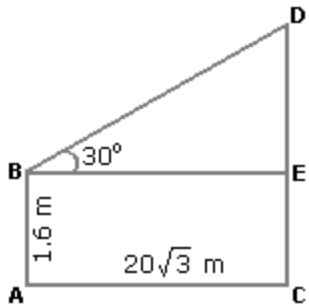


## Answer & Explanation

**Answer:** Option A

## Explanation:

Let AB be the observer and CD be the tower.



Draw  $BE \perp CD$ .

Then,  $CE = AB = 1.6$  m,

$$BE = AC = 203 \text{ m.}$$

$$\begin{aligned}\frac{DE}{BE} &= \tan 30^\circ = \frac{1}{3} \\ \Rightarrow DE &= \frac{203}{3} \text{ m} = 20 \text{ m.}\end{aligned}$$

$$\therefore CD = CE + DE = (1.6 + 20) \text{ m} = 21.6 \text{ m.}$$

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5. From a point P on a level ground, the angle of elevation of the top tower is  $30^\circ$ . If the tower is 100 m high, the distance of point P from the foot of the tower is:

A. 149 m

B. 156 m

C. 173 m

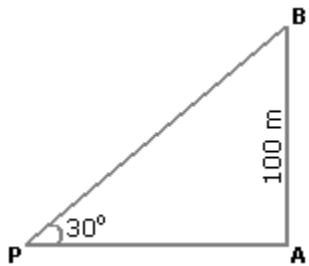
D. 200 m

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let AB be the tower.



Then,  $\angle APB = 30^\circ$  and  $AB = 100$  m.

$$\frac{AB}{AP} = \tan 30^\circ = \frac{1}{3}$$
$$\Rightarrow AP = (AB \times 3) \text{ m}$$

$$= 100 \times 3 \text{ m}$$

$$= (100 \times 1.73) \text{ m}$$

$$= 173 \text{ m.}$$

The angle of elevation of the sun, when the length of the shadow of a tree 3 times the height of the tree, is:

A.  $30^\circ$

B.  $45^\circ$

C.  $60^\circ$

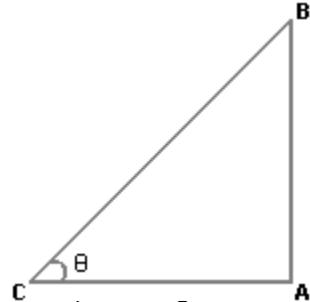
D.  $90^\circ$

#### Answer & Explanation

Answer: Option A

Explanation:

Let AB be the tree and AC be its shadow.



Let  $\angle ACB = \theta$ .

$$\text{Then, } \frac{AC}{AB} = 3 \Rightarrow \cot \theta = 3$$
$$\therefore \theta = 30^\circ.$$

## Compound Interest

### Formulas

1. Let Principal = P, Rate = R% per annum, Time = n years.
2. When interest is compound Annually:

$$\text{Amount} = P \left( 1 + \frac{R}{100} \right)^n$$

3. When interest is compounded Half-yearly:

$$\text{Amount} = P \left[ 1 + \frac{(R/2)}{100} \right]^{2n}$$

**4. When interest is compounded Quarterly:**

$$\text{Amount} = P \left[ 1 + \frac{(R/4)}{100} \right]^{4n}$$

**5. When interest is compounded Annually but time is in fraction, say  $3\frac{2}{5}$  years.**

$$\text{Amount} = P \left( 1 + \frac{R}{100} \right)^3 \times \left( 1 + \frac{\frac{2}{5}R}{100} \right)$$

**6. When Rates are different for different years, say  $R_1\%$ ,  $R_2\%$ ,  $R_3\%$  for 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> year respectively.**

$$\text{Then, Amount} = P \left( 1 + \frac{R_1}{100} \right) \left( 1 + \frac{R_2}{100} \right) \left( 1 + \frac{R_3}{100} \right).$$

**7. Present worth of Rs.  $x$  due  $n$  years hence is given by:**

$$\text{Present Worth} = \frac{x}{\left( 1 + \frac{R}{100} \right)}.$$

1. A bank offers 5% compound interest calculated on half-yearly basis. A customer deposits Rs. 1600 each on 1<sup>st</sup> January and 1<sup>st</sup> July of a year. At the end of the year, the amount he would have gained by way of interest is:

- |                   |                   |
|-------------------|-------------------|
| <b>A.</b> Rs. 120 | <b>B.</b> Rs. 121 |
| <b>C.</b> Rs. 122 | <b>D.</b> Rs. 123 |

**Answer & Explanation**

**Answer:** Option **B**

**Explanation:**

$$\begin{aligned} \text{Amount} &= \text{Rs.} \left[ 1600 \times \left( 1 + \frac{5}{2 \times 100} \right)^2 + 1600 \times \left( 1 + \frac{5}{2 \times 100} \right) \right] \\ &= \text{Rs.} \left[ 1600 \times \frac{41}{40} \times \frac{41}{40} + 1600 \times \frac{41}{40} \right] \\ &= \text{Rs.} \lceil 1600 \times \underline{\frac{41}{40}} (\underline{\frac{41}{40}} + 1) \rceil \end{aligned}$$

$$\begin{aligned}
 & 40 \quad 40 \\
 & = \text{Rs.} \left[ \frac{1600 \times 41 \times 81}{40 \times 40} \right] \\
 & = \text{Rs.} 3321.
 \end{aligned}$$

$\therefore$  C.I. = Rs. (3321 - 3200) = Rs. 121

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2. The difference between simple and compound interests compounded annually on a certain sum of money for 2 years at 4% per annum is Re. 1. The sum (in Rs.) is:

- |               |               |
|---------------|---------------|
| <b>A.</b> 625 | <b>B.</b> 630 |
| <b>C.</b> 640 | <b>D.</b> 650 |

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Let the sum be Rs.  $x$ . Then,

$$\begin{aligned}
 \text{C.I.} &= \left[ x \left( 1 + \frac{4}{100} \right)^2 - x \right] = \left( \frac{676}{625}x - x \right) = \frac{51}{625}x. \\
 \text{S.I.} &= \left( \frac{x \times 4 \times 2}{100} \right) = \frac{2x}{25}. \\
 \therefore \frac{51x}{625} - \frac{2x}{25} &= 1
 \end{aligned}$$

$$\Rightarrow x = 625.$$

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3. There is 60% increase in an amount in 6 years at simple interest. What will be the compound interest of Rs. 12,000 after 3 years at the same rate?

- |                         |                    |
|-------------------------|--------------------|
| <b>A.</b> Rs. 2160      | <b>B.</b> Rs. 3120 |
| <b>C.</b> Rs. 3972      | <b>D.</b> Rs. 6240 |
| <b>E.</b> None of these |                    |

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Let P = Rs. 100. Then, S.I. Rs. 60 and T = 6 years.

$$\therefore R = \left( \frac{100 \times 60}{100 \times 6} \right) = 10\% \text{ p.a.}$$

Now, P = Rs. 12000. T = 3 years and R = 10% p.a.

$$\begin{aligned}\therefore \text{C.I.} &= \text{Rs.} \left[ 12000 \times \left\{ \left( 1 + \frac{10}{100} \right)^3 - 1 \right\} \right] \\ &= \text{Rs.} \left( 12000 \times \frac{331}{1000} \right) \\ &= 3972.\end{aligned}$$

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4.

What is the difference between the compound interests on Rs. 5000 for  $1\frac{1}{2}$  years at 4% per annum compounded yearly and half-yearly?

- |                    |                    |
|--------------------|--------------------|
| <b>A.</b> Rs. 2.04 | <b>B.</b> Rs. 3.06 |
| <b>C.</b> Rs. 4.80 | <b>D.</b> Rs. 8.30 |

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\begin{aligned}\text{C.I. when interest compounded yearly} &= \text{Rs.} \left[ 5000 \times \left( 1 + \frac{4}{100} \right) \times \left( 1 + \frac{\frac{1}{2} \times 4}{100} \right) \right] \\ &= \text{Rs.} \left( 5000 \times \frac{26}{25} \times \frac{51}{50} \right) \\ &= \text{Rs.} 5304.\end{aligned}$$

$$\begin{aligned}\text{C.I. when interest is compounded half-yearly} &= \text{Rs.} \left[ 5000 \times \left( 1 + \frac{2}{100} \right)^3 \right]\end{aligned}$$

$$= \text{Rs.} \left( 5000 \times \frac{51}{50} \times \frac{51}{50} \times \frac{51}{50} \right)$$

$$= \text{Rs. } 5306.04$$

$\therefore$  Difference = Rs. (5306.04 - 5304) = Rs. 2.04

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5. The compound interest on Rs. 30,000 at 7% per annum is Rs. 4347. The period (in years) is:

- |             |                          |
|-------------|--------------------------|
| <b>A.</b> 2 | <b>B.</b> $2\frac{1}{2}$ |
| <b>C.</b> 3 | <b>D.</b> 4              |

#### **Answer & Explanation**

**Answer:** Option A

#### **Explanation:**

Amount = Rs. (30000 + 4347) = Rs. 34347.

Let the time be  $n$  years.

$$\text{Then, } 30000 \left( 1 + \frac{7}{100} \right)^n = 34347$$

$$\Rightarrow \left( \frac{107}{100} \right)^n = \frac{34347}{30000} = \frac{11449}{10000} = \left( \frac{107}{100} \right)^2$$

$\therefore n = 2$  years.

6. What will be the compound interest on a sum of Rs. 25,000 after 3 years at the rate of 12 p.c.p.a.?

- |                         |                        |
|-------------------------|------------------------|
| <b>A.</b> Rs. 9000.30   | <b>B.</b> Rs. 9720     |
| <b>C.</b> Rs. 10123.20  | <b>D.</b> Rs. 10483.20 |
| <b>E.</b> None of these |                        |

#### **Answer & Explanation**

**Answer:** Option C

#### **Explanation:**

$$\begin{aligned}
 \text{Amount} &= \text{Rs.} \left[ 25000 \times \left( 1 + \frac{12}{100} \right)^3 \right] \\
 &= \text{Rs.} \left( 25000 \times \frac{28}{25} \times \frac{28}{25} \times \frac{28}{25} \right) \\
 &= \text{Rs.} 35123.20
 \end{aligned}$$

$$\therefore \text{C.I.} = \text{Rs.} (35123.20 - 25000) = \text{Rs.} 10123.20$$

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7. At what rate of compound interest per annum will a sum of Rs. 1200 become Rs. 1348.32 in 2 years?

- |              |                |
|--------------|----------------|
| <b>A.</b> 6% | <b>B.</b> 6.5% |
| <b>C.</b> 7% | <b>D.</b> 7.5% |

#### **Answer & Explanation**

**Answer:** Option A

#### **Explanation:**

Let the rate be R% p.a.

$$\begin{aligned}
 \text{Then, } 1200 \times \left( 1 + \frac{R}{100} \right)^2 &= 1348.32 \\
 \Rightarrow \left( 1 + \frac{R}{100} \right)^2 &= \frac{134832}{120000} = \frac{11236}{10000} \\
 \therefore \left( 1 + \frac{R}{100} \right)^2 &= \left( \frac{106}{100} \right)^2 \\
 \Rightarrow 1 + \frac{R}{100} &= \frac{106}{100} \\
 \Rightarrow R &= 6\%
 \end{aligned}$$

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8. The least number of complete years in which a sum of money put out at 20% compound interest will be more than doubled is:

- |             |             |
|-------------|-------------|
| <b>A.</b> 3 | <b>B.</b> 4 |
| <b>C.</b> 5 | <b>D.</b> 6 |

#### **Answer & Explanation**

**Answer:** Option **B**

#### **Explanation:**

$$P \left(1 + \frac{20}{100}\right)^n > 2P \Rightarrow \left(\frac{6}{5}\right)^n > 2.$$

Now,  $\left(\frac{6}{5} \times \frac{6}{5} \times \frac{6}{5} \times \frac{6}{5}\right) > 2$ .

So,  $n = 4$  years.

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9. Albert invested an amount of Rs. 8000 in a fixed deposit scheme for 2 years at compound interest rate 5 p.c.p.a. How much amount will Albert get on maturity of the fixed deposit?

- A.** Rs. 8600      **B.** Rs. 8620  
**C.** Rs. 8820      **D.** None of these

#### **Answer & Explanation**

**Answer:** Option **C**

#### **Explanation:**

$$\begin{aligned} \text{Amount} &= \text{Rs.} \left[ 8000 \times \left(1 + \frac{5}{100}\right)^2\right] \\ &= \text{Rs.} \left(8000 \times \frac{21}{20} \times \frac{21}{20}\right) \\ &= \text{Rs.} 8820. \end{aligned}$$

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10. The effective annual rate of interest corresponding to a nominal rate of 6% per annum payable half-yearly is:

- A.** 6.06%      **B.** 6.07%  
**C.** 6.08%      **D.** 6.09%

#### **Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Amount of Rs. 100 for 1 year} \\ \text{when compounded half-yearly} = \text{Rs. } \left[ 100 \times \left( 1 + \frac{3}{100} \right)^2 \right] = \text{Rs. } 106.09$$

$\therefore$  Effective rate =  $(106.09 - 100)\% = 6.09\%$

11. Simple interest on a certain sum of money for 3 years at 8% per annum is half the compound interest on Rs. 4000 for 2 years at 10% per annum. The sum placed on simple interest is:

A. Rs. 1550

B. Rs. 1650

C. Rs. 1750

D. Rs. 2000

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\begin{aligned} \text{C.I.} &= \text{Rs. } \left[ 4000 \times \left( 1 + \frac{10}{100} \right)^2 - 4000 \right] \\ &= \text{Rs. } \left( 4000 \times \frac{11}{10} \times \frac{11}{10} - 4000 \right) \\ &= \text{Rs. } 840. \end{aligned}$$

$\therefore$  Sum =  $\text{Rs. } \left( \frac{420 \times 100}{3 \times 8} \right) = \text{Rs. } 1750.$

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- 
12. If the simple interest on a sum of money for 2 years at 5% per annum is Rs. 50, what is the compound interest on the same at the same rate and for the same time?

A. Rs. 51.25

B. Rs. 52

C. Rs. 54.25

D. Rs. 60

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\text{Sum} = \text{Rs. } \left( \frac{50 \times 100}{2 \times 5} \right) = \text{Rs. } 500.$$

$$\begin{aligned}
 \text{Amount} &= \text{Rs. } \left[ 500 \times \left( 1 + \frac{5}{100} \right)^2 \right] \\
 &= \text{Rs. } \left( 500 \times \frac{21}{20} \times \frac{21}{20} \right) \\
 &= \text{Rs. } 551.25
 \end{aligned}$$

$\therefore \text{C.I.} = \text{Rs. } (551.25 - 500) = \text{Rs. } 51.25$

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13. The difference between simple interest and compound on Rs. 1200 for one year at 10% per annum reckoned half-yearly is:

- A. Rs. 2.50
- B. Rs. 3
- C. Rs. 3.75
- D. Rs. 4
- E. None of these

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$\begin{aligned}
 \text{S.I.} &= \text{Rs. } \left( \frac{1200 \times 10 \times 1}{100} \right) = \text{Rs. } 120. \\
 \text{C.I.} &= \text{Rs. } \left[ 1200 \times \left( 1 + \frac{5}{100} \right)^2 - 1200 \right] = \text{Rs. } 123.
 \end{aligned}$$

$\therefore \text{Difference} = \text{Rs. } (123 - 120) = \text{Rs. } 3.$

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14. The difference between compound interest and simple interest on an amount of Rs. 15,000 for 2 years is Rs. 96. What is the rate of interest per annum?

- A. 8
- B. 10
- C. 12
- D. Cannot be determined
- E. None of these

### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$\begin{aligned} & \left[ 15000 \times \left( 1 + \frac{R}{100} \right)^2 - 15000 \right] - \left( \frac{15000 \times R \times 2}{100} \right) = 96 \\ \Rightarrow & 15000 \left[ \left( 1 + \frac{R}{100} \right)^2 - 1 - \frac{2R}{100} \right] = 96 \\ \Rightarrow & 15000 \left[ \frac{(100+R)^2 - 10000 - (200 \times R)}{10000} \right] = 96 \\ \Rightarrow & R^2 = \left( \frac{96 \times 2}{3} \right) = 64 \\ \Rightarrow & R = 8. \\ \therefore & \text{Rate} = 8\%. \end{aligned}$$

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15. The compound interest on a certain sum for 2 years at 10% per annum is Rs. 525. The simple interest on the same sum for double the time at half the rate percent per annum is:

A. Rs. 400

B. Rs. 500

C. Rs. 600

D. Rs. 800

### Answer & Explanation

**Answer:** Option B

**Explanation:**

Let the sum be Rs. P.

$$\begin{aligned} \text{Then, } & \left[ P \left( 1 + \frac{10}{100} \right)^2 - P \right] = 525 \\ \Rightarrow & P \left[ \left( \frac{11}{10} \right)^2 - 1 \right] = 525 \\ \Rightarrow & P = \left( \frac{525 \times 100}{21} \right) = 2500. \end{aligned}$$

$\therefore$  Sum = Rs. 2500.

So, S.I. = Rs.  $\left( \frac{2500 \times 5 \times 4}{100} \right)$  = Rs. 500

## Percentage

### Formulas

#### 1. Concept of Percentage:

By a certain **percent**, we mean that many hundredths.

Thus,  $x$  percent means  $x$  hundredths, written as  $x\%$ .

To express  $x\%$  as a fraction: We have,  $x\% = \frac{x}{100}$ .

$$\text{Thus, } 20\% = \frac{20}{100} = \frac{1}{5}.$$

To express  $\frac{a}{b}$  as a percent: We have,  $\frac{a}{b} = \left( \frac{a}{b} \times 100 \right)\%$ .

$$\text{Thus, } \frac{1}{4} = \left( \frac{1}{4} \times 100 \right)\% = 25\%.$$

#### 2. Percentage Increase/Decrease:

If the price of a commodity increases by  $R\%$ , then the reduction in consumption so as not to increase the expenditure is:

$$\left[ \frac{R}{(100 + R)} \times 100 \right]\%$$

If the price of a commodity decreases by  $R\%$ , then the increase in consumption so as not to decrease the expenditure is:

$$\left[ \frac{R}{(100 - R)} \times 100 \right]\%$$

#### 3. Results on Population:

Let the population of a town be  $P$  now and suppose it increases at the rate of  $R\%$  per annum, then:

$$1. \text{Population after } n \text{ years} = P \left( 1 + \frac{R}{100} \right)^n$$

$$2. \text{Population } n \text{ years ago} = \frac{P}{\left( 1 + \frac{R}{100} \right)^n}$$

#### 4. Results on Depreciation:

Let the present value of a machine be P. Suppose it depreciates at the rate of R% per annum. Then:

1. Value of the machine after  $n$  years =  $P \left(1 - \frac{R}{100}\right)^n$
2. Value of the machine  $n$  years ago =  $\frac{P}{\left(1 - \frac{R}{100}\right)^n}$
3. If A is R% more than B, then B is less than A by  $\left[ \frac{R}{(100 + R)} \times 100 \right] \%$ .
4. If A is R% less than B, then B is more than A by  $\left[ \frac{R}{(100 - R)} \times 100 \right] \%$ .

1. A batsman scored 110 runs which included 3 boundaries and 8 sixes. What percent of his total score did he make by running between the wickets?

- A.** 45%                                   **B.**  $45\frac{5}{11}\%$   
**C.**  $54\frac{6}{11}\%$                                    **D.** 55%

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$\text{Number of runs made by running} = 110 - (3 \times 4 + 8 \times 6)$$

$$= 110 - (60)$$

$$= 50.$$

$$\therefore \text{Required percentage} = \left( \frac{50}{110} \times 100 \right) \% = 45\frac{5}{11}\%$$

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2. Two students appeared at an examination. One of them secured 9 marks more than the other and his marks was 56% of the sum of their marks. The marks obtained by them are:

- A.** 39, 30                                   **B.** 41, 32  
**C.** 42, 33                                   **D.** 43, 34

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

Let their marks be  $(x + 9)$  and  $x$ .

$$\text{Then, } x + 9 = \frac{56}{100}(x + 9 + x)$$

$$\Rightarrow 25(x + 9) = 14(2x + 9)$$

$$\Rightarrow 3x = 99$$

$$\Rightarrow x = 33$$

So, their marks are 42 and 33.

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3. A fruit seller had some apples. He sells 40% apples and still has 420 apples. Originally, he had:

A. 588 apples

B. 600 apples

C. 672 apples

D. 700 apples

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Suppose originally he had  $x$  apples.

Then,  $(100 - 40)\%$  of  $x = 420$ .

$$\begin{aligned}\Rightarrow \frac{60}{100} \times x &= 420 \\ \Rightarrow x &= \left( \frac{420 \times 100}{60} \right) = 700.\end{aligned}$$

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- 
4. What percentage of numbers from 1 to 70 have 1 or 9 in the unit's digit?

A. 1

B. 14

C. 20

D. 21

### Answer & Explanation

**Answer:** Option C

#### Explanation:

Clearly, the numbers which have 1 or 9 in the unit's digit, have squares that end in the digit 1. Such numbers from 1 to 70 are 1, 9, 11, 19, 21, 29, 31, 39, 41, 49, 51, 59, 61, 69.

Number of such number = 14

$$\therefore \text{Required percentage} = \left( \frac{14}{70} \times 100 \right) \% = 20\%.$$

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- 
5. If  $A = x\%$  of  $y$  and  $B = y\%$  of  $x$ , then which of the following is true?

- A. A is smaller than B.      B. A is greater than B  
C. Relationship between A and B cannot be determined.      D. If  $x$  is smaller than  $y$ , then A is greater than B.  
E. None of these

### Answer & Explanation

**Answer:** Option E

#### Explanation:

$$x\% \text{ of } y = \left( \frac{x}{100} \times y \right) = \left( \frac{y}{100} \times x \right) = y\% \text{ of } x$$

$\therefore A = B$ .

6. If  $20\% \text{ of } a = b$ , then  $b\%$  of 20 is the same as:

- A. 4% of  $a$       B. 5% of  $a$   
C. 20% of  $a$       D. None of these

### Answer & Explanation

**Answer:** Option A

#### Explanation:

$$20\% \text{ of } a = b \Rightarrow \frac{20}{100}a = b.$$

$$\therefore b\% \text{ of } 20 = \left( \frac{b}{100} \times 20 \right) = \left( \frac{20a}{100} \times \frac{1}{20} \times 20 \right) = \frac{4}{100}a = 4\% \text{ of } a.$$

7. In a certain school, 20% of students are below 8 years of age. The number of students above  $\frac{2}{3}$  years of age is  $\frac{2}{3}$  of the number of students of 8 years of age which is 48. What is the total number of students in the school?
- A.** 72                      **B.** 80  
**C.** 120                      **D.** 150  
**E.** 100

**Answer & Explanation**

**Answer:** Option E

**Explanation:**

Let the number of students be  $x$ . Then,

Number of students above 8 years of age =  $(100 - 20)\%$  of  $x = 80\%$  of  $x$ .

$$\begin{aligned} \therefore 80\% \text{ of } x &= 48 + \frac{2}{3} \text{ of } 48 \\ \Rightarrow \frac{80}{100}x &= 80 \\ \Rightarrow x &= 100. \end{aligned}$$

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8. Two numbers A and B are such that the sum of 5% of A and 4% of B is two-third of the sum of 6% of A and 8% of B. Find the ratio of A : B.
- A.** 2 : 3                      **B.** 1 : 1  
**C.** 3 : 4                      **D.** 4 : 3

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\begin{aligned} 5\% \text{ of } A + 4\% \text{ of } B &= \frac{2}{3} (6\% \text{ of } A + 8\% \text{ of } B) \\ \Rightarrow \underline{5} \text{ A} + \underline{4} \text{ B} &= \underline{2} (\underline{6} \text{ A} + \underline{8} \text{ B}) \end{aligned}$$

$$\begin{aligned}
 & \Rightarrow \frac{1}{20} A + \frac{1}{25} B = \frac{1}{25} A + \frac{4}{75} B \\
 & \Rightarrow \left( \frac{1}{20} - \frac{1}{25} \right) A = \left( \frac{4}{75} - \frac{1}{25} \right) B \\
 & \Rightarrow \frac{1}{100} A = \frac{1}{75} B \\
 & \frac{A}{B} = \frac{100}{75} = \frac{4}{3}.
 \end{aligned}$$

$\therefore$  Required ratio = 4 : 3

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9. A student multiplied a number by  $\frac{3}{5}$  instead of  $\frac{5}{3}$ .

What is the percentage error in the calculation?

- |               |               |
|---------------|---------------|
| <b>A.</b> 34% | <b>B.</b> 44% |
| <b>C.</b> 54% | <b>D.</b> 64% |

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

Let the number be  $x$ .

$$\text{Then, error} = \frac{5}{3}x - \frac{3}{5}x = \frac{16}{15}x.$$

$$\text{Error\%} = \left( \frac{16x}{15} \times \frac{3}{5x} \times 100 \right)\% = 64\%.$$

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10. In an election between two candidates, one got 55% of the total valid votes, 20% of the votes were invalid. If the total number of votes was 7500, the number of valid votes that the other candidate got, was:

- |                |                |
|----------------|----------------|
| <b>A.</b> 2700 | <b>B.</b> 2900 |
| <b>C.</b> 3000 | <b>D.</b> 3100 |

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Number of valid votes = 80% of 7500 = 6000.

$\therefore$  Valid votes polled by other candidate = 45% of 6000

$$= \left( \frac{45}{100} \times 6000 \right) = 2700.$$

11. Three candidates contested an election and received 1136, 7636 and 11628 votes respectively. What percentage of the total votes did the winning candidate get?

A. 57%

B. 60%

C. 65%

D. 90%

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Total number of votes polled =  $(1136 + 7636 + 11628) = 20400$ .

$\therefore$  Required percentage =  $\left( \frac{11628}{20400} \times 100 \right)\% = 57\%$ .

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12. Two tailors X and Y are paid a total of Rs. 550 per week by their employer. If X is paid 120 percent of the sum paid to Y, how much is Y paid per week?

A. Rs. 200

B. Rs. 250

C. Rs. 300

D. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the sum paid to Y per week be Rs. z.

Then,  $z + 120\%$  of  $z = 550$ .

$$\Rightarrow z + \frac{120}{100}z = 550$$

$$\Rightarrow \frac{11}{5}z = 550$$

$$\Rightarrow z = \left( \frac{550 \times 5}{11} \right) = 250.$$

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13. Gauri went to the stationers and bought things worth Rs. 25, out of which 30 paise went on sales tax on taxable purchases. If the tax rate was 6%, then what was the cost of the tax free items?

- A. Rs. 15      B. Rs. 15.70  
 C. Rs. 19.70      D. Rs. 20

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Let the amount taxable purchases be Rs.  $x$ .

$$\text{Then, } 6\% \text{ of } x = \frac{30}{100}$$

$$\Rightarrow x = \left( \frac{30}{100} \times \frac{100}{6} \right) = 5.$$

$\therefore$  Cost of tax free items = Rs.  $[25 - (5 + 0.30)]$  = Rs. 19.70

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14. Rajeev buys good worth Rs. 6650. He gets a rebate of 6% on it. After getting the rebate, he pays sales tax @ 10%. Find the amount he will have to pay for the goods.

- A. Rs. 6876.10      B. Rs. 6999.20  
 C. Rs. 6654      D. Rs. 7000

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$\text{Rebate} = 6\% \text{ of Rs. } 6650 = \text{Rs. } \left( \frac{6}{100} \times 6650 \right) = \text{Rs. } 399.$$

$$\text{Sales tax} = 10\% \text{ of Rs. } (6650 - 399) = \text{Rs. } \left( \frac{10}{100} \times 6251 \right) = \text{Rs. } 625.10$$

- ∴ Final amount = Rs.  $(6251 + 625.10)$  = Rs. 6876.10

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15. The population of a town increased from 1,75,000 to 2,62,500 in a decade. The average percent increase of population per year is:

- A.** 4.37%      **B.** 5%  
**C.** 6%      **D.** 8.75%

## Answer & Explanation

**Answer:** Option B

### **Explanation:**

Increase in 10 years = (262500 - 175000) = 87500.

$$\text{Increase\%} = \left( \frac{87500}{175000} \times 100 \right)\% = 50\%.$$

$$\therefore \text{Required average} = \left( \frac{50}{10} \right) \% = 5\%$$

## Clock

## Formulas

## 1. Minute Spaces:

The face or dial of watch is a circle whose circumference is divided into 60 equal parts, called minute spaces.

## Hour Hand and Minute Hand

A clock has two hands, the smaller one is called the **hour hand** or **short hand** while the larger one is called **minute hand** or **long hand**.

2.

- i. In 60 minutes, the minute hand gains 55 minutes on the hour hand.
  - ii. In every hour, both the hands coincide once.
  - iii. The hands are in the same straight line when they are coincident or opposite to each other.
  - iv. When the two hands are at right angles, they are 15 minute spaces apart.
  - v. When the hands are in opposite directions, they are 30 minute spaces apart.
  - vi. Angle traced by hour hand in 12 hrs =  $360^\circ$

- vii. Angle traced by minute hand in 60 min. =  $360^\circ$ .  
viii. If a watch or a clock indicates 8.15, when the correct time is 8, it is said to be 15 minutes **too fast**.

On the other hand, if it indicates 7.45, when the correct time is 8, it is said to be 15 minutes **too slow**.

1. An accurate clock shows 8 o'clock in the morning. Through how many degrees will the hour hand rotate when the clock shows 2 o'clock in the afternoon?

- A.**  $144^\circ$       **B.**  $150^\circ$   
**C.**  $168^\circ$       **D.**  $180^\circ$

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

$$\text{Angle traced by the hour hand in 6 hours} = \left( \frac{360}{12} \times 6 \right)^\circ = 180^\circ.$$

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2. The reflex angle between the hands of a clock at 10.25 is:

- A.**  $180^\circ$       **B.**  $192\frac{1}{2}^\circ$   
**C.**  $195^\circ$       **D.**  $197\frac{1}{2}^\circ$

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

$$\text{Angle traced by hour hand in } \frac{125}{12} \text{ hrs} = \left( \frac{360}{12} \times \frac{125}{12} \right)^\circ = 312\frac{1}{2}^\circ.$$

$$\text{Angle traced by minute hand in 25 min} = \left( \frac{360}{60} \times 25 \right)^\circ = 150^\circ.$$

$$\therefore \text{Reflex angle} = 360^\circ - \left( 312\frac{1}{2}^\circ - 150^\circ \right)^\circ = 360^\circ - 162\frac{1}{2}^\circ = 197\frac{1}{2}^\circ.$$

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3. A clock is started at noon. By 10 minutes past 5, the hour hand has turned through:

- A.**  $145^\circ$       **B.**  $150^\circ$

C.  $155^\circ$

D.  $160^\circ$

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Angle traced by hour hand in 12 hrs =  $360^\circ$ .

Angle traced by hour hand in 5 hrs 10 min. i.e.,  $\frac{31}{6}$  hrs =  $\left(\frac{360}{12} \times \frac{31}{6}\right)^\circ = 155^\circ$ .

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4. A watch which gains 5 seconds in 3 minutes was set right at 7 a.m. In the afternoon of the same day, when the watch indicated quarter past 4 o'clock, the true time is:

A.  $59\frac{7}{12}$  min. past 3

B. 4 p.m.

C.  $58\frac{7}{11}$  min. past 3

D.  $2\frac{3}{11}$  min. past 4

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Time from 7 a.m. to 4.15 p.m. = 9 hrs 15 min. =  $\frac{37}{4}$  hrs.

3 min. 5 sec. of this clock = 3 min. of the correct clock.

$\Rightarrow \frac{37}{720}$  hrs of this clock =  $\frac{1}{20}$  hrs of the correct clock.

$\Rightarrow \frac{37}{4}$  hrs of this clock =  $\left(\frac{1}{20} \times \frac{720}{37} \times \frac{37}{4}\right)$  hrs of the correct clock.

= 9 hrs of the correct clock.

$\therefore$  The correct time is 9 hrs after 7 a.m. i.e., 4 p.m.

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- 
5. How much does a watch lose per day, if its hands coincide every 64 minutes?

A.  $32\frac{8}{11}$  min.

B.  $36\frac{5}{11}$  min.

C. 90 min.

D. 96 min.

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

55 min. spaces are covered in 60 min.

$$\text{60 min. spaces are covered in } \left( \frac{60}{55} \times 60 \right) \text{ min.} = 65\frac{5}{11} \text{ min.}$$
$$\text{Loss in 64 min.} = \left( 65\frac{5}{11} - 64 \right) = \frac{16}{11} \text{ min.}$$
$$\text{Loss in 24 hrs} = \left( \frac{16}{11} \times \frac{1}{64} \times 24 \times 60 \right) \text{ min.} = 32\frac{8}{11} \text{ min.}$$

6. At what time between 7 and 8 o'clock will the hands of a clock be in the same straight line but, not together?

A. 5 min. past 7

B.  $5\frac{2}{11}$  min. past 7

C.  $5\frac{3}{11}$  min. past 7

D.  $5\frac{5}{11}$  min. past 7

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

When the hands of the clock are in the same straight line but not together, they are 30 minute spaces apart.

At 7 o'clock, they are 25 min. spaces apart.

∴ Minute hand will have to gain only 5 min. spaces.

55 min. spaces are gained in 60 min.

$$\text{5 min. spaces are gained in } \left( \frac{60}{55} \times 5 \right) \text{ min.} = 5\frac{5}{11} \text{ min.}$$

∴ Required time =  $5\frac{5}{11}$  min. past 7.

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7. At what time between 5.30 and 6 will the hands of a clock be at right angles?

A.  $43\frac{5}{11}$  min. past 5

B.  $43\frac{7}{11}$  min. past 5

C. 40 min. past 5

D. 45 min. past 5

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

At 5 o'clock, the hands are 25 min. spaces apart.

To be at right angles and that too between 5.30 and 6, the minute hand has to gain  $(25 + 15) = 40$  min. spaces.

55 min. spaces are gained in 60 min.

$$40 \text{ min. spaces are gained in } \left( \frac{60}{55} \times 40 \right)_{\text{min}} = 43\frac{7}{11} \text{ min.}$$

$$\therefore \text{Required time} = 43\frac{7}{11} \text{ min. past 5.}$$

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- 
8. The angle between the minute hand and the hour hand of a clock when the time is 4.20, is:

A.  $0^\circ$

B.  $10^\circ$

C.  $5^\circ$

D.  $20^\circ$

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Angle traced by hour hand in } \frac{13}{3} \text{ hrs} = \left( \frac{360}{12} \times \frac{13}{3} \right)^\circ = 130^\circ.$$

$$\text{Angle traced by min. hand in 20 min.} = \left( \frac{360}{60} \times 20 \right)^\circ = 120^\circ.$$

$$\therefore \text{Required angle} = (130 - 120)^\circ = 10^\circ.$$

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- 
9. At what angle the hands of a clock are inclined at 15 minutes past 5?

A.  $58 \frac{1}{2}^\circ$

B.  $64^\circ$

C.  $67 \frac{1}{2}^\circ$

D.  $72 \frac{1}{2}^\circ$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\text{Angle traced by hour hand in } \frac{21}{4} \text{ hrs} = \left( \frac{360}{12} \times \frac{21}{4} \right)^\circ = 157 \frac{1}{2}^\circ$$

$$\text{Angle traced by min. hand in 15 min.} = \left( \frac{360}{60} \times 15 \right)^\circ = 90^\circ.$$

$$\therefore \text{Required angle} = \left( 157 \frac{1}{2} \right)^\circ - 90^\circ = 67 \frac{1}{2}^\circ$$

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- 
10. At 3:40, the hour hand and the minute hand of a clock form an angle of:

A.  $120^\circ$

B.  $125^\circ$

C.  $130^\circ$

D.  $135^\circ$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Angle traced by hour hand in 12 hrs. =  $360^\circ$ .

$$\text{Angle traced by it in } \frac{11}{3} \text{ hrs} = \left( \frac{360}{12} \times \frac{11}{3} \right)^\circ = 110^\circ.$$

Angle traced by minute hand in 60 min. =  $360^\circ$ .

$$\text{Angle traced by it in 40 min.} = \left( \frac{360}{60} \times 40 \right)^\circ = 240^\circ.$$

$\therefore$  Required angle  $(240 - 110)^\circ = 130^\circ$ .

1. How many times are the hands of a clock at right angle in a day?

A. 22

B. 24

C. 44

D. 48

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

In 12 hours, they are at right angles 22 times.

∴ In 24 hours, they are at right angles 44 times.

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12. The angle between the minute hand and the hour hand of a clock when the time is 8.30, is:

A.  $80^\circ$

B.  $75^\circ$

C.  $60^\circ$

D.  $105^\circ$

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Angle traced by hour hand in  $\frac{17}{2}$  hrs =  $\left( \frac{360}{12} \times \frac{17}{2} \right)^\circ = 255.$

Angle traced by min. hand in 30 min. =  $\left( \frac{360}{60} \times 30 \right)^\circ = 180.$

∴ Required angle =  $(255 - 180)^\circ = 75^\circ.$

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13. How many times in a day, are the hands of a clock in straight line but opposite in direction?

A. 20

B. 22

C. 24

D. 48

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

The hands of a clock point in opposite directions (in the same straight line) 11 times in every 12 hours. (Because between 5 and 7 they point in opposite directions at 6 o'clock only).

So, in a day, the hands point in the opposite directions 22 times.

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14. At what time between 4 and 5 o'clock will the hands of a watch point in opposite directions?

A. 45 min. past 4

B. 40 min. past 4

C.  $50\frac{4}{11}$  min. past 4

D.  $54\frac{6}{11}$  min. past 4

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

At 4 o'clock, the hands of the watch are 20 min. spaces apart.

To be in opposite directions, they must be 30 min. spaces apart.

∴ Minute hand will have to gain 50 min. spaces.

55 min. spaces are gained in 60 min.

50 min. spaces are gained in  $\left(\frac{60}{55} \times 50\right)$  min. or  $54\frac{6}{11}$  min.

∴ Required time =  $54\frac{6}{11}$  min. past 4.

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15. At what time between 9 and 10 o'clock will the hands of a watch be together?

A. 45 min. past 9

B. 50 min. past 9

C.  $49\frac{1}{11}$  min. past 9

D.  $48\frac{2}{11}$  min. past 9

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

To be together between 9 and 10 o'clock, the minute hand has to gain 45 min. spaces.

55 min. spaces gained in 60 min.

45 min. spaces are gained in  $\left(\frac{60}{55} \times 45\right)$  min.

- $\frac{55}{11}$        $\frac{11}{11}$
- ∴ The hands are together at  $49\frac{1}{11}$  min. past 9.
16. At what time, in minutes, between 3 o'clock and 4 o'clock, both the needles will coincide each other?
- A.  $5\frac{1}{11}$ "      B.  $12\frac{4}{11}$ "
- C.  $13\frac{4}{11}$ "      D.  $16\frac{4}{11}$ "

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

At 3 o'clock, the minute hand is 15 min. spaces apart from the hour hand.

To be coincident, it must gain 15 min. spaces.

55 min. are gained in 60 min.

$$15 \text{ min. are gained in } \left( \frac{60}{55} \times 15 \right)_{\text{min}} = 16\frac{4}{11} \text{ min.}$$

∴ The hands are coincident at  $16\frac{4}{11}$  min. past 3.

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- 
17. How many times do the hands of a clock coincide in a day?

- A. 20      B. 21
- C. 22      D. 24

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

The hands of a clock coincide 11 times in every 12 hours (Since between 11 and 1, they coincide only once, i.e., at 12 o'clock).

**AM**

12:00  
1:05  
2:11

3:16  
4:22  
5:27  
6:33  
7:38  
8:44  
9:49  
10:55

**PM**

12:00  
1:05  
2:11  
3:16  
4:22  
5:27  
6:33  
7:38  
8:44  
9:49  
10:55

The hands overlap about every 65 minutes, not every 60 minutes.

- ∴ The hands coincide 22 times in a day.

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18. How many times in a day, the hands of a clock are straight?

- |              |              |
|--------------|--------------|
| <b>A.</b> 22 | <b>B.</b> 24 |
| <b>C.</b> 44 | <b>D.</b> 48 |

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

In 12 hours, the hands coincide or are in opposite direction 22 times.

- ∴ In 24 hours, the hands coincide or are in opposite direction 44 times a day.

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19. A watch which gains uniformly is 2 minutes low at noon on Monday and is 4 min. 48 sec fast at 2 p.m. on the following Monday. When was it correct?

- A. 2 p.m. on Tuesday      B. 2 p.m. on Wednesday  
 C. 3 p.m. on Thursday      D. 1 p.m. on Friday

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Time from 12 p.m. on Monday to 2 p.m. on the following Monday = 7 days 2 hours = 170 hours.

∴ The watch gains  $\left(2 + 4\frac{4}{5}\right)$  min. or  $\frac{34}{5}$  min. in 170 hrs.

Now,  $\frac{34}{5}$  min. are gained in 170 hrs.

∴ 2 min. are gained in  $\left(170 \times \frac{5}{34} \times 2\right)$  hrs = 50 hrs.

∴ Watch is correct 2 days 2 hrs. after 12 p.m. on Monday i.e., it will be correct at 2 p.m. on Wednesday.

## Volume and Surface Area

### Formulas

#### 1. CUBOID

Let length =  $l$ , breadth =  $b$  and height =  $h$  units. Then

- i. **Volume** =  $(l \times b \times h)$  cubic units.
- ii. **Surface area** =  $2(lb + bh + lh)$  sq. units.
- iii. **Diagonal** =  $\sqrt{l^2 + b^2 + h^2}$  units.

#### 2. CUBE

Let each edge of a cube be of length  $a$ . Then,

- i. **Volume** =  $a^3$  cubic units.
- ii. **Surface area** =  $6a^2$  sq. units.
- iii. **Diagonal** =  $3a$  units.

#### 3. CYLINDER

Let radius of base =  $r$  and Height (or length) =  $h$ . Then,

- i. **Volume** =  $(\pi r^2 h)$  cubic units.

- ii. **Curved surface area** =  $(2\pi rh)$  sq. units.
- iii. **Total surface area** =  $2\pi r(h + r)$  sq. units.

#### 4. CONE

Let radius of base =  $r$  and Height =  $h$ . Then,

- i. **Slant height,  $l$** ,  $l = \sqrt{h^2 + r^2}$  units.
- ii. **Volume** =  $\left(\frac{1}{3}\pi r^2 h\right)$  cubic units.
- iii. **Curved surface area** =  $(\pi rl)$  sq. units.
- iv. **Total surface area** =  $(\pi rl + \pi r^2)$  sq. units.

#### 5. SPHERE

Let the radius of the sphere be  $r$ . Then,

- i. **Volume** =  $\left(\frac{4}{3}\pi r^3\right)$  cubic units.
- ii. **Surface area** =  $(4\pi r^2)$  sq. units.

#### 6. HEMISPHERE

Let the radius of a hemisphere be  $r$ . Then,

- i. **Volume** =  $\left(\frac{2}{3}\pi r^3\right)$  cubic units.
- ii. **Curved surface area** =  $(2\pi r^2)$  sq. units.
- iii. **Total surface area** =  $(3\pi r^2)$  sq. units.

Note: 1 litre = 1000 cm<sup>3</sup>.

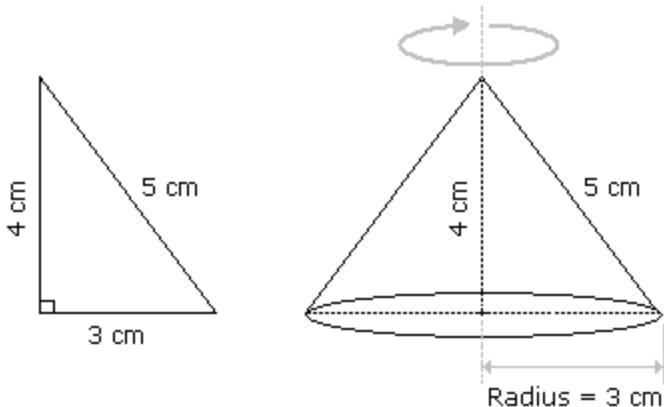
1. A right triangle with sides 3 cm, 4 cm and 5 cm is rotated the side of 3 cm to form a cone. The volume of the cone so formed is:

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| <b>A.</b> $12\pi$ cm <sup>3</sup> | <b>B.</b> $15\pi$ cm <sup>3</sup> |
| <b>C.</b> $16\pi$ cm <sup>3</sup> | <b>D.</b> $20\pi$ cm <sup>3</sup> |

#### Answer & Explanation

**Answer:** Option A

**Explanation:**



Clearly, we have  $r = 3 \text{ cm}$  and  $h = 4 \text{ cm}$ .

$$\therefore \text{Volume} = \frac{1}{3}\pi r^2 h = \left( \frac{1}{3} \times \pi \times 3^2 \times 4 \right) \text{cm}^3 = 12\pi \text{ cm}^3.$$

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2. In a shower, 5 cm of rain falls. The volume of water that falls on 1.5 hectares of ground is:

- |  |  |
|--|--|
| <b>A.</b> 75 cu. m<br><br><b>C.</b> 7500 cu. m | <b>B.</b> 750 cu. m<br><br><b>D.</b> 75000 cu. m |
|--|--|

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$1 \text{ hectare} = 10,000 \text{ m}^2$$

$$\text{So, Area} = (1.5 \times 10000) \text{ m}^2 = 15000 \text{ m}^2.$$

$$\text{Depth} = \frac{5}{100} \text{m} = \frac{1}{20} \text{m}.$$

$$\therefore \text{Volume} = (\text{Area} \times \text{Depth}) = \left( 15000 \times \frac{1}{20} \right) \text{m}^3 = 750 \text{ m}^3.$$

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3. A hall is 15 m long and 12 m broad. If the sum of the areas of the floor and the ceiling is equal to the sum of the areas of four walls, the volume of the hall is:

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| <b>A.</b> 720<br><br><b>C.</b> 1200 | <b>B.</b> 900<br><br><b>D.</b> 1800 |
|-------------------------------------|-------------------------------------|

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

$$2(15 + 12) \times h = 2(15 \times 12)$$

$$\Rightarrow h = \frac{180}{27} \text{ m} = \frac{20}{3} \text{ m.}$$

$$\therefore \text{Volume} = \left( 15 \times 12 \times \frac{20}{3} \right) \text{m}^3 = 1200 \text{ m}^3.$$

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- 
4. 66 cubic centimetres of silver is drawn into a wire 1 mm in diameter. The length of the wire in metres will be:

A. 84

B. 90

C. 168

D. 336

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

Let the length of the wire be  $h$ .

$$\text{Radius} = \frac{1}{2} \text{ mm} = \frac{1}{20} \text{ cm. Then,}$$

$$\Rightarrow \frac{22}{7} \times \frac{1}{20} \times \frac{1}{20} \times h = 66.$$

$$\Rightarrow h = \left( \frac{66 \times 20 \times 20 \times 7}{22} \right) = 8400 \text{ cm} = 84 \text{ m.}$$

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- 
5. A hollow iron pipe is 21 cm long and its external diameter is 8 cm. If the thickness of the pipe is 1 cm and iron weighs 8 g/cm<sup>3</sup>, then the weight of the pipe is:

A. 3.6 kg

B. 3.696 kg

C. 36 kg

D. 36.9 kg

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

External radius = 4 cm,

Internal radius = 3 cm.

$$\begin{aligned}\text{Volume of iron} &= \left( \frac{22}{7} \times [(4)^2 - (3)^2] \times 21 \right) \text{cm}^3 \\ &= \left( \frac{22}{7} \times 7 \times 1 \times 21 \right) \text{cm}^3 \\ &= 462 \text{ cm}^3.\end{aligned}$$

∴ Weight of iron =  $(462 \times 8)$  gm = 3696 gm = 3.696 kg.

6. A boat having a length 3 m and breadth 2 m is floating on a lake. The boat sinks by 1 cm when a man gets on it. The mass of the man is:

A. 12 kg

B. 60 kg

C. 72 kg

D. 96 kg

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\begin{aligned}\text{Volume of water displaced} &= (3 \times 2 \times 0.01) \text{ m}^3 \\ &= 0.06 \text{ m}^3.\end{aligned}$$

$$\begin{aligned}\therefore \text{Mass of man} &= \text{Volume of water displaced} \times \text{Density of water} \\ &= (0.06 \times 1000) \text{ kg} \\ &= 60 \text{ kg}.\end{aligned}$$

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- 
7. 50 men took a dip in a water tank 40 m long and 20 m broad on a religious day. If the average displacement of water by a man is  $4 \text{ m}^3$ , then the rise in the water level in the tank will be:

A. 20 cm

B. 25 cm

C. 35 cm

D. 50 cm

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Total volume of water displaced =  $(4 \times 50) \text{ m}^3 = 200 \text{ m}^3$ .

$$\therefore \text{Rise in water level} = \left( \frac{200}{40 \times 20} \right) \text{m} = 0.25 \text{ m} = 25 \text{ cm.}$$

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- 
8. The slant height of a right circular cone is 10 m and its height is 8 m. Find the area of its curved surface.

A.  $30\pi \text{ m}^2$

B.  $40\pi \text{ m}^2$

C.  $60\pi \text{ m}^2$

D.  $80\pi \text{ m}^2$

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$l = 10 \text{ m,}$

$h = 8 \text{ m.}$

So,  $r = l^2 - h^2 = (10)^2 - 8^2 = 6 \text{ m.}$

$$\therefore \text{Curved surface area} = \pi r l = (\pi \times 6 \times 10) \text{ m}^2 = 60\pi \text{ m}^2.$$

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- 
9. A cistern 6m long and 4 m wide contains water up to a depth of 1 m 25 cm. The total area of the wet surface is:

A.  $49 \text{ m}^2$

B.  $50 \text{ m}^2$

C.  $53.5 \text{ m}^2$

D.  $55 \text{ m}^2$

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\begin{aligned}
 \text{Area of the wet surface} &= [2(lb + bh + lh) - lb] \\
 &= 2(bh + lh) + lb \\
 &= [2(4 \times 1.25 + 6 \times 1.25) + 6 \times 4] \text{ m}^2 \\
 &= 49 \text{ m}^2.
 \end{aligned}$$

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10. A metallic sheet is of rectangular shape with dimensions 48 m x 36 m. From each of its corners, a square is cut off so as to make an open box. If the length of the square is 8 m, the volume of the box (in  $\text{m}^3$ ) is:

- |                |                |
|----------------|----------------|
| <b>A.</b> 4830 | <b>B.</b> 5120 |
| <b>C.</b> 6420 | <b>D.</b> 8960 |

#### [Answer & Explanation](#)

**Answer:** Option **B**

#### **Explanation:**

Clearly,  $l = (48 - 16)\text{m} = 32 \text{ m}$ ,

$b = (36 - 16)\text{m} = 20 \text{ m}$ ,

$h = 8 \text{ m}$ .

$\therefore$  Volume of the box  $= (32 \times 20 \times 8) \text{ m}^3 = 5120 \text{ m}^3$ .

11. The curved surface area of a cylindrical pillar is  $264 \text{ m}^2$  and its volume is  $924 \text{ m}^3$ . Find the ratio of its diameter to its height.

- |                 |                 |
|-----------------|-----------------|
| <b>A.</b> 3 : 7 | <b>B.</b> 7 : 3 |
| <b>C.</b> 6 : 7 | <b>D.</b> 7 : 6 |

#### [Answer & Explanation](#)

**Answer:** Option **B**

#### **Explanation:**

$$\frac{\pi r^2 h}{2\pi rh} = \frac{924}{264} \Rightarrow r = \left( \frac{924}{264} \times 2 \right) = 7 \text{ m.}$$

$$\text{And, } 2\pi rh = 264 \Rightarrow h = \left( 264 \times \frac{7}{22} \times \frac{1}{2} \times \frac{1}{7} \right) = 6 \text{ m.}$$

$$\therefore \text{Required ratio} = \frac{2r}{h} = \frac{14}{6} = 7 : 3.$$

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- 
12. A cistern of capacity 8000 litres measures externally 3.3 m by 2.6 m by 1.1 m and its walls are 5 cm thick. The thickness of the bottom is:

A. 90 cm

B. 1 dm

C. 1 m

D. 1.1 cm

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the thickness of the bottom be  $x$  cm.

$$\text{Then, } [(330 - 10) \times (260 - 10) \times (110 - x)] = 8000 \times 1000$$

$$\Rightarrow 320 \times 250 \times (110 - x) = 8000 \times 1000$$

$$\Rightarrow (110 - x) = \frac{8000 \times 1000}{320 \times 250} = 100$$

$$\Rightarrow x = 10 \text{ cm} = 1 \text{ dm.}$$

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- 
13. What is the total surface area of a right circular cone of height 14 cm and base radius 7 cm?

A. 344.35  $\text{cm}^2$

B. 462  $\text{cm}^2$

C. 498.35  $\text{cm}^2$

D. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$h = 14 \text{ cm}, r = 7 \text{ cm.}$$

$$\text{So, } l = (7)^2 + (14)^2 = 245 = 75 \text{ cm.}$$

$$\therefore \text{Total surface area} = \pi r l + \pi r^2$$

$$= \left( \frac{22}{7} \times 7 \times 75 + \frac{22}{7} \times 7 \times 7 \right) \text{cm}^2$$

$$\begin{aligned}
 &= [154(5 + 1)] \text{ cm}^2 \\
 &= (154 \times 3.236) \text{ cm}^2 \\
 &= 498.35 \text{ cm}^2.
 \end{aligned}$$

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14. A large cube is formed from the material obtained by melting three smaller cubes of 3, 4 and 5 cm side. What is the ratio of the total surface areas of the smaller cubes and the large cube?

- |                   |                   |
|-------------------|-------------------|
| <b>A.</b> 2 : 1   | <b>B.</b> 3 : 2   |
| <b>C.</b> 25 : 18 | <b>D.</b> 27 : 20 |

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Volume of the large cube =  $(3^3 + 4^3 + 5^3) = 216 \text{ cm}^3$ .

Let the edge of the large cube be  $a$ .

So,  $a^3 = 216 \Rightarrow a = 6 \text{ cm}$ .

$$\therefore \text{Required ratio} = \left( \frac{6 \times (3^2 + 4^2 + 5^2)}{6 \times 6^2} \right) = \frac{50}{36} = 25 : 18.$$

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15. How many bricks, each measuring 25 cm x 11.25 cm x 6 cm, will be needed to build a wall of 8 m x 6 m x 22.5 cm?

- |                |                |
|----------------|----------------|
| <b>A.</b> 5600 | <b>B.</b> 6000 |
| <b>C.</b> 6400 | <b>D.</b> 7200 |

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\text{Number of bricks} = \frac{\text{Volume of the wall}}{\text{Volume of 1 brick}} = \left( \frac{800 \times 600 \times 22.5}{25 \times 11.25 \times 6} \right) = 6400.$$

## Problems on Numbers

### Formulas

#### Some Basic Formulae:

- i.  $(a + b)(a - b) = (a^2 - b^2)$
- ii.  $(a + b)^2 = (a^2 + b^2 + 2ab)$
- iii.  $(a - b)^2 = (a^2 + b^2 - 2ab)$
- iv.  $(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$
- v.  $(a^3 + b^3) = (a + b)(a^2 - ab + b^2)$
- vi.  $(a^3 - b^3) = (a - b)(a^2 + ab + b^2)$
- vii.  $(a^3 + b^3 + c^3 - 3abc) = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ac)$
- viii. When  $a + b + c = 0$ , then  $a^3 + b^3 + c^3 = 3abc$ .

1. If one-third of one-fourth of a number is 15, then three-tenth of that number is:

A. 35

B. 36

C. 45

D. 54

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let the number be  $x$ .

Then,  $\frac{1}{3}$  of  $\frac{1}{4}$  of  $x = 15 \Leftrightarrow x = 15 \times 12 = 180$ .

So, required number =  $\left(\frac{3}{10} \times 180\right) = 54$ .

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- ix.
2. Three times the first of three consecutive odd integers is 3 more than twice the third. The third integer is:

A. 9

B. 11

C. 13

D. 15

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let the three integers be  $x$ ,  $x + 2$  and  $x + 4$ .

Then,  $3x = 2(x + 4) + 3 \Leftrightarrow x = 11$ .

$\therefore$  Third integer =  $x + 4 = 15$ .

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- x.
- 
3. The difference between a two-digit number and the number obtained by interchanging the positions of its digits is 36. What is the difference between the two digits of that number?

A. 3

B. 4

C. 9

D. Cannot be determined

E. None of these

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let the ten's digit be  $x$  and unit's digit be  $y$ .

Then,  $(10x + y) - (10y + x) = 36$

$$\Rightarrow 9(x - y) = 36$$

$$\Rightarrow x - y = 4.$$

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- xi.
- 
4. The difference between a two-digit number and the number obtained by interchanging the digits is 36. What is the difference between the sum and the difference of the digits of the number if the ratio between the digits of the number is 1 : 2 ?

A. 4

B. 8

C. 16

D. None of these

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Since the number is greater than the number obtained on reversing the digits, so the ten's digit is

greater than the unit's digit.

Let ten's and unit's digits be  $2x$  and  $x$  respectively.

$$\text{Then, } (10 \times 2x + x) - (10x + 2x) = 36$$

$$\Rightarrow 9x = 36$$

$$\Rightarrow x = 4.$$

$$\therefore \text{Required difference} = (2x + x) - (2x - x) = 2x = 8.$$

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xii.

5. A two-digit number is such that the product of the digits is 8. When 18 is added to the number, then the digits are reversed. The number is:

A. 18

B. 24

C. 42

D. 81

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let the ten's and unit digit be  $x$  and  $\frac{8}{x}$  respectively.

$$\text{Then, } \left( 10x + \frac{8}{x} \right) + 18 = 10 \times \frac{8}{x} + x$$

$$\Rightarrow 10x^2 + 8 + 18x = 80 + x^2$$

$$\Rightarrow 9x^2 + 18x - 72 = 0$$

$$\Rightarrow x^2 + 2x - 8 = 0$$

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

$$\Rightarrow x = 2.$$

6. The sum of the digits of a two-digit number is 15 and the difference between the digits is 3. What is the two-digit number?

A. 69

B. 78

C. 96

D. Cannot be determined

- E. None of these

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let the ten's digit be  $x$  and unit's digit be  $y$ .

Then,  $x + y = 15$  and  $x - y = 3$  or  $y - x = 3$ .

Solving  $x + y = 15$  and  $x - y = 3$ , we get:  $x = 9, y = 6$ .

Solving  $x + y = 15$  and  $y - x = 3$ , we get:  $x = 6, y = 9$ .

So, the number is either 96 or 69.

Hence, the number cannot be determined.

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- 
7. The sum of the squares of three numbers is 138, while the sum of their products taken two at a time is 131. Their sum is:

A. 20

B. 30

C. 40

D. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let the numbers be  $a, b$  and  $c$ .

Then,  $a^2 + b^2 + c^2 = 138$  and  $(ab + bc + ca) = 131$ .

$(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca) = 138 + 2 \times 131 = 400$ .

$\Rightarrow (a + b + c) = 400 = 20$ .

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- 
8. A number consists of two digits. If the digits interchange places and the new number is added to the original number, then the resulting number will be divisible by:

A. 3

B. 5

C. 9

D. 11

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let the ten's digit be  $x$  and unit's digit be  $y$ .

Then, number =  $10x + y$ .

Number obtained by interchanging the digits =  $10y + x$ .

$$\therefore (10x + y) + (10y + x) = 11(x + y), \text{ which is divisible by 11.}$$

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- 
9. In a two-digit, if it is known that its unit's digit exceeds its ten's digit by 2 and that the product of the given number and the sum of its digits is equal to 144, then the number is:

A. 24

B. 26

C. 42

D. 46

#### Answer & Explanation

**Answer:** Option A

#### Explanation:

Let the ten's digit be  $x$ .

Then, unit's digit =  $x + 2$ .

$$\text{Number} = 10x + (x + 2) = 11x + 2.$$

$$\text{Sum of digits} = x + (x + 2) = 2x + 2.$$

$$\therefore (11x + 2)(2x + 2) = 144$$

$$\Rightarrow 22x^2 + 26x - 140 = 0$$

$$\Rightarrow 11x^2 + 13x - 70 = 0$$

$$\Rightarrow (x - 2)(11x + 35) = 0$$

$$\Rightarrow x = 2.$$

Hence, required number =  $11x + 2 = 24$ .

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- 
10. Find a positive number which when increased by 17 is equal to 60 times the reciprocal of the number.

A. 3

B. 10

C. 17

D. 20

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let the number be  $x$ .

$$\text{Then, } x + 17 = \frac{60}{x}$$

$$\Rightarrow x^2 + 17x - 60 = 0$$

$$\Rightarrow (x + 20)(x - 3) = 0$$

$$\Rightarrow x = 3.$$

11. The product of two numbers is 9375 and the quotient, when the larger one is divided by the smaller, is 15. The sum of the numbers is:

A. 380

B. 395

C. 400

D. 425

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the numbers be  $x$  and  $y$ .

$$\text{Then, } xy = 9375 \text{ and } \frac{x}{y} = 15.$$

$$\underline{xy} = \underline{9375}$$

$$(x/y) = 15$$

$$\Rightarrow y^2 = 625.$$

$$\Rightarrow y = 25.$$

$$\Rightarrow x = 15y = (15 \times 25) = 375.$$

$\therefore$  Sum of the numbers  $= x + y = 375 + 25 = 400$ .

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- 
12. The product of two numbers is 120 and the sum of their squares is 289. The sum of the number is:

A. 20

B. 23

C. 169

D. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the numbers be  $x$  and  $y$ .

Then,  $xy = 120$  and  $x^2 + y^2 = 289$ .

$$\therefore (x + y)^2 = x^2 + y^2 + 2xy = 289 + (2 \times 120) = 529$$

$$\therefore x + y = 529 = 23.$$

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- 
13. A number consists of 3 digits whose sum is 10. The middle digit is equal to the sum of the other two and the number will be increased by 99 if its digits are reversed. The number is:

A. 145

B. 253

C. 370

D. 352

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the middle digit be  $x$ .

Then,  $2x = 10$  or  $x = 5$ . So, the number is either 253 or 352.

Since the number increases on reversing the digits, so the hundred's digit is smaller than the unit's digit.

Hence, required number = 253.

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- 
14. The sum of two numbers is 25 and their difference is 13. Find their product.

A. 104

B. 114

C. 315

D. 325

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the numbers be  $x$  and  $y$ .

Then,  $x + y = 25$  and  $x - y = 13$ .

$$4xy = (x + y)^2 - (x - y)^2$$

$$= (25)^2 - (13)^2$$

$$= (625 - 169)$$

$$= 456$$

$$\therefore xy = 114.$$

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- 
15. What is the sum of two consecutive even numbers, the difference of whose squares is 84?

A. 34

B. 38

C. 42

D. 46

**Answer & Explanation**

**Answer:** Option C

## Explanation:

Let the numbers be  $x$  and  $x + 2$ .

$$\text{Then, } (x + 2)^2 - x^2 = 84$$

$$\Rightarrow 4x + 4 = 84$$

$$\Rightarrow 4x = 80$$

$$\Rightarrow x = 20.$$

∴ The required sum =  $x + (x + 2) = 2x + 2 = 42$ .

# Simplification

# FORmulas

1. A man has Rs. 480 in the denominations of one-rupee notes, five-rupee notes and ten-rupee notes. The number of notes of each denomination is equal. What is the total number of notes that he has ?

A. 45      B. 60  
C. 75      D. 90

## Answer & Explanation

**Answer:** Option D

## Explanation:

Let number of notes of each denomination be  $x$ .

$$\text{Then } x + 5x + 10x = 480$$

$$\Rightarrow 16x = 480$$

$$\therefore x = 30.$$

Hence, total number of notes =  $3x = 90$ .

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2. There are two examinations rooms A and B. If 10 students are sent from A to B, then the number of students in each room is the same. If 20 candidates are sent from B to A, then the number of

students in A is double the number of students in B. The number of students in room A is:

- |        |        |
|--------|--------|
| A. 20  | B. 80  |
| C. 100 | D. 200 |

#### [Answer & Explanation](#)

**Answer:** Option C

#### **Explanation:**

Let the number of students in rooms A and B be  $x$  and  $y$  respectively.

$$\text{Then, } x - 10 = y + 10 \Rightarrow x - y = 20 \dots \text{(i)}$$

$$\text{and } x + 20 = 2(y - 20) \Rightarrow x - 2y = -60 \dots \text{(ii)}$$

Solving (i) and (ii) we get:  $x = 100$ ,  $y = 80$ .

$\therefore$  The required answer A = 100.

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- 
3. The price of 10 chairs is equal to that of 4 tables. The price of 15 chairs and 2 tables together is Rs. 4000. The total price of 12 chairs and 3 tables is:

- |             |             |
|-------------|-------------|
| A. Rs. 3500 | B. Rs. 3750 |
| C. Rs. 3840 | D. Rs. 3900 |

#### [Answer & Explanation](#)

**Answer:** Option D

#### **Explanation:**

Let the cost of a chair and that of a table be Rs.  $x$  and Rs.  $y$  respectively.

$$\text{Then, } 10x = 4y \text{ or } y = \frac{5}{2}x.$$

$$\therefore 15x + 2y = 4000$$

$$\Rightarrow 15x + 2 \times \frac{5}{2}x = 4000$$

$$\Rightarrow 20x = 4000$$

$\therefore x = 200.$

$$\text{So, } y = \left( \frac{5}{2} \times 200 \right) = 500.$$

Hence, the cost of 12 chairs and 3 tables =  $12x + 3y$

$$= \text{Rs. } (2400 + 1500)$$

$$= \text{Rs. } 3900.$$

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- 
4. If  $a - b = 3$  and  $a^2 + b^2 = 29$ , find the value of  $ab$ .

A. 10

B. 12

C. 15

D. 18

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

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

$$= 29 - 9 = 20$$

$$\Rightarrow ab = 10.$$

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- 
5. The price of 2 sarees and 4 shirts is Rs. 1600. With the same money one can buy 1 saree and 6 shirts. If one wants to buy 12 shirts, how much shall he have to pay ?

A. Rs. 1200

B. Rs. 2400

C. Rs. 4800

D. Cannot be determined

E. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the price of a saree and a shirt be Rs.  $x$  and Rs.  $y$  respectively.

Then,  $2x + 4y = 1600 \dots \text{(i)}$

and  $x + 6y = 1600 \dots \text{(ii)}$

Divide equation (i) by 2, we get the below equation.

$$\Rightarrow x + 2y = 800. \dots \text{(iii)}$$

Now subtract (iii) from (ii)

$$\begin{array}{r} x + 6y = 1600 \quad (-) \\ x + 2y = 800 \\ \hline \hline 4y = 800 \\ \hline \end{array}$$

Therefore,  $y = 200$ .

Now apply value of  $y$  in (iii)

$$\Rightarrow x + 2 \times 200 = 800$$

$$\Rightarrow x + 400 = 800$$

Therefore  $x = 400$

Solving (i) and (ii) we get  $x = 400$ ,  $y = 200$ .

- ∴ Cost of 12 shirts = Rs.  $(12 \times 200) = \text{Rs. } 2400$ .
6. A sum of Rs. 1360 has been divided among A, B and C such that A gets  $\frac{2}{3}$  of what B gets and B gets  $\frac{1}{4}$  of what C gets. B's share is:

A. Rs. 120

B. Rs. 160

C. Rs. 240

D. Rs. 300

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

Let C's share = Rs.  $x$

Then, B's share = Rs.  $\frac{x}{4}$ , A's share = Rs.  $\left(\frac{2}{3} \times \frac{x}{4}\right) = \text{Rs. } \frac{x}{6}$

$$\therefore \underline{x} + \underline{\frac{x}{4}} + \underline{x} = 1360$$

$$\Rightarrow \frac{\frac{6}{17}x}{12} = 1360$$

$$\Rightarrow x = \frac{1360 \times 12}{17} = \text{Rs. } 960$$

Hence, B's share = Rs.  $\left(\frac{960}{4}\right)$  = Rs. 240.

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7. One-third of Rahul's savings in National Savings Certificate is equal to one-half of his savings in Public Provident Fund. If he has Rs. 1,50,000 as total savings, how much has he saved in Public Provident Fund ?

A. Rs. 30,000

B. Rs. 50,000

C. Rs. 60,000

D. Rs. 90,000

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

Let savings in N.S.C and P.P.F. be Rs.  $x$  and Rs.  $(150000 - x)$  respectively. Then,

$$\begin{aligned} \frac{1}{3}x &= \frac{1}{2}(150000 - x) \\ \Rightarrow \frac{x}{3} + \frac{x}{2} &= 75000 \\ \Rightarrow \frac{5x}{6} &= 75000 \\ \Rightarrow x &= \frac{75000 \times 6}{5} = 90000 \end{aligned}$$

∴ Savings in Public Provident Fund = Rs.  $(150000 - 90000)$  = Rs. 60000

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8. A fires 5 shots to B's 3 but A kills only once in 3 shots while B kills once in 2 shots. When B has missed 27 times, A has killed:

A. 30 birds

B. 60 birds

C. 72 birds

D. 90 birds

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Let the total number of shots be  $x$ . Then,

$$\text{Shots fired by A} = \frac{5}{8}x$$

$$\text{Shots fired by B} = \frac{3}{8}x$$

$$\text{Killing shots by A} = \frac{1}{3} \text{ of } \frac{5}{8}x = \frac{5}{24}x$$

$$\text{Shots missed by B} = \frac{1}{2} \text{ of } \frac{3}{8}x = \frac{3}{16}x$$

$$\therefore \frac{3x}{16} = 27 \text{ or } x = \left( \frac{27 \times 16}{3} \right) = 144.$$

$$\text{Birds killed by A} = \frac{5x}{24} = \left( \frac{5}{24} \times 144 \right) = 30.$$

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- 
9. Eight people are planning to share equally the cost of a rental car. If one person withdraws from the arrangement and the others share equally the entire cost of the car, then the share of each of the remaining persons increased by:

A.  $\frac{1}{7}$

B.  $\frac{1}{8}$

C.  $\frac{1}{9}$

D.  $\frac{7}{8}$

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

$$\text{Original share of 1 person} = \frac{1}{8}$$

$$\text{New share of 1 person} = \frac{1}{7}$$

$$\text{Increase} = \left( \frac{1}{7} - \frac{1}{8} \right) = \frac{1}{56}$$

$$\therefore \text{Required fraction} = \frac{(1/56)}{(1/8)} = \left( \frac{1}{56} \times \frac{8}{1} \right) = \frac{1}{7}$$

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- 
10. To fill a tank, 25 buckets of water is required. How many buckets of water will be required to fill the same tank if the capacity of the bucket is reduced to two-fifth of its present?

A. 10

B. 35

C. 62.5

D. Cannot be determined

E. None of these

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Let the capacity of 1 bucket =  $x$ .

Then, the capacity of tank =  $25x$ .

$$\text{New capacity of bucket} = \frac{2}{5}x$$

$$\begin{aligned}\therefore \text{Required number of buckets} &= \frac{25x}{(2x/5)} \\ &= \left( 25x \times \frac{5}{2x} \right) \\ &= \frac{125}{2}\end{aligned}$$

$$= 62.5$$

11. In a regular week, there are 5 working days and for each day, the working hours are 8. A man gets Rs. 2.40 per hour for regular work and Rs. 3.20 per hours for overtime. If he earns Rs. 432 in 4 weeks, then how many hours does he work for ?

A. 160

B. 175

C. 180

D. 195

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Suppose the man works overtime for  $x$  hours.

Now, working hours in 4 weeks =  $(5 \times 8 \times 4) = 160$ .

$$\therefore 160 \times 2.40 + x \times 3.20 = 432$$

$$\Rightarrow 3.20x = 432 - 384 = 48$$

$$\Rightarrow x = 15.$$

Hence, total hours of work =  $(160 + 15) = 175$ .

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- 
12. Free notebooks were distributed equally among children of a class. The number of notebooks each child got was one-eighth of the number of children. Had the number of children been half, each child would have got 16 notebooks. Total how many notebooks were distributed ?

A. 256

B. 432

C. 512

D. 640

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let total number of children be  $x$ .

$$\text{Then, } x \times \frac{1}{8}x = \frac{x}{2} \times 16 \Leftrightarrow x = 64.$$

$$\therefore \text{Number of notebooks} = \frac{1}{8}x^2 = \left( \frac{1}{8} \times 64 \times 64 \right) = 512.$$

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- 
13. A man has some hens and cows. If the number of heads be 48 and the number of feet equals 140, then the number of hens will be:

A. 22

B. 23

C. 24

D. 26

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let the number of hens be  $x$  and the number of cows be  $y$ .

$$\text{Then, } x + y = 48 \dots \text{(i)}$$

$$\text{and } 2x + 4y = 140 \Rightarrow x + 2y = 70 \dots \text{(ii)}$$

Solving (i) and (ii) we get:  $x = 26$ ,  $y = 22$ .

∴ The required answer = 26.

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14.  $\frac{(469 + 174)^2 - (469 - 174)^2}{(469 \times 174)} = ?$

A. 2

B. 4

C. 295

D. 643

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\begin{aligned}\text{Given exp.} &= \frac{(a + b)^2 - (a - b)^2}{ab} \\ &= \frac{4ab}{ab}\end{aligned}$$

$$= 4 \text{ (where } a = 469, b = 174.)$$

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- 
15. David gets on the elevator at the 11<sup>th</sup> floor of a building and rides up at the rate of 57 floors per minute. At the same time, Albert gets on an elevator at the 51st floor of the same building and rides down at the rate of 63 floors per minute. If they continue travelling at these rates, then at which floor will their paths cross?

A. 19

B. 28

C. 30

D. 37

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Suppose their paths cross after  $x$  minutes.

$$\text{Then, } 11 + 57x = 51 - 63x \Leftrightarrow 120x = 40$$

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

$$\text{Number of floors covered by David in } (1/3) \text{ min.} = \left( \frac{1}{3} \times 57 \right) = 19.$$

So, their paths cross at (11 + 19) i.e., 30<sup>th</sup> floor.

## Ratio and Proportion

### Formulas

#### 1. Ratio:

The ratio of two quantities  $a$  and  $b$  in the same units, is the fraction  $\frac{a}{b}$  and we write it as  $a : b$ .

In the ratio  $a : b$ , we call  $a$  as the first term or **antecedent** and  $b$ , the second term or **consequent**.

Eg. The ratio  $5 : 9$  represents  $\frac{5}{9}$  with antecedent = 5, consequent = 9.

**Rule:** The multiplication or division of each term of a ratio by the same non-zero number does not affect the ratio.

Eg.  $4 : 5 = 8 : 10 = 12 : 15$ . Also,  $4 : 6 = 2 : 3$ .

#### 2. Proportion:

The equality of two ratios is called proportion.

If  $a : b = c : d$ , we write  $a : b :: c : d$  and we say that  $a, b, c, d$  are in proportion.

Here  $a$  and  $d$  are called **extremes**, while  $b$  and  $c$  are called **mean terms**.

Product of means = Product of extremes.

Thus,  $a : b :: c : d \Leftrightarrow (b \times c) = (a \times d)$ .

#### 3. Fourth Proportional:

If  $a : b = c : d$ , then  $d$  is called the fourth proportional to  $a, b, c$ .

#### Third Proportional:

$a : b = c : d$ , then  $c$  is called the third proportion to  $a$  and  $b$ .

#### Mean Proportional:

Mean proportional between  $a$  and  $b$  is  $ab$ .

#### 4. Comparison of Ratios:

We say that  $(a : b) > (c : d) \Leftrightarrow \frac{a}{b} > \frac{c}{d}$ .

#### 5. Compounded Ratio:

6. The compounded ratio of the ratios:  $(a : b)$ ,  $(c : d)$ ,  $(e : f)$  is  $(ace : bdf)$ .

#### 7. Duplicate Ratios:

Duplicate ratio of  $(a : b)$  is  $(a^2 : b^2)$ .

Sub-duplicate ratio of  $(a : b)$  is  $(a : b)$ .

Triplicate ratio of  $(a : b)$  is  $(a^3 : b^3)$ .

Sub-triplicate ratio of  $(a : b)$  is  $(a^{1/3} : b^{1/3})$ .

If  $\frac{a}{b} = \frac{c}{d}$ , then  $\frac{a+b}{a-b} = \frac{c+d}{c-d}$ . [componendo and dividendo]

#### 8. Variations:

We say that  $x$  is directly proportional to  $y$ , if  $x = ky$  for some constant  $k$  and we write,  $x \propto y$ .

We say that  $x$  is inversely proportional to  $y$ , if  $xy = k$  for some constant  $k$  and

we write,  $x \propto \frac{1}{y}$ .

1. A and B together have Rs. 1210. If  $\frac{4}{15}$  of A's amount is equal to  $\frac{2}{5}$  of B's amount, how much amount does B have?

A. Rs. 460

B. Rs. 484

C. Rs. 550

D. Rs. 664

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

$$\begin{aligned}\frac{4}{15} A &= \frac{2}{5} B \\ \Rightarrow A &= \left( \frac{2}{5} \times \frac{15}{4} \right) B \\ \Rightarrow A &= \underline{3} B\end{aligned}$$

$$\Rightarrow \frac{A}{B} = \frac{3}{2}$$

$$\Rightarrow A : B = 3 : 2.$$

$$\therefore B's\ share = \text{Rs. } \left( 1210 \times \frac{2}{5} \right) = \text{Rs. } 484.$$

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2. Two numbers are respectively 20% and 50% more than a third number. The ratio of the two numbers is:
- A. 2 : 5      B. 3 : 5  
C. 4 : 5      D. 6 : 7

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the third number be  $x$ .

$$\text{Then, first number} = 120\% \text{ of } x = \frac{120x}{100} = \frac{6x}{5}$$

$$\text{Second number} = 150\% \text{ of } x = \frac{150x}{100} = \frac{3x}{2}$$

$$\therefore \text{Ratio of first two numbers} = \left( \frac{6x}{5} : \frac{3x}{2} \right) = 12x : 15x = 4 : 5.$$

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- 
3. A sum of money is to be distributed among A, B, C, D in the proportion of 5 : 2 : 4 : 3. If C gets Rs. 1000 more than D, what is B's share?
- A. Rs. 500      B. Rs. 1500  
C. Rs. 2000      D. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the shares of A, B, C and D be Rs.  $5x$ , Rs.  $2x$ , Rs.  $4x$  and Rs.  $3x$  respectively.

Then,  $4x - 3x = 1000$

$$\Rightarrow x = 1000.$$

$\therefore$  B's share = Rs.  $2x = \text{Rs. } (2 \times 1000) = \text{Rs. } 2000$ .

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- 
4. Seats for Mathematics, Physics and Biology in a school are in the ratio  $5 : 7 : 8$ . There is a proposal to increase these seats by 40%, 50% and 75% respectively. What will be the ratio of increased seats?

A.  $2 : 3 : 4$

B.  $6 : 7 : 8$

C.  $6 : 8 : 9$

D. None of these

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Originally, let the number of seats for Mathematics, Physics and Biology be  $5x$ ,  $7x$  and  $8x$  respectively.

Number of increased seats are (140% of  $5x$ ), (150% of  $7x$ ) and (175% of  $8x$ ).

$$\Rightarrow \left( \frac{140}{100} \times 5x \right), \left( \frac{150}{100} \times 7x \right) \text{ and } \left( \frac{175}{100} \times 8x \right)$$

$$\Rightarrow 7x, \frac{21x}{2} \text{ and } 14x.$$

$$\therefore \text{The required ratio} = 7x : \frac{21x}{2} : 14x$$

$$\Rightarrow 14x : 21x : 28x$$

$$\Rightarrow 2 : 3 : 4.$$

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- 
5. In a mixture 60 litres, the ratio of milk and water  $2 : 1$ . If this ratio is to be  $1 : 2$ , then the quantity of water to be further added is:

A. 20 litres

B. 30 litres

C. 40 litres

D. 60 litres

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

$$\text{Quantity of milk} = \left( 60 \times \frac{2}{3} \right) \text{ litres} = 40 \text{ litres.}$$

Quantity of water in it = (60 - 40) litres = 20 litres.

New ratio = 1 : 2

Let quantity of water to be added further be  $x$  litres.

$$\text{Then, milk : water} = \left( \frac{40}{20+x} \right).$$

$$\text{Now, } \left( \frac{40}{20+x} \right) = \frac{1}{2}$$

$$\Rightarrow 20 + x = 80$$

$$\Rightarrow x = 60.$$

$\therefore$  Quantity of water to be added = 60 litres.

6. The ratio of the number of boys and girls in a college is 7 : 8. If the percentage increase in the number of boys and girls be 20% and 10% respectively, what will be the new ratio?

A. 8 : 9

B. 17 : 18

C. 21 : 22

D. Cannot be determined

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Originally, let the number of boys and girls in the college be  $7x$  and  $8x$  respectively.

Their increased number is (120% of  $7x$ ) and (110% of  $8x$ ).

$$\Rightarrow \left( \frac{120}{100} \times 7x \right) \text{ and } \left( \frac{110}{100} \times 8x \right)$$
$$\Rightarrow \frac{42x}{5} \text{ and } \frac{44x}{5}$$

$$\therefore \text{The required ratio} = \left( \frac{42x}{5} : \frac{44x}{5} \right) = 21 : 22.$$

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- 
7. Salaries of Ravi and Sumit are in the ratio 2 : 3. If the salary of each is increased by Rs. 4000, the new ratio becomes 40 : 57. What is Sumit's salary?
- A. Rs. 17,000      B. Rs. 20,000  
C. Rs. 25,500      D. Rs. 38,000

**Answer & Explanation**

**Answer:** Option D

**Explanation:**

Let the original salaries of Ravi and Sumit be Rs.  $2x$  and Rs.  $3x$  respectively.

$$\text{Then, } \frac{2x + 4000}{3x + 4000} = \frac{40}{57}$$

$$\Rightarrow 57(2x + 4000) = 40(3x + 4000)$$

$$\Rightarrow 6x = 68,000$$

$$\Rightarrow 3x = 34,000$$

Sumit's present salary =  $(3x + 4000) = \text{Rs.}(34000 + 4000) = \text{Rs. } 38,000$ .

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- 
8. If  $0.75 : x :: 5 : 8$ , then  $x$  is equal to:
- A. 1.12      B. 1.2  
C. 1.25      D. 1.30

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$(x \times 5) = (0.75 \times 8) \Rightarrow x = \left(\frac{6}{5}\right) = 1.20$$

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- 
9. The sum of three numbers is 98. If the ratio of the first to second is 2 : 3 and that of the second to the third is 5 : 8, then the second number is:

A. 20

B. 30

C. 48

D. 58

#### Answer & Explanation

**Answer:** Option B

#### Explanation:

Let the three parts be A, B, C. Then,

$$\begin{aligned}A : B = 2 : 3 \text{ and } B : C = 5 : 8 &= \left(5 \times \frac{3}{5}\right) : \left(8 \times \frac{3}{5}\right) = 3 : \frac{24}{5} \\ \Rightarrow A : B : C &= 2 : 3 : \frac{24}{5} = 10 : 15 : 24 \\ \Rightarrow B &= \left(98 \times \frac{15}{49}\right) = 30.\end{aligned}$$

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10.

If Rs. 782 be divided into three parts, proportional to  $\frac{1}{2} : \frac{2}{3} : \frac{3}{4}$ , then the first part is:

A. Rs. 182

B. Rs. 190

C. Rs. 196

D. Rs. 204

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

$$\text{Given ratio} = \frac{1}{2} : \frac{2}{3} : \frac{3}{4} = 6 : 8 : 9.$$

$$\therefore 1^{\text{st}} \text{ part} = \text{Rs.} \left(782 \times \frac{6}{23}\right) = \text{Rs.} 204$$

11. The salaries A, B, C are in the ratio 2 : 3 : 5. If the increments of 15%, 10% and 20% are allowed respectively in their salaries, then what will be new ratio of their salaries?

A. 3 : 3 : 10

B. 10 : 11 : 20

C. 23 : 33 : 60

D. Cannot be determined

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

Let A = 2k, B = 3k and C = 5k.

$$\begin{aligned} \text{A's new salary} &= \frac{115}{100} \text{ of } 2k = \left\{ \frac{115}{100} \times 2k \right\} = \frac{23k}{10} \\ \text{B's new salary} &= \frac{110}{100} \text{ of } 3k = \left\{ \frac{110}{100} \times 3k \right\} = \frac{33k}{10} \\ \text{C's new salary} &= \frac{120}{100} \text{ of } 5k = \left\{ \frac{120}{100} \times 5k \right\} = 6k \\ \therefore \text{New ratio} &= \left( \frac{23k}{10} : \frac{33k}{10} : 6k \right) = 23 : 33 : 60 \end{aligned}$$

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12. If 40% of a number is equal to two-third of another number, what is the ratio of first number to the second number?

A. 2 : 5

B. 3 : 7

C. 5 : 3

D. 7 : 3

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

$$\begin{aligned} \text{Let } 40\% \text{ of } A &= \frac{2}{3} B \\ \text{Then, } \frac{40A}{100} &= \frac{2B}{3} \\ \Rightarrow \frac{2A}{5} &= \frac{2B}{3} \\ \Rightarrow \frac{A}{B} &= \left( \frac{2}{3} \times \frac{5}{2} \right) = \frac{5}{3} \\ \therefore A : B &= 5 : 3. \end{aligned}$$

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13. The fourth proportional to 5, 8, 15 is:

A. 18

B. 24

C. 19

D. 20

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the fourth proportional to 5, 8, 15 be  $x$ .

Then,  $5 : 8 : 15 : x$

$$\Rightarrow 5x = (8 \times 15)$$

$$x = \frac{(8 \times 15)}{5} = 24.$$

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14. Two numbers are in the ratio 3 : 5. If 9 is subtracted from each, the new numbers are in the ratio 12 : 23. The smaller number is:

A. 27

B. 33

C. 49

D. 55

[Answer & Explanation](#)

**Answer:** Option B

**Explanation:**

Let the numbers be  $3x$  and  $5x$ .

$$\text{Then, } \frac{3x - 9}{5x - 9} = \frac{12}{23}$$

$$\Rightarrow 23(3x - 9) = 12(5x - 9)$$

$$\Rightarrow 9x = 99$$

$$\Rightarrow x = 11.$$

$$\therefore \text{The smaller number} = (3 \times 11) = 33.$$

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15. In a bag, there are coins of 25 p, 10 p and 5 p in the ratio of 1 : 2 : 3. If there is Rs. 30 in all, how many 5 p coins are there?

A. 50

B. 100

C. 150

D. 200

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Let the number of 25 p, 10 p and 5 p coins be  $x$ ,  $2x$ ,  $3x$  respectively.

$$\text{Then, sum of their values} = \text{Rs.} \left( \frac{25x}{100} + \frac{10 \times 2x}{100} + \frac{5 \times 3x}{100} \right) = \text{Rs.} \frac{60x}{100}$$
$$\therefore \frac{60x}{100} = 30 \Leftrightarrow x = \frac{30 \times 100}{60} = 50.$$

Hence, the number of 5 p coins =  $(3 \times 50) = 150$ .

## Boats and Streams

### Formulas

1. A boat can travel with a speed of 13 km/hr in still water. If the speed of the stream is 4 km/hr, find the time taken by the boat to go 68 km downstream.

A. 2 hours

B. 3 hours

C. 4 hours

D. 5 hours

#### Answer & Explanation

**Answer:** Option C

#### Explanation:

Speed downstream =  $(13 + 4)$  km/hr = 17 km/hr.

$$\text{Time taken to travel 68 km downstream} = \left( \frac{68}{17} \right) \text{ hrs} = 4 \text{ hrs.}$$

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2. A man's speed with the current is 15 km/hr and the speed of the current is 2.5 km/hr. The man's speed against the current is:

A. 8.5 km/hr

B. 9 km/hr

C. 10 km/hr

D. 12.5 km/hr

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

Man's rate in still water =  $(15 - 2.5)$  km/hr = 12.5 km/hr.

Man's rate against the current =  $(12.5 - 2.5)$  km/hr = 10 km/hr.

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3. A boat running upstream takes 8 hours 48 minutes to cover a certain distance, while it takes 4 hours to cover the same distance running downstream. What is the ratio between the speed of the boat and speed of the water current respectively?

A. 2 : 1

B. 3 : 2

C. 8 : 3

D. Cannot be determined

E. None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Let the man's rate upstream be  $x$  kmph and that downstream be  $y$  kmph.

Then, distance covered upstream in 8 hrs 48 min = Distance covered downstream in 4 hrs.

$$\begin{aligned} \Rightarrow & \left( x \times 8\frac{4}{5} \right) = (y \times 4) \\ \Rightarrow & \frac{44}{5}x = 4y \\ \Rightarrow & y = \frac{11}{5}x. \\ \therefore \text{ Required ratio} &= \left( \frac{y+x}{2} \right) : \left( \frac{y-x}{2} \right) \\ &= \left( \frac{16x}{5} \times \frac{1}{2} \right) : \left( \frac{6x}{5} \times \frac{1}{2} \right) \\ &= \frac{8}{5} : \frac{3}{5} \\ &= 8 : 3. \end{aligned}$$

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4. A motorboat, whose speed in 15 km/hr in still water goes 30 km downstream and comes back in a total of 4 hours 30 minutes. The speed of the stream (in km/hr) is:
- A. 4      B. 5  
C. 6      D. 10

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let the speed of the stream be  $x$  km/hr. Then,

Speed downstream =  $(15 + x)$  km/hr,

Speed upstream =  $(15 - x)$  km/hr.

$$\begin{aligned}\therefore \frac{30}{(15+x)} + \frac{30}{(15-x)} &= 4\frac{1}{2} \\ \Rightarrow \frac{900}{225-x^2} &= \frac{9}{2} \\ \Rightarrow 9x^2 &= 225 \\ \Rightarrow x^2 &= 25 \\ \Rightarrow x &= 5 \text{ km/hr.}\end{aligned}$$

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5. In one hour, a boat goes 11 km/hr along the stream and 5 km/hr against the stream. The speed of the boat in still water (in km/hr) is:
- A. 3 km/hr      B. 5 km/hr  
C. 8 km/hr      D. 9 km/hr

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

Speed in still water =  $\frac{1}{2}(11 + 5)$  kmph = 8 kmph.

6. A boat running downstream covers a distance of 16 km in 2 hours while for covering the same

distance upstream, it takes 4 hours. What is the speed of the boat in still water?

- A. 4 km/hr      B. 6 km/hr  
C. 8 km/hr      D. Data inadequate

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$\text{Rate downstream} = \left( \frac{\frac{16}{2}}{2} \right) \text{kmph} = 8 \text{ kmph.}$$

$$\text{Rate upstream} = \left( \frac{\frac{16}{4}}{4} \right) \text{kmph} = 4 \text{ kmph.}$$

$$\therefore \text{Speed in still water} = \frac{1}{2}(8 + 4) \text{ kmph} = 6 \text{ kmph.}$$

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7. The speed of a boat in still water is 15 km/hr and the rate of current is 3 km/hr. The distance travelled downstream in 12 minutes is:

- A. 1.2 km      B. 1.8 km  
C. 2.4 km      D. 3.6 km

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8. A boat takes 90 minutes less to travel 36 miles downstream than to travel the same distance upstream. If the speed of the boat in still water is 10 mph, the speed of the stream is:

- A. 2 mph      B. 2.5 mph  
C. 3 mph      D. 4 mph

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Let the speed of the stream  $x$  mph. Then,

Speed downstream =  $(10 + x)$  mph,

Speed upstream =  $(10 - x)$  mph.

$$\therefore \frac{36}{10-x} - \frac{36}{10+x} = 90$$

$$\Rightarrow 72x \times 60 = 90(100 - x^2)$$

$$\Rightarrow x^2 + 48x - 100 = 0$$

$$\Rightarrow (x+50)(x-2) = 0$$

$$\Rightarrow x = 2 \text{ mph.}$$

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9. A man can row at 5 kmph in still water. If the velocity of current is 1 kmph and it takes him 1 hour to row to a place and come back, how far is the place?

- A.** 2.4 km      **B.** 2.5 km  
**C.** 3 km      **D.** 3.6 km

## Answer & Explanation

**Answer:** Option A

## Explanation:

Speed downstream =  $(5 + 1)$  kmph = 6 kmph.

$$\text{Speed upstream} = (5 - 1) \text{ kmph} = 4 \text{ kmph.}$$

Let the required distance be  $x$  km.

$$\text{Then, } \frac{x}{6} + \frac{x}{4} = 1$$

$$\Rightarrow 2x + 3x = 12$$

$$\Rightarrow 5x = 12$$

$$\Rightarrow x = 2.4 \text{ km.}$$

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10. A boat covers a certain distance downstream in 1 hour, while it comes back in  $1\frac{1}{2}$  hours. If the speed of the stream be 3 kmph, what is the speed of the boat in still water?

C. 14 kmph

D. 15 kmph

E. None of these

#### Answer & Explanation

**Answer:** Option D

#### Explanation:

Let the speed of the boat in still water be  $x$  kmph. Then,

Speed downstream =  $(x + 3)$  kmph,

Speed upstream =  $(x - 3)$  kmph.

$$\therefore (x + 3) \times 1 = (x - 3) \times \frac{3}{2}$$

$$\Rightarrow 2x + 6 = 3x - 9$$

$$\Rightarrow x = 15 \text{ kmph.}$$

## Races and Games

### Formulas

1. **Races:** A contest of speed in running, riding, driving, sailing or rowing is called a race.
2. **Race Course:** The ground or path on which contests are made is called a race course.
3. **Starting Point:** The point from which a race begins is known as a starting point.
4. **Winning Point or Goal:** The point set to bound a race is called a winning point or a goal.
5. **Winner:** The person who first reaches the winning point is called a winner.
6. **Dead Heat Race:** If all the persons contesting a race reach the goal exactly at the same time, the race is said to be dead heat race.
7. **Start:** Suppose A and B are two contestants in a race. If before the start of the race, A is at the starting point and B is ahead of A by 12 metres, then we say that 'A gives B, a start of 12 metres'.

To cover a race of 100 metres in this case, A will have to cover 100 metres while B will have to cover only  $(100 - 12) = 88$  metres.

In a 100 race, 'A can give B 12 m' or 'A can give B a start of 12 m' or 'A beats B by 12 m' means that while A runs 100 m, B runs  $(100 - 12) = 88$  m.

8. **Games:** 'A game of 100, means that the person among the contestants who scores 100 points first is the winner'.

If A scores 100 points while B scores only 80 points, then we say that 'A can give B 20 points'.

1. In a 100 m race, A can give B 10 m and C 28 m. In the same race B can give C:

A. 18 m

B. 20 m

C. 27 m

D. 9 m

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

$$A : B = 100 : 90.$$

$$A : C = 100 : 72.$$

$$B : C = \frac{B}{A} \times \frac{A}{C} = \frac{90}{100} \times \frac{100}{72} = \frac{90}{72}.$$

When B runs 90 m, C runs 72 m.

When B runs 100 m, C runs  $\left(\frac{72}{90} \times 100\right)_m = 80$  m.

$\therefore$  B can give C 20 m.

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- 
2. A and B take part in 100 m race. A runs at 5 kmph. A gives B a start of 8 m and still beats him by 8 seconds. The speed of B is:

A. 5.15 kmph

B. 4.14 kmph

C. 4.25 kmph

D. 4.4 kmph

#### Answer & Explanation

**Answer:** Option B

**Explanation:**

$$A's \text{ speed} = \left(5 \times \frac{5}{18}\right)_{\text{m/sec}} = \frac{25}{18} \text{ m/sec.}$$

$$\text{Time taken by A to cover 100 m} = \left(100 \times \frac{18}{25}\right)_{\text{sec}} = 72 \text{ sec.}$$

$\therefore$  Time taken by B to cover 92 m =  $(72 + 8) = 80$  sec.

$$\therefore \text{B's speed} = \left( \frac{92}{80} \times \frac{18}{5} \right) \text{kmph.} = 4.14 \text{ kmph.}$$

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3. In a 500 m race, the ratio of the speeds of two contestants A and B is 3 : 4. A has a start of 140 m. Then, A wins by:

A. 60 m

B. 40 m

C. 20 m

D. 10 m

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

To reach the winning post A will have to cover a distance of  $(500 - 140)$ m, i.e., 360 m.

While A covers 3 m, B covers 4 m.

While A covers 360 m, B covers  $\left( \frac{4}{3} \times 360 \right) \text{m} = 480 \text{ m.}$

Thus, when A reaches the winning post, B covers 480 m and therefore remains 20 m behind.

$\therefore$  A wins by 20 m.

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4. In a 100 m race, A beats B by 10 m and C by 13 m. In a race of 180 m, B will beat C by:

A. 5.4 m

B. 4.5 m

C. 5 m

D. 6 m

[Answer & Explanation](#)

**Answer:** Option D

**Explanation:**

$A : B = 100 : 90.$

A : C = 100 : 87.

$$\frac{B}{C} = \frac{B}{A} \times \frac{A}{C} = \frac{90}{100} \times \frac{100}{87} = \frac{30}{29}.$$

When B runs 30 m, C runs 29 m.

When B runs 180 m, C runs  $\left( \frac{29}{30} \times 180 \right)_{\text{m}} = 174 \text{ m.}$

$\therefore$  B beats C by  $(180 - 174) \text{ m} = 6 \text{ m.}$

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5. At a game of billiards, A can give B 15 points in 60 and A can give C 20 points in 60. How many points can B give C in a game of 90?

- A. 30 points      B. 20 points  
C. 10 points      D. 12 points

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

A : B = 60 : 45.

A : C = 60 : 40.

$$\therefore \frac{B}{C} = \left( \frac{B}{A} \times \frac{A}{C} \right) = \left( \frac{45}{60} \times \frac{60}{40} \right) = \frac{45}{40} = \frac{90}{80} = 90 : 80.$$

$\therefore$  B can give C 10 points in a game of 90

6. In a race of 200 m, A can beat B by 31 m and C by 18 m. In a race of 350 m, C will beat B by:

- A. 22.75 m      B. 25 m  
C. 19.5 m      D.  $7\frac{4}{7} \text{ m}$

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

$$A : B = 200 : 169.$$

$$A : C = 200 : 182.$$

$$\frac{C}{B} = \left( \frac{C}{A} \times \frac{A}{B} \right) = \left( \frac{182}{200} \times \frac{200}{169} \right) = 182 : 169.$$

When C covers 182 m, B covers 169 m.

When C covers 350 m, B covers  $\left(\frac{169}{182} \times 350\right)_m = 325$  m.

Therefore, C beats B by  $(350 - 325)$  m = 25 m.

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7. In 100 m race, A covers the distance in 36 seconds and B in 45 seconds.  
In this race A beats B by:

- A.** 20 m                                    **B.** 25 m  
**C.** 22.5 m                                    **D.** 9 m

## Answer & Explanation

**Answer:** Option A

## Explanation:

$$\text{Distance covered by B in 9 sec.} = \left( \frac{100}{45} \times 9 \right)_{\text{m}} = 20 \text{ m.}$$

∴ A beats B by 20 metres.

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8. In a game of 100 points, A can give B 20 points and C 28 points. Then, B can give C:

- A. 8 points
  - B. 10 points
  - C. 14 points
  - D. 40 points

## Answer & Explanation

**Answer:** Option B

**Explanation:**

A : B = 100 : 80.

A : C = 100 : 72.

$$\therefore \frac{B}{C} = \left( \frac{B}{A} \times \frac{A}{C} \right) = \left( \frac{80}{100} \times \frac{100}{72} \right) = \frac{10}{9} = \frac{100}{90} = 100 : 90.$$

$\therefore$  B can give C 10 points.

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9. In a 200 metres race A beats B by 35 m or 7 seconds. A's time over the course is:

- A.** 40 sec                    **B.** 47 sec  
**C.** 33 sec                    **D.** None of these

**Answer & Explanation**

**Answer:** Option C

**Explanation:**

B runs 35 m in 7 sec.

$$\therefore B \text{ covers } 200 \text{ m in } \left( \frac{7}{35} \times 200 \right) = 40 \text{ sec.}$$

B's time over the course = 40 sec.

$\therefore$  A's time over the course (40 - 7) sec = 33 sec.

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10. A can run 22.5 m while B runs 25 m. In a kilometre race B beats A by:

- A.** 100 m                    **B.**  $111\frac{1}{9}$  m  
**C.** 25 m                    **D.** 50 m

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

When B runs 25 m, A runs  $\frac{45}{2}$  m.

When B runs 1000 m, A runs  $\left(\frac{45}{2} \times \frac{1}{25} \times 1000\right)_m = 900$  m.

- ∴ B beats A by 100 m.
11. In a 300 m race A beats B by 22.5 m or 6 seconds. B's time over the course is:
- A. 86 sec      B. 80 sec  
C. 76 sec      D. None of these

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

B runs  $\frac{45}{2}$  m in 6 sec.

∴ B covers 300 m in  $\left(6 \times \frac{2}{45} \times 300\right)_{sec} = 80$  sec.

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12. A runs  $1\frac{2}{3}$  times as fast as B. If A gives B a start of 80 m, how far must the winning post be so that A and B might reach it at the same time?
- A. 200 m      B. 300 m  
C. 270 m      D. 160 m

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

Ratio of the speeds of A and B =  $\frac{5}{3} : 1 = 5 : 3$ .

Thus, in race of 5 m, A gains 2 m over B.

2 m are gained by A in a race of 5 m.

80 m will be gained by A in race of  $\left(\frac{5}{2} \times 80\right)_m = 200$  m.

- Winning post is 200 m away from the starting point.

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13. In a 100 m race, A can beat B by 25 m and B can beat C by 4 m. In the same race, A can beat C by:

A. 21 m

B. 26 m

C. 28 m

D. 29 m

#### Answer & Explanation

**Answer:** Option C

**Explanation:**

$$A : B = 100 : 75$$

$$B : C = 100 : 96.$$

$$\therefore A : C = \left( \frac{A}{B} \times \frac{B}{C} \right) = \left( \frac{100}{75} \times \frac{100}{96} \right) = \frac{100}{72} = 100 : 72.$$

$\therefore$  A beats C by  $(100 - 72)$  m = 28 m.

## True Discount

### Formulas

#### IMPORTANT CONCEPTS

Suppose a man has to pay Rs. 156 after 4 years and the rate of interest is 14% per annum. Clearly, Rs. 100 at 14% will amount to R. 156 in 4 years. So, the payment of Rs. now will clear off the debt of Rs. 156 due 4 years hence. We say that:

Sum due = Rs. 156 due 4 years hence;

Present Worth (P.W.) = Rs. 100;

True Discount (T.D.) = Rs.  $(156 - 100) = \text{Rs. } 56 = (\text{Sum due}) - (\text{P.W.})$

We define: **T.D. = Interest on P.W.; Amount = (P.W.) + (T.D.)**

Interest is reckoned on P.W. and true discount is reckoned on the amount.

## IMPORTANT FORMULAE

Let rate = R% per annum and Time = T years. Then,

1.  $P.W. = \frac{100 \times \text{Amount}}{100 + (R \times T)} = \frac{100 \times T.D.}{R \times T}$
2.  $T.D. = \frac{(P.W.) \times R \times T}{100} = \frac{\text{Amount} \times R \times T}{100 + (R \times T)}$
3.  $\text{Sum} = \frac{(S.I.) \times (T.D.)}{(S.I.) - (T.D.)}$
4.  $(S.I.) - (T.D.) = S.I. \text{ on T.D.}$

5. When the sum is put at compound interest, then P.W. = 
$$\frac{\text{Amount}}{\left(1 + \frac{R}{100}\right)^T}$$

A man purchased a cow for Rs. 3000 and sold it the same day for Rs. 3600, allowing the buyer a credit of 2 years. If the rate of interest be 10% per annum, then the man has a gain of:

- A.** 0%                            **B.** 5%
- C.** 7.5%                            **D.** 10%

### Answer & Explanation

**Answer:** Option A

#### Explanation:

C.P. = Rs. 3000.

$$S.P. = \text{Rs. } \left[ \frac{3600 \times 100}{100 + (10 \times 2)} \right] = \text{Rs. } 3000.$$

Gain = 0%.

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2. The true discount on Rs. 2562 due 4 months hence is Rs. 122. The rate percent is:

- A.** 12%                            **B.**  $13\frac{1}{3}\%$
- C.** 15%                            **D.** 14%

### Answer & Explanation

**Answer:** Option C

**Explanation:**

P.W. = Rs. (2562 - 122) = Rs. 2440.

∴ S.I. on Rs. 2440 for 4 months is Rs. 122.

$$\therefore \text{Rate} = \left[ \frac{100 \times 122}{2440 \times \frac{1}{3}} \right] \% = 15\%.$$

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3. A trader owes a merchant Rs. 10,028 due 1 year hence. The trader wants to settle the account after 3 months. If the rate of interest 12% per annum, how much cash should he pay?

A. Rs. 9025.20

B. Rs. 9200

C. Rs. 9600

D. Rs. 9560

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Required money = P.W. of Rs. 10028 due 9 months hence

$$= \text{Rs.} \left[ \frac{10028 \times 100}{100 + \left( 12 \times \frac{9}{12} \right)} \right]$$
$$= \text{Rs.} 9200.$$

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4. A man wants to sell his scooter. There are two offers, one at Rs. 12,000 cash and the other a credit of Rs. 12,880 to be paid after 8 months, money being at 18% per annum. Which is the better offer?

A. Rs. 12,000 in cash

B. s. 12,880 at credit

C. Both are equally good

**Answer & Explanation**

**Answer:** Option A

**Explanation:**

$$\begin{aligned}
 \text{P.W. of Rs. 12,880 due 8 months hence} &= \text{Rs.} \left[ \frac{12880 \times 100}{100 + \left( 18 \times \frac{8}{12} \right)} \right] \\
 &= \text{Rs.} \left( \frac{12880 \times 100}{112} \right) \\
 &= \text{Rs. 11500.}
 \end{aligned}$$

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5. If Rs. 10 be allowed as true discount on a bill of Rs. 110 due at the end of a certain time, then the discount allowed on the same sum due at the end of double the time is:

- |                  |                     |
|------------------|---------------------|
| <b>A.</b> Rs. 20 | <b>B.</b> Rs. 21.81 |
| <b>C.</b> Rs. 22 | <b>D.</b> Rs. 18.33 |

#### **Answer & Explanation**

**Answer:** Option D

#### **Explanation:**

S.I. on Rs. (110 - 10) for a certain time = Rs. 10.

S.I. on Rs. 100 for double the time = Rs. 20.

T.D. on Rs. 120 = Rs. (120 - 100) = Rs. 20.

$$\text{T.D. on Rs. 110} = \text{Rs.} \left( \frac{20}{120} \times 110 \right) = \text{Rs. 18.33}$$

6. Goods were bought for Rs. 600 and sold the same for Rs. 688.50 at a credit of 9 months and thus gaining 2% The rate of interest per annum is:

- |                             |                             |
|-----------------------------|-----------------------------|
| <b>A.</b> $16\frac{2}{3}\%$ | <b>B.</b> $14\frac{1}{2}\%$ |
| <b>C.</b> $13\frac{1}{3}\%$ | <b>D.</b> 15%               |

#### **Answer & Explanation**

**Answer:** Option A

#### **Explanation:**

$$\text{S.P.} = 102\% \text{ of Rs. 600} = \left( \frac{102}{100} \times 600 \right) = \text{Rs. 612.}$$

Now, P.W. = Rs. 612 and sum = Rs. 688.50.

$$\therefore \text{T.D.} = \text{Rs. } (688.50 - 612) = \text{Rs. } 76.50.$$

Thus, S.I. on Rs. 612 for 9 months is Rs. 76.50.

$$\therefore \text{Rate} = \left( \frac{\frac{100 \times 76.50}{612 \times \frac{3}{4}}}{\%} \right) = 16 \frac{2}{3}\%$$

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7. The true discount on a bill due 9 months hence at 16% per annum is Rs. 189. The amount of the bill is:

- A. Rs. 1386      B. Rs. 1764  
C. Rs. 1575      D. Rs. 2268

**Answer & Explanation**

**Answer:** Option B

**Explanation:**

Let P.W. be Rs.  $x$ .

Then, S.I. on Rs.  $x$  at 16% for 9 months = Rs. 189.

$$\therefore x \times 16 \times \frac{9}{12} \times \frac{1}{100} = 189 \text{ or } x = 1575.$$

- $\therefore$  P.W. = Rs. 1575.  
 $\therefore$  Sum due = P.W. + T.D. = Rs.  $(1575 + 189)$  = Rs. 1764.

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8. A man buys a watch for Rs. 1950 in cash and sells it for Rs. 2200 at a credit of 1 year. If the rate of interest is 10% per annum, the man:

- A. gains Rs. 55      B. gains Rs. 50  
C. loses Rs. 30      D. gains Rs. 30

**Answer & Explanation**

**Answer:** Option B

## Explanation:

S.P. = P.W. of Rs. 2200 due 1 year hence

$$= \text{Rs. } \left[ \frac{2200 \times 100}{100 + (10 \times 1)} \right]$$

= Rs. 2000.

∴ Gain = Rs. (2000 - 1950) = Rs. 50.

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9. The true discount on Rs. 1760 due after a certain time at 12% per annum is Rs. 160. The time after which it is due is:

- A.** 6 months                                    **B.** 8 months  
**C.** 9 months                                    **D.** 10 months

## Answer & Explanation

**Answer:** Option D

## Explanation:

$$\text{P.W.} = \text{Rs. } (1760 - 160) = \text{Rs. } 1600.$$

∴ S.I. on Rs. 1600 at 12% is Rs. 160.

$$\therefore \text{Time} = \left( \frac{100 \times 160}{1600 \times 12} \right) = \frac{5}{6} \text{ years} = \left( \frac{5}{6} \times 12 \right) \text{months} = 10 \text{ months.}$$

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10. The present worth of Rs. 2310 due  $2\frac{1}{2}$  years hence, the rate of interest being 15% per annum, is:

- A.** Rs. 1750                                    **B.** Rs. 1680  
**C.** Rs. 1840                                    **D.** Rs. 1443.75

## Answer & Explanation

**Answer:** Option B

## Explanation:

$$P.W. = \text{Rs. } \left[ \frac{100 \times 2310}{100 + \left( 15 \times \frac{5}{2} \right)} \right] = \text{Rs. } 1680.$$

11. Rs. 20 is the true discount on Rs. 260 due after a certain time. What will be the true discount on the same sum due after half of the former time, the rate of interest being the same?

- A.** Rs. 10                                    **B.** Rs. 10.40  
**C.** Rs. 15.20                                    **D.** Rs. 13

## Answer & Explanation

**Answer:** Option B

## Explanation:

S.I. on Rs. (260 - 20) for a given time = Rs. 20.

S.I. on Rs. 240 for half the time = Rs. 10.

T.D. on Rs. 250 = Rs. 10.

$$\therefore \text{T.D. on Rs. } 260 = \text{Rs.} \left( \frac{10}{250} \times 260 \right) = \text{Rs. } 10.40$$

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12. The interest on Rs. 750 for 2 years is the same as the true discount on Rs. 960 due 2 years hence. If the rate of interest is the same in both cases, it is:

- A. 12%      B. 14%  
C. 15%      D.  $16\frac{2}{3}\%$

## Answer & Explanation

**Answer:** Option B

## Explanation:

S.I. on Rs. 750 = T.D. on Rs. 960.

This means P.W. of Rs. 960 due 2 years hence is Rs. 750.

$$\therefore \text{T.D.} = \text{Rs. } (960 - 750) = \text{Rs. } 210.$$

Thus, S.I. on Rs 750 for 2 years is Rs. 210.

$$\therefore \text{Rate} = \left( \frac{100 \times 210}{750 \times 2} \right) \% = 14\%$$

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13. The simple interest and the true discount on a certain sum for a given time and at a given rate are Rs. 85 and Rs. 80 respectively. The sum is:

A. Rs. 1800

B. Rs. 1450

C. Rs. 1360

D. Rs. 6800

[Answer & Explanation](#)

**Answer:** Option C

**Explanation:**

$$\text{Sum} = \frac{\text{S.I.} \times \text{T.D.}}{(\text{S.I.}) - (\text{T.D.})} = \frac{85 \times 80}{(85 - 80)} = \text{Rs. } 1360.$$

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14. The present worth of Rs. 1404 due in two equal half-yearly installments at 8% per annum simple interest is:

A. Rs. 1325

B. Rs. 1300

C. Rs. 1350

D. Rs. 1500

[Answer & Explanation](#)

**Answer:** Option A

**Explanation:**

Required sum = P.W. of Rs. 702 due 6 months + P.W. of Rs. 702 due 1 year hence

$$\begin{aligned} &= \text{Rs.} \left[ \left( \frac{\frac{100 \times 702}{1}}{100 + 8 \times \frac{1}{2}} \right) + \left( \frac{\frac{100 \times 702}{1}}{100 + (8 \times 1)} \right) \right] \\ &= \text{Rs.} (675 + 650) \\ &= \text{Rs. } 1325. \end{aligned}$$

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15. If the true discount on a sum due 2 years hence at 14% per annum be Rs. 168, the sum due is:

A. Rs. 768

B. Rs. 968

C. Rs. 1960

D. Rs. 2400

#### Answer & Explanation

**Answer:** Option A

**Explanation:**

$$P.W. = \frac{100 \times T.D.}{R \times T} = \frac{100 \times 168}{14 \times 2} = 600.$$

$\therefore$  Sum = (P.W. + T.D.) = Rs. (600 + 168) = Rs. 768.