20. At what time will the train reach city X from city Y ? **(S.B.I.P.O. 1999)**

I. The train crosses another train of equal length of 200 metres and running in opposite direction in 15 seconds.

II. The train leaves city Y at 7.15 a.m. for city X situated at a distance of 558 km.

III. The 200 metres long train crosses a signal pole in 10 seconds.

(*a*) I only (*b*) II only (*c*) III only
(*d*) I or III only (*e*) All I, II and III are required.

ANSWERS

1. (*d*)	2. (*e*)	3. (*c*)	4. (*e*)	5. (*a*)	6. (*e*)	7. (*a*)	8. (*d*)
9. (*e*)	10. (*d*)	11. (*b*)	12. (*e*)	13. (*a*)	14. (*b*)	15. (*d*)	16. (*e*)
17. (*d*)	18. (*e*)	19. (*e*)	20. (*a*)				

SOLUTIONS

1. Time taken by the train to cross a stationary engine

$$= \frac{\text{(Length of train + Length of engine)}}{\text{(Speed of the train)}}$$

$$\Rightarrow \frac{\text{(Length of train + Length of engine)}}{\text{(Speed of the train)}} = 20 \text{ (given)}$$

Hence, to find the speed of the train, the length of the train and the length of the engine both must be known.

$\therefore$ The correct answer is (*d*).

2. Let two trains of lengths *a* and *b* metres be moving in opposite directions at *u* m / s and *v* m / s.

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

$\therefore \frac{a+b}{u+v} = 4.8.$

In order to find *u*, we must know *a*, *b* and *v*,
i.e., length of first train, length of second train and the speed of the second train.

Thus, P and Q are not sufficient.

$\therefore$ The correct answer is (*e*).

3. Let the length of the train be *a* metres.

Time taken to cross a singal post $= \frac{\text{Length of the train}}{\text{Speed of the train}} \Rightarrow x = \frac{l}{\text{Speed.}}$ ...(*i*)

Time taken to cross the platform $= \frac{(l+100)}{\text{Speed}} \Rightarrow y = \frac{l+100}{\text{Speed}}$ ...(*ii*)

Thus, from (*i*) and (*ii*), we can find *l*.

Also, II gives, speed $= \left(80 \times \frac{5}{18}\right)$ m / s $= \frac{200}{9}$ m / s.

Thus, the data in I or II alone are sufficient to answer the question.

$\therefore$ The correct answer is (*c*).

4. Speed of the first train $= \dfrac{\text{(sum of the lengths of the two trains)}}{\text{Time taken}}$

$$= \frac{(120+180)}{4} \text{ m/s} = 75 \text{ m/s}.$$

So, both the statements are necessary to get the answer.

$\therefore$ The correct answer is (*e*).

5. Speed of the train $= \dfrac{\text{Length of the train}}{\text{Time taken to cross the post}} = \dfrac{90}{9} \text{ m/s} = 10 \text{ m/s}.$

Thus, I alone gives the answer.

Time taken to cross a platform $= \dfrac{\text{(Length of train + Length of platform)}}{\text{Speed of the train}}$

$\Rightarrow$ Speed $= \dfrac{(l+180)}{27}$

But, l is not given. So, speed cannot be obtained.

So, II alone does not give the answer.

$\therefore$ The correct answer is (*a*).

6. Time taken by train to cross a man $= \dfrac{\text{Length of train}}{\text{Speed of train}} \Rightarrow$ Speed $= \dfrac{l}{9}$ ...(*i*)

Time taken by train to cross a platform $= \dfrac{\text{(Length of train + Length of platform)}}{\text{Speed of the train}}$

$\Rightarrow$ Speed $= \dfrac{l+240}{24}$ ...(*ii*)

From (*i*) and (*ii*), we get $\dfrac{l}{9} = \dfrac{l+240}{24}$.

Thus, l can be obtained. So both I and II are necessary to get the answer.

$\therefore$ The correct answer is (*e*).

7. Speed $= \dfrac{\text{Length of the train}}{\text{Time taken to cross the pole}} = \dfrac{280}{18} \text{ m/s} = \dfrac{140}{9} \text{ m/s}.$

$\therefore$ I alone gives the answer.

Time taken to cross the platform $= \dfrac{\text{(Length of train + Length of platform)}}{\text{Speed of the train}}$

$\Rightarrow$ Speed $= \dfrac{(280+p)}{45}$ m/s.

But, p = length of platform, is not given.

$\therefore$ II is not sufficient to give the answer.

$\therefore$ The correct answer is (*a*).

8. Let the two trains of length a metres and b metres be moving in opposite directions at u m/s and v m/s. Then,

I gives, $u + v = 160$.

II gives, $v = \dfrac{b}{9}$.

From these equations, we cannot obtain u.

$\therefore$ The correct answer is (*d*).

9. Let the two trains of length a metres and b metres be moving in opposite directions at u m/s and v m/s.

Time taken to cross each other $= \dfrac{(a+b)}{(u+v)}$ sec.

Now, $b = 180$, $u + v = \left(150 \times \dfrac{5}{18}\right)$ m/sec $= \dfrac{125}{3}$ m/sec.

$\Rightarrow\ 9 = \dfrac{a+180}{(125/3)} \Rightarrow a = (375 - 180) = 195$ m.

Thus, both I and II are necessary to get the answer.

$\therefore$ The correct answer is (*e*).

10. Let the two trains of length a metres and b metres be moving in opposite directions at u m/s and v m/s.

Time taken to cross each other $= \dfrac{(a+b)}{(u+v)}$ m/sec. $\Rightarrow x = \dfrac{(a+a)}{(u+u)} = \dfrac{a}{u}$. ...(*i*)

Time taken to cross the pole $= \dfrac{\text{Length of the train}}{\text{Speed of the train}} = \dfrac{a}{u} \Rightarrow \dfrac{a}{u} = 5$ ...(*ii*)

From (*i*) and (*ii*) also, we cannot find u.

$\therefore$ The correct answer is (*d*).

11. Time taken to cross a pole $= \dfrac{\text{Length of train}}{\text{Speed of train}} \Rightarrow 10 = \dfrac{\text{Length of train}}{\left(108 \times \dfrac{5}{18}\right)}$

$\Rightarrow$ Length of the train = 300 m.

Clearly, II is sufficient to get the answer.

Also, I is not sufficient to get the answer.

$\therefore$ The correct answer is (*b*).

12. Time taken to cross the train, running in opposite directions $= \dfrac{(l_1 + l_2)}{(u+v)}$ sec.

$\Rightarrow\ 10 = \dfrac{(210+300)}{(u+v)} \Rightarrow u + v = 51.$

Time taken to cross the train, running in same direction $= \dfrac{(l_1 + l_2)}{(u-v)}$ sec.

$\Rightarrow\ 30 = \dfrac{(210+300)}{\left(u - 60 \times \dfrac{5}{18}\right)} \Rightarrow u = \left(17 + \dfrac{50}{3}\right)$ m/sec.

Thus, u and v can be obtained.

$\therefore$ Correct answer is (*e*).

13. Let the speed of the train be x metres/sec.

Time taken to cross a tree $= \dfrac{\text{Length of the train}}{\text{Speed of the train}}$

Time taken to cross a platform $= \dfrac{(\text{Length of train} + \text{Length of platform})}{\text{Speed of the train}}$ ...(*ii*)

I gives, $13 = \dfrac{l}{x} \Rightarrow 13x$

II gives $27 = \dfrac{l+250}{x} \Rightarrow \dfrac{13x+250}{x} = 24 \Rightarrow x = \dfrac{125}{7}$ m/sec.

Thus I and II give the speed of the train.

$\therefore$ The correct answer is (*a*)

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

Time taken to cross a platform $= \dfrac{\text{(Length of train + Length of platform)}}{\text{Speed of the train}}$

Time taken by the train to cross a stationary train

$$= \frac{\text{(Sum of the lengths of the trains)}}{\text{Speed of moving train}}$$

Time taken to cross a signal pole $= \dfrac{\text{Length of train}}{\text{Speed of train}}$

I gives, $21 = \dfrac{(l+300)}{x}$; II gives, $\dfrac{39}{2} = \dfrac{2l}{x}$; III gives, $\dfrac{39}{4} = \dfrac{l}{x}$.

Thus, (I and II) or (I and III) give x.

$\therefore$ Correct answer is (*b*).

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

Time taken to cross a signal pole $= \dfrac{\text{Length of train}}{\text{Speed of train}}$.

Time taken to cross a platform $= \dfrac{\text{(Length of train + Length of platform)}}{\text{Speed of the train}}$

Length of train = 330 m.

I and III give, $18 = \dfrac{330}{x} \Rightarrow x = \dfrac{330}{18}$ m/s $= \dfrac{55}{3}$ m/s.

II and III give, $36 = \dfrac{2 \times 330}{x} \Rightarrow x = \dfrac{660}{36}$ m/s $= \dfrac{55}{3}$ m/s.

$\therefore$ Correct answer is (*d*).

16. Time taken to cross a pole $= \dfrac{\text{Length of train}}{\text{Its speed}} \Rightarrow 20 = \dfrac{l}{\text{speed}} \Rightarrow \text{speed} = \dfrac{l}{20}$ ...(*i*)

Time taken to cross a platform $= \dfrac{(l+800)}{\text{speed}}$

$\Rightarrow 100 = \dfrac{(l+800)}{\text{speed}} \Rightarrow \text{speed} = \dfrac{(l+800)}{100}$ ...(*ii*)

Time taken to pass through a tunnel $= \dfrac{(l+400)}{60}$

$\Rightarrow 60 = \dfrac{(l+400)}{\text{speed}} \Rightarrow \text{speed} = \dfrac{(l+400)}{60}$ ...(*iii*)

Equating any two out of three will give us l.

$\therefore$ Correct answer is (*e*).

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

III gives that the men are moving in the same direction.

I gives, time taken to pass a man $= \dfrac{l}{\left(x - 3 \times \dfrac{5}{18}\right)} = \left(\dfrac{6l}{6x-5}\right)$ sec.

$\therefore \dfrac{6l}{6x-5} = 9 \Rightarrow 54x - 6l = 45 \Rightarrow 18x - 2l = 15$ ...(*i*)

II gives, time taken to pass another man $= \dfrac{l}{\left(x - 6 \times \dfrac{5}{18}\right)}$ sec $= \dfrac{3l}{(3x-5)}$ sec.

$\therefore \quad \dfrac{3l}{(3x-5)} = 10 \Rightarrow 30x - 3l = 50$ ...(*ii*)

On solving (*i*) and (*ii*), we get : $x = \dfrac{55}{6}$ m/sec.

Thus, all I, II, III are needed to get the answer.

$\therefore$ (*d*) is correct.

18. II. Let the speeds of A and B be $3x$ m/sec and $2x$ m/sec.

I. Length of train A $= (3x \times 6)$ m $= 18x$ metres.

III. Length of train B $= (500 - 18x)$ m.

Relative speed $= (3x + 2x)$ m/sec $= 5x$ m/sec.

Time taken by A to cross B $= \dfrac{\text{Sum of their lengths}}{\text{Relative speed}} = \dfrac{500}{5x}$ sec.

Thus, even with the information in all the three statements, question cannot be answered.

$\therefore$ Correct answer is (*e*).

19. Let the length of train P be x metres.

II. These trains are running in opposite directions.

III. Length of train Q is 180 m.

I. Time taken by P to cross Q $= \dfrac{(180 + x)}{\text{Relative speed}} \Rightarrow 18 = \dfrac{(180 + x)}{\text{Relative speed}}$

Thus, even with I, II and III, the answer cannot be obtained.

$\therefore$ Correct answer is (*e*).

20. III gives, speed $= \dfrac{200}{10}$ m/s $= 20$ m/s $= \left(20 \times \dfrac{18}{5}\right)$ km/hr $= 72$ km/hr.

II gives, time taken $= \left(\dfrac{558}{72}\right)$ hrs $= \dfrac{31}{4}$ hrs $= 7\dfrac{3}{4}$ hrs $= 7$ hrs 45 min.

So, the train will reach city X at 3 p.m.

Hence, I is redundant.

19. BOATS AND STREAMS

IMPORTANT FACTS AND FORMULAE

1. In water, the direction along the stream is called ***downstream***. And, the direction against the stream is called ***upstream***.
2. If the speed of a boat in still water is u km/hr and the speed of the stream is v km/hr, then :

$$\textit{Speed downstream} = (u+v) \text{ km/hr}$$

$$\textit{Speed upstream} = (u-v) \text{ km/hr.}$$

3. If the speed downstream is a km/hr and the speed upstream is b km/hr, then :

$$\textit{Speed in still water} = \frac{1}{2}(a+b) \text{ km/hr}$$

$$\textit{Rate of stream} = \frac{1}{2}(a-b) \text{ km/hr}$$

SOLVED EXAMPLES

Ex. 1. ***A man can row upstream at 7 kmph and downstream at 10 kmph. Find man's rate in still water and the rate of current.***

Sol. Rate in still water $= \frac{1}{2}(10+7)$ km/hr $= 8.5$ km/hr.

Rate of current $= \frac{1}{2}(10-7)$ km/hr $= 1.5$ km/hr.

Ex. 2. ***A man takes 3 hours 45 minutes to row a boat 15 km downstream of a river and 2 hours 30 minutes to cover a distance of 5 km upstream. Find the speed of the river current in km/hr.***

Sol. Rate downstream $= \left(\frac{15}{3\frac{3}{4}}\right)$ km/hr $= \left(15 \times \frac{4}{15}\right)$ km/hr $= 4$ km/hr.

Rate upstream $= \left(\frac{5}{2\frac{1}{2}}\right)$ km/hr $= \left(5 \times \frac{2}{5}\right)$ km/hr $= 2$ km/hr.

$\therefore$ Speed of current $= \frac{1}{2}(4-2)$ km/hr $= 1$ km/hr.

Ex. 3. ***A man can row 18 kmph in still water. It takes him thrice as long to row up as to row down the river. Find the rate of stream.***

Sol. Let man's rate upstream be x kmph. Then, his rate downstream $= 3x$ kmph.

$\therefore$ Rate in still water $= \frac{1}{2}(3x+x)$ kmph $= 2x$ kmph.

So, $2x = 18$ or $x = 9$.

$\therefore$ Rate upstream $= 9$ km/hr, Rate downstream $= 27$ km/hr.

Hence, rate of stream $= \frac{1}{2}(27-9)$ km/hr $= 9$ km/hr.

Ex. 4. ***There is a road beside a river. Two friends started from a place A, moved to a temple situated at another place B and then returned to A again. One of them moves on a cycle at a speed of 12 km/hr, while the other sails on a boat at a speed of 10 km/hr. If the river flows at the speed of 4 km/hr, which of the two friends will return to place A first ?*** (R.R.B. 2001)

Sol. Clearly, the cyclist moves both ways at a speed of 12 km/hr.

So, average speed of the cyclist = 12 km/hr.

The boat sailor moves downstream @ (10 + 4) *i.e.*, 14 km/hr and upstream @ (10 – 4) *i.e.*, 6 km/hr.

So, average speed of the boat sailor $= \left(\frac{2 \times 14 \times 6}{14 + 6}\right)$ km/hr

$= \frac{42}{5}$ km/hr = 8.4 km/hr.

Since the average speed of the cyclist is greater, he will return to A first.

Ex. 5. ***A man can row $7\frac{1}{2}$ kmph in still water. If in a river running at 1.5 km an hour, it takes him 50 minutes to row to a place and back, how far off is the place ?*** (R.R.B. 2002)

Sol. Speed downstream = (7.5 + 1.5) kmph = 9 kmph;

Speed upstream = (7.5 – 1.5) kmph = 6 kmph.

Let the required distance be x km. Then,

$$\frac{x}{9} + \frac{x}{6} = \frac{50}{60} \Leftrightarrow 2x + 3x = \left(\frac{5}{6} \times 18\right) \Leftrightarrow 5x = 15 \Leftrightarrow x = 3.$$

Hence, the required distance is 3 km.

Ex. 6. ***In a stream running at 2 kmph, a motorboat goes 6 km upstream and back again to the starting point in 33 minutes. Find the speed of the motorboat in still water.***

Sol. Let the speed of the motorboat in still water be x kmph. Then,

Speed downstream = $(x + 2)$ kmph; Speed upstream = $(x - 2)$ kmph.

$$\therefore \quad \frac{6}{x+2} + \frac{6}{x-2} = \frac{33}{60} \Leftrightarrow 11x^2 - 240x - 44 = 0 \Leftrightarrow 11x^2 - 242x + 2x - 44 = 0$$

$$\Leftrightarrow (x - 22)(11x + 2) = 0 \Leftrightarrow x = 22.$$

Hence, speed of motorboat in still water = 22 kmph.

Ex. 7. ***A man can row 40 km upstream and 55 km downstream in 13 hours. Also, he can row 30 km upstream and 44 km downstream in 10 hours. Find the speed of the man in still water and the speed of the current.***

Sol. Let rate upstream = x km/hr and rate downstream = y km/hr.

Then, $\frac{40}{x} + \frac{55}{y} = 13$ ...(*i*) and $\frac{30}{x} + \frac{44}{y} = 10$ ...(*ii*)

Multiplying (*ii*) by 4 and (*i*) by 3 and subtracting, we get : $\frac{11}{y} = 1$ or $y = 11$.

Substituting $y = 11$ in (*i*), we get : $x = 5$.

$\therefore$ Rate in still water $= \frac{1}{2}(11 + 5)$ kmph = 8 kmph.

Rate of current $= \frac{1}{2}(11 - 5)$ kmph = 3 kmph.

EXERCISE 19A

(OBJECTIVE TYPE QUESTIONS)

Directions : *Mark (✓) against the correct answer* :

1. In one hour, a boat goes 11 km along the stream and 5 km against the stream. The speed of the boat in still water (in km / hr) is : (S.S.C. 2000)
   (*a*) 3 (*b*) 5 (*c*) 8 (*d*) 9
2. A man can row upstream at 8 kmph and downstream at 13 kmph. The speed of the stream is :
   (*a*) 2.5 km / hr (*b*) 4.2 km / hr (*c*) 5 km / hr (*d*) 10.5 km / hr
3. A man rows downstream 32 km and 14 km upstream. If he takes 6 hours to cover each distance, then the velocity (in kmph) of the current is :
   (*a*) $\frac{1}{2}$ (*b*) 1 (*c*) $1\frac{1}{2}$ (*d*) 2
4. 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 ? (S.B.I.P.O. 2002)
   (*a*) 4 km / hr (*b*) 6 km / hr (*c*) 8 km / hr (*d*) Data inadequate
5. A boatman goes 2 km against the current of the stream in 1 hour and goes 1 km along the current in 10 minutes. How long will it take to go 5 km in stationary water ? (R.R.B. 2002)
   (*a*) 40 minutes (*b*) 1 hour (*c*) 1 hr 15 min (*d*) 1 hr 30 min
6. A man can row three-quarters of a kilometre against the stream in $11\frac{1}{4}$ minutes. The speed (in km / hr) of the man in still water is : (L.I.C.A.A.O. 2003)
   (*a*) 2 (*b*) 3 (*c*) 4 (*d*) 5
7. A man takes twice as long to row a distance against the stream as to row the same distance in favour of the stream. The ratio of the speed of the boat (in still water) and the stream is : (S.S.C. 1998)
   (*a*) 2 : 1 (*b*) 3 : 1 (*c*) 3 : 2 (*d*) 4 : 3
8. 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 ? (Bank P.O. 2003)
   (*a*) 2 : 1 (*b*) 3 : 2 (*c*) 8 : 3
   (*d*) Cannot be determined (*e*) None of these
9. If a boat goes 7 km upstream in 42 minutes and the speed of the stream is 3 kmph, then the speed of the boat in still water is :
   (*a*) 4.2 km / hr (*b*) 9 km / hr (*c*) 13 km / hr (*d*) 21 km / hr
10. 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 : (M.A.T. 1997)
    (*a*) 8.5 km / hr (*b*) 9 km / hr (*c*) 10 km / hr (*d*) 12.5 km / hr
11. If a man rows at the rate of 5 kmph in still water and his rate against the current is 3.5 kmph, then the man's rate along the current is :
    (*a*) 4.25 kmph (*b*) 6 kmph (*c*) 6.5 kmph (*d*) 8.5 kmph
12. 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. (R.R.B. 2003)
    (*a*) 2 hours (*b*) 3 hours (*c*) 4 hours (*d*) 5 hours

13. Speed of a boat in standing water is 9 kmph and the speed of the stream is 1.5 kmph. A man rows to a place at a distance of 105 km and comes back to the starting point. The total time taken by him is :

(a) 16 hours (b) 18 hours (c) 20 hours (d) 24 hours

14. 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

15. 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

(S.S.C. 2004)

16. A boat takes 19 hours for travelling downstream from point A to point B and coming back to a point C midway between A and B. If the velocity of the stream is 4 kmph and the speed of the boat in still water is 14 kmph, what is the distance between A and B ?

(a) 160 km (b) 180 km (c) 200 km (d) 220 km

17. A man can row $9\frac{1}{3}$ kmph in still water and finds that it takes him thrice as much time to row up than as to row down the same distance in the river. The speed of the current is :

(a) $3\frac{1}{3}$ km / hr (b) $3\frac{1}{9}$ km / hr (c) $4\frac{2}{3}$ km / hr (d) $4\frac{1}{2}$ km / hr

18. 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 ?

(Bank P.O. 2003)

(a) 12 kmph (b) 13 kmph (c) 14 kmph
(d) 15 kmph (e) None of these

19. A motorboat, whose speed is 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

(R.R.B. 2002)

20. The speed of a boat in still water is 10 km / hr. If it can travel 26 km downstream and 14 km upstream in the same time, the speed of the stream is :

(a) 2 km / hr (b) 2.5 km / hr (c) 3 km / hr (d) 4 km / hr

21. 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 :

(M.A.T. 1997)

(a) 2 mph (b) 2.5 mph (c) 3 mph (d) 4 mph

22. A man rows to a place 48 km distant and back in 14 hours. He finds that he can row 4 km with the stream in the same time as 3 km against the stream. The rate of the stream is :

(a) 1 km / hr (b) 1.5 km / hr (c) 1.8 km / hr (d) 3.5 km / hr

23. A boat covers 24 km upstream and 36 km downstream in 6 hours while it covers 36 km upstream and 24 km downstream in $6\frac{1}{2}$ hours. The velocity of the current is :

(a) 1 km / hr (b) 1.5 km / hr (c) 2 km / hr (d) 2.5 km / hr

24. At his usual rowing rate, Rahul can travel 12 miles downstream in a certain river in 6 hours less than it takes him to travel the same distance upstream. But if he could double his usual rowing rate for his 24-mile round trip, the downstream 12 miles would then take only one hour less than the upstream 12 miles. What is the speed of the current in miles per hour? **(M.A.T. 2001)**

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

ANSWERS

1. (*c*)	**2.** (*a*)	**3.** (*c*)	**4.** (*b*)	**5.** (*c*)	**6.** (*d*)	**7.** (*b*)	**8.** (*c*)
9. (*c*)	**10.** (*c*)	**11.** (*c*)	**12.** (*c*)	**13.** (*d*)	**14.** (*d*)	**15.** (*a*)	**16.** (*b*)
17. (*c*)	**18.** (*d*)	**19.** (*b*)	**20.** (*c*)	**21.** (*a*)	**22.** (*a*)	**23.** (*c*)	**24.** (*d*)

SOLUTIONS

1. Speed in still water $= \frac{1}{2}(11+5)$ kmph $= 8$ kmph.

2. Speed of stream $= \frac{1}{2}(13-8)$ kmph $= 2.5$ kmph.

3. Rate downstream $= \left(\frac{32}{6}\right)$ kmph; Rate upstream $= \left(\frac{14}{6}\right)$ kmph.

   $\therefore$ Velocity of current $= \frac{1}{2}\left(\frac{32}{6}-\frac{14}{6}\right)$ kmph $= \frac{3}{2}$ kmph $= 1.5$ kmph.

4. Rate downstream $= \left(\frac{16}{2}\right)$ kmph $= 8$ kmph; Rate upstream $= \left(\frac{16}{4}\right)$ kmph $= 4$ kmph.

   $\therefore$ Speed in still water $= \frac{1}{2}(8+4)$ kmph $= 6$ kmph.

5. Rate downstream $= \left(\frac{1}{10}\times 60\right)$ km/hr $= 6$ km/hr; Rate upstream $= 2$ km/hr.

   Speed in still water $= \frac{1}{2}(6+2)$ km/hr $= 4$ km/hr.

   $\therefore$ Required time $= \left(\frac{5}{4}\right)$ hrs $= 1\frac{1}{4}$ hrs $= 1$ hr 15 min.

6. Rate upstream $= \left(\frac{750}{675}\right)$ m/sec $= \frac{10}{9}$ m/sec;

   Rate downstream $= \left(\frac{750}{450}\right)$ m/sec $= \frac{5}{3}$ m/sec.

   $\therefore$ Rate in still water $= \frac{1}{2}\left(\frac{10}{9}+\frac{5}{3}\right)$ m/sec $= \frac{25}{18}$ m/sec $= \left(\frac{25}{18}\times\frac{18}{5}\right)$ km/hr

   $= 5$ km/hr.

7. Let man's rate upstream be x kmph. Then, his rate downstream $= 2x$ kmph.

   $\therefore$ (Speed in still water) : (Speed of stream) $= \left(\frac{2x+x}{2}\right) : \left(\frac{2x-x}{2}\right) = \frac{3x}{2} : \frac{x}{2} = 3 : 1.$

8. Let the man' 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.

$$\Rightarrow \left(x \times 8\frac{4}{5}\right) = (y \times 4) \Rightarrow \frac{44}{5}x = 4y \Rightarrow y = \frac{11}{5}x.$$

$$\therefore \text{ Required ratio} = \left(\frac{y+x}{2}\right) : \left(\frac{y-x}{2}\right) = \left(\frac{16x}{5} \times \frac{1}{2}\right) : \left(\frac{6x}{5} \times \frac{1}{2}\right) = \frac{8}{5} : \frac{3}{5} = 8 : 3.$$

9. Rate upstream $= \left(\frac{7}{42} \times 60\right)$ kmph = 10 kmph.
Speed of stream = 3 kmph.
Let speed in still water be x km / hr. Then, speed upstream = $(x - 3)$ km / hr.
$\therefore$ $x - 3 = 10$ or $x = 13$ km / hr.

10. 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.

11. Let the rate along the current be x kmph. Then, $\frac{1}{2}(x + 3.5) = 5$ or $x = 6.5$ kmph.

12. Speed downstream = (13 + 4) km / hr = 17 km / hr.
Time taken to travel 68 km downstream $= \left(\frac{68}{17}\right)$ hrs = 4 hrs.

13. Speed upstream = 7.5 kmph; Speed downstream = 10.5 kmph.
$\therefore$ Total time taken $= \left(\frac{105}{7.5} + \frac{105}{10.5}\right)$ hours = 24 hours.

14. Speed downstream = (15 + 3) kmph = 18 kmph.
Distance travelled $= \left(18 \times \frac{12}{60}\right)$ km = 3.6 km.

15. Speed downstream = (5 + 1) kmph = 6 kmph; Speed upstream = (5 – 1) kmph = 4 kmph.
Let the required distance be x km.
Then, $\frac{x}{6} + \frac{x}{4} = 1 \Leftrightarrow 2x + 3x = 12 \Leftrightarrow 5x = 12 \Leftrightarrow x = 2.4$ km.

16. Speed downstream = (14 + 4) km / hr = 18 km / hr;
Speed upstream = (14 – 4) km / hr = 10 km / hr.
Let the distance between A and B be x km. Then,
$$\frac{x}{18} + \frac{(x/2)}{10} = 19 \Leftrightarrow \frac{x}{18} + \frac{x}{20} = 19 \Leftrightarrow \frac{19x}{180} = 19 \Leftrightarrow x = 180 \text{ km}.$$

17. Let speed upstream be x kmph. Then, speed downstream = $3x$ kmph.
Speed in still water $= \frac{1}{2}(3x + x)$ kmph = $2x$ kmph.
$\therefore$ $2x = \frac{28}{3} \Rightarrow x = \frac{14}{3}$.
So, Speed upstream $= \frac{14}{3}$ km / hr; Speed downstream = 14 km / hr.
Hence, speed of the current $= \frac{1}{2}\left(14 - \frac{14}{3}\right)$ km / hr $= \frac{14}{3}$ km / hr $= 4\frac{2}{3}$ km / hr.

18. Let the speed of the boat in still water be x kmph. Then,
Speed downstream = $(x + 3)$ kmph, Speed upstream = $(x - 3)$ kmph.
$$\therefore (x+3) \times 1 = (x-3) \times \frac{3}{2} \Leftrightarrow 2x + 6 = 3x - 9 \Leftrightarrow x = 15 \text{ kmph}.$$

19. Let the speed of the stream be x km / hr. Then,

Speed downstream = $(15 + x)$ km / hr, Speed upstream = $(15 - x)$ km / hr.

$$\therefore \quad \frac{30}{(15+x)} + \frac{30}{(15-x)} = 4\frac{1}{2} \quad \Leftrightarrow \quad \frac{900}{225 - x^2} = \frac{9}{2} \quad \Leftrightarrow \quad 9x^2 = 225$$

$$\Leftrightarrow \quad x^2 = 25 \quad \Leftrightarrow \quad x = 5 \text{ km / hr.}$$

20. Let the speed of the stream be x km / hr. Then,

Speed downstream = $(10 + x)$ km / hr, Speed upstream = $(10 - x)$ km / hr.

$$\therefore \quad \frac{26}{(10+x)} = \frac{14}{(10-x)} \quad \Leftrightarrow \quad 260 - 26x = 140 + 14x \quad \Leftrightarrow \quad 40x = 120 \quad \Leftrightarrow \quad x = 3 \text{ km / hr.}$$

21. Let the speed of the stream be x mph. Then,

Speed downstream = $(10 + x)$ mph, Speed upstream = $(10 - x)$ mph.

$$\therefore \quad \frac{36}{(10-x)} - \frac{36}{(10+x)} = \frac{90}{60} \quad \Leftrightarrow \quad 72x \times 60 = 90\,(100 - x^2) \quad \Leftrightarrow \quad x^2 + 48x + 100 = 0$$

$$\Leftrightarrow \quad (x + 50)\,(x - 2) = 0 \quad \Leftrightarrow \quad x = 2 \text{ mph.}$$

22. Suppose he moves 4 km downstream in x hours. Then,

Speed downstream = $\left(\frac{4}{x}\right)$ km / hr, Speed upstream = $\left(\frac{3}{x}\right)$ km / hr.

$$\therefore \quad \frac{48}{(4/x)} + \frac{48}{(3/x)} = 14 \text{ or } x = \frac{1}{2}.$$

So, Speed downstream = 8 km / hr, Speed upstream = 6 km / hr.

Rate of the stream = $\frac{1}{2}(8 - 6)$ km / hr = 1 km / hr.

23. Let rate upstream = x kmph and rate downstream = y kmph.

Then, $\frac{24}{x} + \frac{36}{y} = 36$ ...(*i*) and $\frac{36}{x} + \frac{24}{y} = \frac{13}{2}$ ...(*ii*)

Adding (*i*) and (*ii*), we get : $60\left(\frac{1}{x} + \frac{1}{y}\right) = \frac{25}{2}$ or $\frac{1}{x} + \frac{1}{y} = \frac{5}{24}$ ...(*iii*)

Subtracting (*i*) from (*ii*), we get : $12\left(\frac{1}{x} - \frac{1}{y}\right) = \frac{1}{2}$ or $\frac{1}{x} - \frac{1}{y} = \frac{1}{24}$ ...(*iv*)

Adding (*iii*) and (*iv*), we get : $\frac{2}{x} = \frac{6}{24}$ or $x = 8$.

So, $\frac{1}{8} + \frac{1}{y} = \frac{5}{24} \Leftrightarrow \frac{1}{y} = \left(\frac{5}{24} - \frac{1}{8}\right) = \frac{1}{12} \Leftrightarrow y = 12.$

$\therefore$ Speed upstream = 8 kmph, Speed downstream = 12 kmph.

Hence, rate of current = $\frac{1}{2}(12 - 8)$ kmph = 2 kmph.

24. Let the speed in still water be x mph and the speed of the current be y mph. Then,

Speed upstream = $(x - y)$; Speed downstream = $(x + y)$

$$\therefore \quad \frac{12}{(x-y)} - \frac{12}{(x+y)} = 6 \quad \Leftrightarrow \quad 6\,(x^2 - y^2) = 24y \quad \Leftrightarrow \quad x^2 - y^2 = 4y$$

$$\Leftrightarrow \quad x^2 = (4y + y^2) \quad \text{...(i)}$$

And, $\frac{12}{(2x-y)} - \frac{12}{(2x+y)} = 1 \Leftrightarrow 4x^2 - y^2 = 24y \Leftrightarrow x^2 = \frac{24y + y^2}{4}$ ...(*ii*)

From (*i*) and (*ii*), we have :

$$4y + y^2 = \frac{24y + y^2}{4} \Leftrightarrow 16y + 4y^2 = 24y + y^2 \Leftrightarrow 3y^2 = 8y \Leftrightarrow y = \frac{8}{3}.$$

$\therefore$ Speed of the current $= \frac{8}{3}$ mph $= 2\frac{2}{3}$ mph.

EXERCISE 19B

(DATA SUFFICIENCY TYPE QUESTIONS)

Directions (*Questions 1 to 6*) : ***Each of the questions given below consists of a statement and/or a question and two statements numbered I and II given below it. You have to decide whether the data provided in the statement(s) is/are sufficient to answer the question. Read both the statements and***

Give answer (a) if the data in Statement I alone are sufficient to answer the question, while the data in Statement II alone are not sufficient to answer the question;

Give answer (b) if the data in Statement II alone are sufficient to answer the question while the data in statement I alone are not sufficient to answer the question;

Give answer (c) if the data either in Statement I or in Statement II alone are sufficient to answer the question;

Give answer (d) if the data even in both Statements I and II together are not sufficient to answer the question;

Give answer (e) if the data in both Statements I and II together are necessary to answer the question.

1. What is the speed of the boat in still water ? **(Bank P.O. 2003)**
   I. It takes 2 hours to cover the distance between A and B downstream.
   II. It takes 4 hours to cover the distance between A and B upstream.
2. What is the speed of the stream ?
   I. The ratio of the speed upstream to the speed downstream of a boat is 2 : 3.
   II. The distance travelled upstream in 2 hours by the boat is more than the distance travelled by it downstream in 1 hour by 4 km.
3. What is the speed of the boat in still water ? **(Bank P.O. 2003)**
   I. The boat covers a distance of 48 kms in 6 hours while running upstream.
   II. The boat covers the same distance in 4 hours while running downstream.
4. What is the man's speed in still water ?
   I. The speed of the stream is one-third of the man's speed in still water.
   II. In a given time, the man can swim twice as far with the stream as he can against it.
5. A boat takes a total time of three hours to travel downstream from P to Q and upstream back from Q to P. What is the speed of the boat in still water ?
   I. The speed of the river current is 1 km per hour.
   II. The distance between P and Q is 4 km. **(S.B.I.P.O. 1997)**
6. What is the speed of the boat in still water ?
   I. The speed downstream of the boat is thrice the speed upstream.
   II. The sum of the speeds of the boat, upstream and downstream is 12 kmph.

Directions (*Questions 7-8*) : ***Each of the questions given below consists of a question followed by three statements. You have to study the question and the statements and decide which of the statement(s) is/are necessary to answer the questions.***

7. What is the speed of the boat in still water ?
   I. The speed downstream is 12 kmph.
   II. The speed upstream is 4 kmph.
   III. In a to and fro journey between two points, the average speed of the boat was 6 kmph.
   (*a*) I and II only (*b*) All I, II and III (*c*) III, and either I or II
   (*d*) Any two of the three (*e*) None of these
8. What is the speed of stream ? **(Bank P.O. 2004)**
   I. The boat covers 24 km in 6 hours moving upstream.
   II. The boat covers 24 km in 3 hours moving downstream.
   III. The ratio between the speed of boat and stream is 3 : 1 respectively.
   (*a*) Any two of the three (*b*) I and II only (*c*) II and III only
   (*d*) I and III only (*e*) All I, II and III

ANSWERS

1. (*d*) 2. (*e*) 3. (*e*) 4. (*d*) 5. (*e*) 6. (*b*) 7. (*d*) 8. (*a*)

SOLUTIONS

1. Let AB = x km.

   I. Speed downstream = $\frac{x}{2}$ km/hr. II. Speed upstream = $\frac{x}{4}$ km/hr.

   Speed of boat in still water = $\frac{1}{2}\left(\frac{x}{2}+\frac{x}{4}\right)$ km/hr.

   Thus, I and II both even do not give the answer.

   ∴ Correct answer is (*d*).

2. I. Let speed upstream = $2x$ km/hr and speed downstream = $3x$ km/hr.

   II. $(2 \times 3x) - (1 \times 2x) = 4 \Leftrightarrow 4x = 4 \Leftrightarrow x = 1$.

   ∴ Speed upstream = 2 km/hr, speed downstream = 3 km/hr.

   Speed of the stream = $\frac{1}{2}(3-2)$ km/hr = $\frac{1}{2}$ km/hr.

   Thus, I and II together give the answer.

   ∴ Correct answer is (*e*).

3. I. Speed upstream = $\frac{48}{6}$ km/hr = 8 km/hr.

   II. Speed downstream = $\frac{48}{4}$ km/hr = 12 km/hr.

   Speed of the boat = $\frac{1}{2}(8+12)$ km/hr = 10 km/hr.

   Thus, I and II together give the answer.

   ∴ Correct answer is (*e*).

4. Let man's speed in still water be x km/hr.

   I. Speed of the stream = $\frac{x}{3}$ km/hr.

   Speed downstream = $\left(x+\frac{x}{3}\right)$ km/hr = $\frac{4x}{3}$ km/hr.

   Speed upstream = $\left(x-\frac{x}{3}\right)$ km/hr = $\frac{2x}{3}$ km/hr.

20. ALLIGATION OR MIXTURE

IMPORTANT FACTS AND FORMULAE

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 a desired price.
2. **Mean Price** : The cost price of a unit quantity of the mixture is called the mean price.
3. **Rule of Alligation** : If two ingredients are mixed, then

$$\left(\frac{\text{Quantity of cheaper}}{\text{Quantity of dearer}}\right) = \frac{(\text{C.P. of dearer}) - (\text{Mean price})}{(\text{Mean price}) - (\text{C.P. of cheaper})}.$$

We present as under :

C.P. of a unit quantity of cheaper (c) — C.P. of a unit quantity of dearer (d)

Mean price (m)

$(d - m)$ — $(m - c)$

$\therefore$ (Cheaper quantity) : (Dearer quantity) = $(d - m) : (m - c)$.

4. Suppose a container contains x units of liquid from which y units are taken out and replaced by water. After n operations, the quantity of pure liquid $= \left[x\left(1 - \frac{y}{x}\right)^n\right]$ units.

SOLVED EXAMPLES

Ex. 1. ***In what ratio must rice at Rs. 9.30 per kg be mixed with rice at Rs. 10.80 per kg so that the mixture be worth Rs. 10 per kg ?***

Sol. By the rule of alligation, we have :

C.P. of 1 kg rice of 1st kind (in paise) — C.P. of 1 kg rice of 2nd kind (in paise)

930 — 1080

Mean price (in paise)

1000

80 — 70

$\therefore$ Required ratio = 80 : 70 = 8 : 7.

Ex. 2. ***How much water must be added to 60 litres of milk at $1\frac{1}{2}$ litres for Rs. 20 so as to have a mixture worth Rs. $10\frac{2}{3}$ a litre ?***

Sol. C.P. of 1 litre of milk = Rs. $\left(20 \times \frac{2}{3}\right)$ = Rs. $\frac{40}{3}$.

C.P. of 1 litre of water | C.P. of 1 litre of milk

0 | Rs. $\frac{40}{3}$

Mean price

$\left(\text{Rs. } \frac{32}{3}\right)$

$\left(\frac{40}{3} - \frac{32}{3}\right) = \frac{8}{3}$ | $\left(\frac{32}{3} - 0\right) = \frac{32}{3}$

$\therefore$ Ratio of water and milk $= \frac{8}{3} : \frac{32}{3} = 8 : 32 = 1 : 4.$

$\therefore$ Quantity of water to be added to 60 litres of milk $= \left(\frac{1}{4} \times 60\right)$ litres $= 15$ litres.

Ex. 3. ***In what ratio must water be mixed with milk to gain 20% by selling the mixture at cost price ?***

Sol. Let C.P. of milk be Re. 1 per litre.

Then, S.P. of 1 litre of mixture = Re. 1.

Gain obtained = 20%.

$\therefore$ C.P. of 1 litre of mixture $= \text{Rs. } \left(\frac{100}{120} \times 1\right) = \text{Re. } \frac{5}{6}.$

By the rule of alligation, we have :

C.P. of 1 litre of water | C.P. of 1 litre of milk

0 | Re. 1

$\left(\text{Re. } \frac{5}{6}\right)$

$\left(1 - \frac{5}{6}\right) = \frac{1}{6}$ | $\left(\frac{5}{6} - 0\right) = \frac{5}{6}$

$\therefore$ Ratio of water and milk $= \frac{1}{6} : \frac{5}{6} = 1 : 5.$

Ex. 4. ***How many kgs. of wheat costing Rs. 8 per kg must be mixed with 36 kg of rice costing Rs. 5.40 per kg so that 20% gain may be obtained by selling the mixture at Rs. 7.20 per kg ?***

Sol. S.P. of 1 kg mixture = Rs. 7.20, Gain = 20%.

$\therefore$ C.P. of 1 kg mixture $= \text{Rs. } \left(\frac{100}{120} \times 7.20\right) = \text{Rs. } 6.$

By the rule of alligation, we have :

C.P. of 1 kg wheat of 1st kind | C.P. of 1 kg wheat of 2nd kind

(800 *p*) | (540 *p*)

Mean price

(600 *p*)

60 | 200

Wheat of 1st kind : Wheat of 2nd kind = 60 : 200 = 3 : 10.

Let x kg of wheat of 1st kind be mixed with 36 kg of wheat of 2nd kind.

Then, $3 : 10 = x : 36$ or $10x = 3 \times 36$ or $x = 10.8$ kg.

Ex. 5. ***The milk and water in two vessels A and B are in the ratio 4 : 3 and 2 : 3 respectively. In what ratio, the liquids in both the vessels be mixed to obtain a new mixture in vessel C containing half milk and half water ?***

Sol. Let the C.P. of milk be Re. 1 per litre.

Milk in 1 litre mixture of A $= \frac{4}{7}$ litre; Milk in 1 litre mixture of B $= \frac{2}{5}$ litre;

Milk in 1 litre mixture of C $= \frac{1}{2}$ litre.

$\therefore$ C.P. of 1 litre mixture in A = Re. $\frac{4}{7}$; C.P. of 1 litre mixture in B = Re. $\frac{2}{5}$.

Mean price = Re. $\frac{1}{2}$.

By the rule of alligation, we have :

C.P. of 1 litre mix. in A C.P. of 1 litre mix. in B

$\left(\frac{4}{7}\right)$ $\left(\frac{2}{5}\right)$

$\left(\frac{1}{2}\right)$

$\left(\frac{1}{10}\right)$ $\left(\frac{1}{14}\right)$

$\therefore$ Required ratio $= \frac{1}{10} : \frac{1}{14} = 7 : 5.$

EXERCISE 20

(OBJECTIVE TYPE QUESTIONS)

Directions : ***Mark (✓) against the correct answer :***

1. 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 per kg ? **(R.R.B. 2003)**
   (*a*) 3 : 7 (*b*) 5 : 7 (*c*) 7 : 3 (*d*) 7 : 5
2. 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. **(IGNOU, 2003)**
   (*a*) 1 : 3 (*b*) 2 : 3 (*c*) 3 : 4 (*d*) 4 : 5
3. In what ratio must tea at Rs. 62 per kg be mixed with tea at Rs. 72 per kg so that the mixture must be worth Rs. 64.50 per kg ?
   (*a*) 3 : 1 (*b*) 3 : 2 (*c*) 4 : 3 (*d*) 5 : 3
4. In what ratio must water be mixed with milk costing Rs. 12 per litre to obtain a mixture worth of Rs. 8 per litre ?
   (*a*) 1 : 2 (*b*) 2 : 1 (*c*) 2 : 3 (*d*) 3 : 2
5. 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 : **(M.B.A. 2002)**
   (*a*) Rs. 18 (*b*) Rs. 18.50 (*c*) Rs. 19 (*d*) Rs. 19.50

6. 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
(S.S.C. 2004)

7. How many kilograms 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

8. In what ratio must water be mixed with milk to gain $16\frac{2}{3}\%$ on selling the mixture at cost price ? **(L.I.C.A.A.O. 2003)**
(*a*) 1 : 6 (*b*) 6 : 1 (*c*) 2 : 3 (*d*) 4 : 3

9. 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%

10. Two vessels A and B contain spirit and water mixed in the ratio 5 : 2 and 7 : 6 respectively. Find the ratio in which these mixture be mixed to obtain a new mixture in vessel C containing spirit and water in the ratio 8 : 5 ?
(*a*) 4 : 3 (*b*) 3 : 4 (*c*) 5 : 6 (*d*) 7 : 9

11. Two vessels A and B contain milk and water mixed in the ratio 8 : 5 and 5 : 2 respectively. The ratio in which these two mixtures be mixed to get a new mixture containing $69\frac{3}{13}\%$ milk, is :
(*a*) 2 : 7 (*b*) 3 : 5 (*c*) 5 : 2 (*d*) 5 : 7

12. 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

13. One quality of wheat at Rs. 9.30 per kg is mixed with another quality at a certain rate in the ratio 8 : 7. If the mixture so formed be worth Rs. 10 per kg, what is the rate per kg of the second quality of wheat ?
(*a*) Rs. 10.30 (*b*) Rs. 10.60 (*c*) Rs. 10.80 (*d*) Rs. 11

14. 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 : **(S.S.C. 1999)**
(*a*) Rs. 169.50 (*b*) Rs. 170 (*c*) Rs. 175.50 (*d*) Rs. 180

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

16. 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*) $\frac{3}{5}$

17. 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

18. 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 the water is 16 : 65. How much wine did the cask hold originally ? **(N.I.F.T. 2003)**

(*a*) 18 litres (*b*) 24 litres (*c*) 32 litres (*d*) 42 litres

19. 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

20. 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 ?

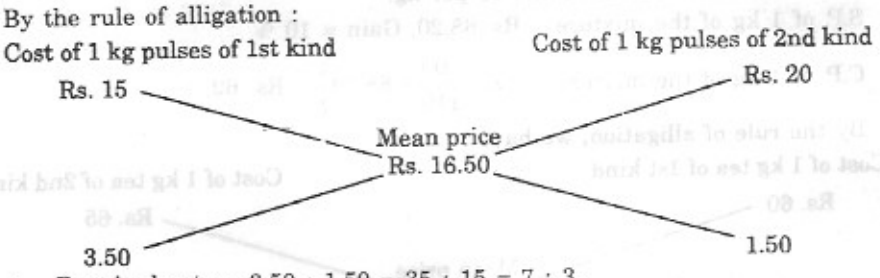
(*a*) $\frac{1}{3}$ (*b*) $\frac{1}{4}$ (*c*) $\frac{1}{5}$ (*d*) $\frac{1}{7}$

ANSWERS

1. (*c*) **2.** (*b*) **3.** (*a*) **4.** (*a*) **5.** (*a*) **6.** (*a*) **7.** (*d*) **8.** (*a*) **9.** (*c*) **10.** (*d*)
11. (*a*) **12.** (*b*) **13.** (*c*) **14.** (*c*) **15.** (*c*) **16.** (*b*) **17.** (*d*) **18.** (*b*) **19.** (*c*) **20.** (*c*)

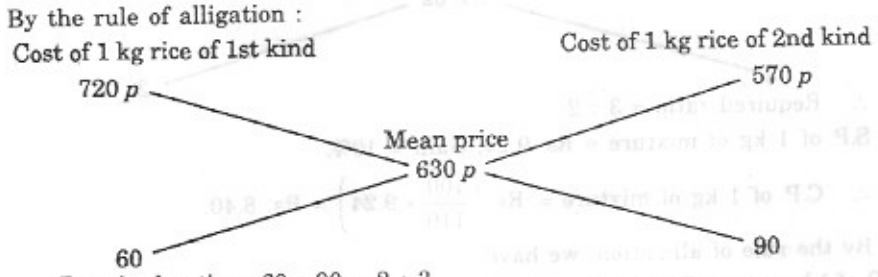
SOLUTIONS

1. By the rule of alligation :



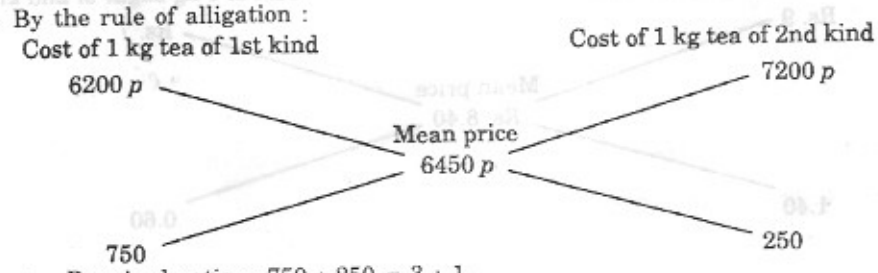
∴ Required rate = 3.50 : 1.50 = 35 : 15 = 7 : 3.

2. By the rule of alligation :



∴ Required ratio = 60 : 90 = 2 : 3.

3. By the rule of alligation :



∴ Required ratio = 750 : 250 = 3 : 1.

4. By the rule of alligation :

C.P. of 1 litre of water — C.P. of 1 litre of milk

0 — Rs. 12

Mean price Rs. 8

4 — 8

Ratio of water to milk = 4 : 8 = 1 : 2.

5. Let the price of the mixed variety be Rs. x per kg.

By the rule of alligation, we have :

Cost of 1 kg of Type 1 rice — Cost of 1 kg of Type 2 rice

Rs. 15 — Rs. 20

Mean price Rs. x

$(20 - x)$ — $(x - 15)$

$$\therefore \quad \frac{(20-x)}{(x-15)} = \frac{2}{3} \Rightarrow 60 - 3x = 2x - 30 \Rightarrow 5x = 90 \Rightarrow x = 18.$$

So, price of the mixture is Rs. 18 per kg.

6. S.P. of 1 kg of the mixture = Rs. 68.20, Gain = 10 %.

C.P. of 1 kg of the mixture = Rs. $\left(\frac{100}{110} \times 68.20\right)$ = Rs. 62.

By the rule of alligation, we have :

Cost of 1 kg tea of 1st kind — Cost of 1 kg tea of 2nd kind

Rs. 60 — Rs. 65

Mean price Rs. 62

3 — 2

$\therefore$ Required ratio = 3 : 2.

7. S.P. of 1 kg of mixture = Rs. 9.24, Gain = 10%.

$\therefore$ C.P. of 1 kg of mixture = Rs. $\left(\frac{100}{110} \times 9.24\right)$ = Rs. 8.40.

By the rule of alligation, we have :

C.P. of 1 kg sugar of 1st kind — Cost of 1 kg sugar of 2nd kind

Rs. 9 — Rs. 7

Mean price Rs. 8.40

1.40 — 0.60

$\therefore$ Ratio of quantities of 1st and 2nd kind = 14 : 6 = 7 : 3.

Let x kg of sugar of 1st kind be mixed with 27 kg of 2nd kind.

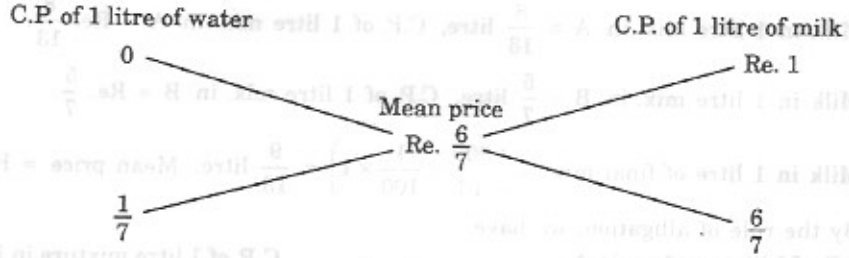
Then, $7 : 3 = x : 27$ or $x = \left(\frac{7 \times 27}{3}\right) = 63$ kg.

8. Let C.P. of 1 litre milk be Re. 1.

S.P. of 1 litre of mixture = Re. 1, Gain $= \frac{50}{3}\%$.

$\therefore$ C.P. of 1 litre of mixture $= \left(100 \times \frac{3}{350} \times 1\right) =$ Re. $\frac{6}{7}$.

By the rule of alligation, we have :

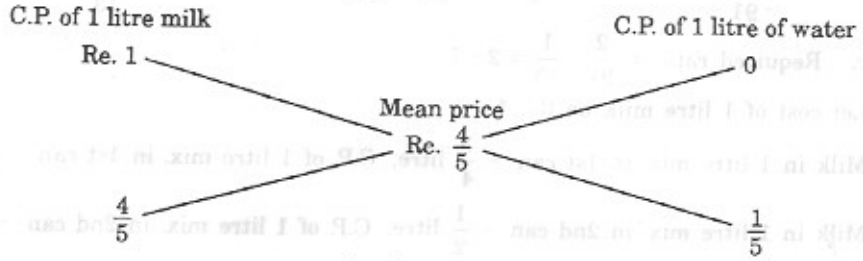


$\therefore$ Ratio of water and milk $= \frac{1}{7} : \frac{6}{7} = 1 : 6$.

9. Let C.P. of 1 litre milk be Re. 1.

Then, S.P. of 1 litre of mixture = Re. 1, Gain = 25%.

C.P. of 1 litre mixture = Re. $\left(\frac{100}{125} \times 1\right) =$ Re. $\frac{4}{5}$.



$\therefore$ Ratio of milk to water $= \frac{4}{5} : \frac{1}{5} = 4 : 1$.

Hence, percentage of water in the mixture $= \left(\frac{1}{5} \times 100\right)\% = 20\%$.

10. Let the C.P. of spirit be Re. 1 per litre.

Spirit in 1 litre mix. of A $= \frac{5}{7}$ litre; C.P. of 1 litre mix. in A = Re. $\frac{5}{7}$.

Spirit in 1 litre mix. of B $= \frac{7}{13}$ litre; C.P. of 1 litre mix. in B = Re. $\frac{7}{13}$.

Spirit in 1 litre mix. of C $= \frac{8}{13}$ litre; Mean price = Re. $\frac{8}{13}$.

By the rule of alligation, we have :

C.P. of 1 litre mixture in A C.P. of 1 litre mixture in B

$\left(\frac{5}{7}\right)$ $\left(\frac{7}{13}\right)$

Mean price

$\left(\frac{8}{13}\right)$

$\left(\frac{1}{13}\right)$ $\frac{9}{91}$

$\therefore$ Required ratio $= \frac{1}{13} : \frac{9}{91} = 7 : 9.$

11. Let cost of 1 litre milk be Re. 1.

Milk in 1 litre mix. in A $= \frac{8}{13}$ litre, C.P. of 1 litre mix. in A = Re. $\frac{8}{13}$.

Milk in 1 litre mix. in B $= \frac{5}{7}$ litre, C.P. of 1 litre mix. in B = Re. $\frac{5}{7}$.

Milk in 1 litre of final mix. $= \left(\frac{900}{13} \times \frac{1}{100} \times 1\right) = \frac{9}{13}$ litre; Mean price = Re. $\frac{9}{13}$.

By the rule of alligation, we have :

C.P. of 1 litre mixture in A C.P. of 1 litre mixture in B

$\frac{8}{13}$ $\frac{5}{7}$

Mean price

$\frac{9}{13}$

$\frac{2}{91}$ $\frac{1}{13}$

$\therefore$ Required ratio $= \frac{2}{91} : \frac{1}{13} = 2 : 7.$

12. Let cost of 1 litre milk be Re. 1.

Milk in 1 litre mix. in 1st can $= \frac{3}{4}$ litre, C.P. of 1 litre mix. in 1st can = Re. $\frac{3}{4}$.

Milk in 1 litre mix. in 2nd can $= \frac{1}{2}$ litre, C.P. of 1 litre mix. in 2nd 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 1st can C.P. of 1 litre mixture in 2nd can

$\frac{3}{4}$ $\frac{1}{2}$

Mean price

$\frac{5}{8}$

$\frac{1}{8}$ $\frac{1}{8}$

$\therefore$ 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.

13. Let the rate of the second quality be Rs. x per kg.

By the rule of alligation, we have :

C.P. of 1 kg wheat of 1st kind — C.P. of 1 kg wheat of 2nd kind

930 p — (100 x) p

Mean price

1000 p

(100 x – 1000) p — 70 p

$$\therefore \quad \frac{100x - 1000}{70} = \frac{8}{7} \Rightarrow 700x - 7000 = 560 \Rightarrow 700x = 7560 \Rightarrow x = \text{Rs. } 10.80.$$

14. Since first and second varieties are mixed in equal proportions, so their average price

$$= \text{Rs.} \left(\frac{126 + 135}{2}\right) = \text{Rs. } 130.50.$$

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 :

Cost of 1 kg tea of 1st kind — Cost of 1 kg tea of 2nd kind

Rs. 130.50 — Rs. x

Mean price

Rs. 153

(x – 153) — 22.50

$$\therefore \quad \frac{x - 153}{22.50} = 1 \Rightarrow x - 153 = 22.50 \Rightarrow x = 175.50.$$

Hence, price of the third variety = Rs. 175.50 per kg.

15. By the rule of alligation, we have :

Profit on 1st part — Profit on 2nd part

8% — 18%

Mean profit

14%

4 — 6

Ratio of 1st and 2nd parts = 4 : 6 = 2 : 3.

$$\therefore \quad \text{Quantity of 2nd kind} = \left(\frac{3}{5} \times 1000\right) \text{ kg} = 600 \text{ kg}.$$

16. By the rule of alligation, we have :

Strength of first jar — Strength of 2nd jar

40% — 19%

Mean strength

26%

7 — 14

So, ratio of 1st and 2nd quantities = 7 : 14 = 1 : 2.

$\therefore$ Required quantity replaced $= \frac{2}{3}$.

17. Amount of milk left after 3 operations

$$= \left[40\left(1-\frac{4}{40}\right)^3\right] \text{ litres} = \left(40 \times \frac{9}{10} \times \frac{9}{10} \times \frac{9}{10}\right) = 29.16 \text{ litres.}$$

18. 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.

$$\therefore \frac{x\left(1-\frac{8}{x}\right)^4}{x} = \frac{16}{81} \Rightarrow \left(1-\frac{8}{x}\right)^4 = \left(\frac{2}{3}\right)^2 \Rightarrow \left(\frac{x-8}{x}\right) = \frac{2}{3}$$

$$\Rightarrow 3x - 24 = 2x \Rightarrow x = 24.$$

19. Suppose the can initially contains $7x$ and $5x$ litres of mixtures A and B respectively.

Quantity of A in mixture left $= \left(7x - \frac{7}{12} \times 9\right)$ litres $= \left(7x - \frac{21}{4}\right)$ litres.

Quantity of B in mixture left $= \left(5x - \frac{5}{12} \times 9\right)$ litres $= \left(5x - \frac{15}{4}\right)$ 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.

20. Suppose the vessel initially contains 8 litres of liquid.

Let x litres of this liquid be replaced with water.

Quantity of water in new mixture $= \left(3 - \frac{3x}{8} + x\right)$ litres.

Quantity of syrup in new mixture $= \left(5 - \frac{5x}{8}\right)$ litres.

$$\therefore \left(3 - \frac{3x}{8} + x\right) = \left(5 - \frac{5x}{8}\right) \Rightarrow 5x + 24 = 40 - 5x \Rightarrow 10x = 16 \Rightarrow x = \frac{8}{5}.$$

So, part of the mixture replaced $= \left(\frac{8}{5} \times \frac{1}{8}\right) = \frac{1}{5}$.

21. SIMPLE INTEREST

IMPORTANT FACTS AND FORMULAE

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 a 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*) $\text{S.I.} = \left(\frac{P \times R \times T}{100}\right)$

   (*ii*) $P = \left(\frac{100 \times \text{S.I.}}{R \times T}\right)$; $R = \left(\frac{100 \times \text{S.I.}}{P \times T}\right)$ and $T = \left(\frac{100 \times \text{S.I.}}{P \times R}\right)$.

SOLVED EXAMPLES

Ex. 1. ***Find the simple interest on Rs. 68,000 at $16\frac{2}{3}$% per annum for 9 months.***

Sol. P = Rs. 68000, $R = \frac{50}{3}$% p.a and $T = \frac{9}{12}$ years $= \frac{3}{4}$ years.

$\therefore$ $\text{S.I.} = \left(\frac{P \times R \times T}{100}\right) = \text{Rs.}\left(68000 \times \frac{50}{3} \times \frac{3}{4} \times \frac{1}{100}\right) = \text{Rs. } 8500.$

Ex. 2. ***Find the simple interest on Rs. 3000 at $6\frac{1}{4}$% per annum for the period from 4th Feb., 2005 to 18th April, 2005.***

Sol. Time = (24 + 31 + 18) days = 73 days $= \frac{73}{365}$ year $= \frac{1}{5}$ year.

P = Rs. 3000 and $R = 6\frac{1}{4}$% p.a. $= \frac{25}{4}$% p.a.

$\therefore$ $\text{S.I.} = \text{Rs.}\left(3000 \times \frac{25}{4} \times \frac{1}{5} \times \frac{1}{100}\right) = \text{Rs. } 37.50.$

Remark : The day on which money is deposited is not counted while the day on which money is withdrawn is counted.

Ex. 3. ***A sum at simple interest at $13\frac{1}{2}$% per annum amounts to Rs. 2502.50 after 4 years. Find the sum.***

Sol. Let sum be Rs. x. Then, $\text{S.I.} = \text{Rs.}\left(x \times \frac{27}{2} \times 4 \times \frac{1}{100}\right) = \text{Rs. } \frac{27x}{50}.$

$\therefore$ $\text{Amount} = \text{Rs.}\left(x + \frac{27x}{50}\right) = \text{Rs. } \frac{77x}{50}.$

$\therefore \quad \frac{77x}{50} = 2502.50 \Leftrightarrow x = \frac{2502.50 \times 50}{77} = 1625.$

Hence, sum = Rs. 1625.

Ex. 4. ***A sum of Rs. 800 amounts to Rs. 920 in 3 years at simple interest. If the interest rate is increased by 3%, it would amount to how much ?***

Sol. S.I. = Rs. (920 – 800) = Rs. 120; P = Rs. 800, T = 3 yrs.

$\therefore \quad R = \left(\frac{100 \times 120}{800 \times 3}\right)\% = 5\%.$

New rate = (5 + 3)% = 8%.

New S.I. = Rs. $\left(\frac{800 \times 8 \times 3}{100}\right)$ = Rs. 192.

$\therefore$ New amount = Rs. (800 + 192) = Rs. 992.

Ex. 5. ***Adam borrowed some money at the rate of 6% p.a. for the first two years, at the rate of 9% p.a. for the next three years, and at the rate of 14% p.a. for the period beyond five years. If he pays a total interest of Rs. 11, 400 at the end of nine years, how much money did he borrow ?*** **(Bank P.O. 1999)**

Sol. Let the sum borrowed be x. Then,

$$\left(\frac{x \times 6 \times 2}{100}\right) + \left(\frac{x \times 9 \times 3}{100}\right) + \left(\frac{x \times 14 \times 4}{100}\right) = 11400$$

$$\Leftrightarrow \left(\frac{3x}{25} + \frac{27x}{100} + \frac{14x}{25}\right) = 11400 \Leftrightarrow \frac{95x}{100} = 11400 \Leftrightarrow x = \left(\frac{11400 \times 100}{95}\right) = 12000.$$

Hence, sum borrowed = Rs. 12,000.

Ex. 6. ***A certain sum of money amounts to Rs. 1008 in 2 years and to Rs. 1164 in $3\frac{1}{2}$ years. Find the sum and the rate of interest.***

Sol. S.I. for $1\frac{1}{2}$ years = Rs. (1164 – 1008) = Rs. 156.

S.I. for 2 years = Rs. $\left(156 \times \frac{2}{3} \times 2\right)$ = Rs. 208.

$\therefore$ Principal = Rs. (1008 – 208) = Rs. 800.

Now, P = 800, T = 2 and S.I. = 208.

$\therefore \quad \text{Rate} = \left(\frac{100 \times 208}{800 \times 2}\right)\% = 13\%.$

Ex. 7. ***At what rate percent per annum will a sum of money double in 16 years ?*** **(R.R.B. 2003)**

Sol. Let principal = P. Then, S.I. = P and T = 16 yrs.

$\therefore \quad \text{Rate} = \left(\frac{100 \times P}{P \times 16}\right)\% = 6\frac{1}{4}\%$ p.a.

Ex. 8. ***The simple interest on a sum of money is $\frac{4}{9}$ of the principal. Find the rate percent and time, if both are numerically equal.*** **(S.S.C. 2000)**

Sol. Let sum = Rs. x. Then, S.I. = Rs. $\frac{4x}{9}$.

Let rate = R% and time = R years.

Then, $\left(\frac{x \times R \times R}{100}\right) = \frac{4x}{9}$ or $R^2 = \frac{400}{9}$ or $R = \frac{20}{3} = 6\frac{2}{3}$.

$\therefore$ Rate $= 6\frac{2}{3}\%$ and Time $= 6\frac{2}{3}$ yrs = 6 yrs 8 months.

Ex. 9. ***The simple interest on a certain sum of money for $2\frac{1}{2}$ years at 12% per annum is Rs. 40 less than the simple interest on the same sum for $3\frac{1}{2}$ years at 10% per annum. Find the sum.***

Sol. Let the sum be Rs. x. Then, $\left(\frac{x \times 10 \times 7}{100 \times 2}\right) - \left(\frac{x \times 12 \times 5}{100 \times 2}\right) = 40$

$\Leftrightarrow \frac{7x}{20} - \frac{3x}{10} = 40 \Leftrightarrow x = (40 \times 20) = 800.$

Hence, the sum is Rs. 800.

Ex. 10. ***A sum was put at simple interest at a certain rate for 3 years. Had it been put at 2% higher rate, it would have fetched Rs. 360 more. Find the sum.***

Sol. Let sum = P and original rate = R. Then, $\left[\frac{P \times (R+2) \times 3}{100}\right] - \left[\frac{P \times R \times 3}{100}\right] = 360$

$\Leftrightarrow$ 3PR + 6P − 3PR = 36000 $\Leftrightarrow$ 6P = 36000 $\Leftrightarrow$ P = 6000.

Hence, sum = Rs. 6000.

Ex. 11. ***What annual instalment will discharge a debt of Rs. 1092 due in 3 years at 12% simple interest ?***

Sol. Let each instalment be Rs. x. Then, $\left(x + \frac{x \times 12 \times 1}{100}\right) + \left(x + \frac{x \times 12 \times 2}{100}\right) + x = 1092$

$\Leftrightarrow \frac{28x}{25} + \frac{31x}{25} + x = 1092 \Leftrightarrow (28x + 31x + 25x) = (1092 \times 25)$

$\Leftrightarrow x = \left(\frac{1092 \times 25}{84}\right) = 325.$

$\therefore$ Each instalment = Rs. 325.

Ex. 12. ***A sum of Rs. 1550 is lent out into two parts, one at 8% and another one at 6%. If the total annual income is Rs. 106, find the money lent at each rate.***

(L.I.C. A.A.O. 2003)

Sol. Let the sum lent at 8% be Rs. x and that at 6% be Rs. $(1550 - x)$.

$\therefore \left[\frac{x \times 8 \times 1}{100}\right] + \left[\frac{(1550 - x) \times 6 \times 1}{100}\right] = 106$

$\Leftrightarrow 8x + 9300 - 6x = 10600 \Leftrightarrow 2x = 1300 \Leftrightarrow x = 650.$

$\therefore$ Money lent at 8% = Rs. 650. Money lent at 6% = Rs. (1550 − 650) = Rs. 900.

EXERCISE 21A

(OBJECTIVE TYPE QUESTIONS)

Directions : ***Mark (✓) against the correct answer :***

1. At the rate of $8\frac{1}{2}\%$ p.a. simple interest, a sum of Rs. 4800 will earn how much interest in 2 years 3 months ?

   (*a*) Rs. 796 (*b*) Rs. 816 (*c*) Rs. 918 (*d*) Rs. 956

2. What will be the simple interest earned on an amount of Rs. 16,800 in 9 months at the rate of $6\frac{1}{4}$% p.a. ?

(*a*) Rs. 787.50 (*b*) Rs. 812.50 (*c*) Rs. 860 (*d*) Rs. 887.50

3. The simple interest on Rs. 1820 from March 9, 2003 to May 21, 2003 at $7\frac{1}{2}$% rate will be :

(*a*) Rs. 22.50 (*b*) Rs. 27.30 (*c*) Rs. 28.80 (*d*) Rs. 29

4. 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. **(S.S.C. 2000)**

(*a*) Rs. 112.50 (*b*) Rs. 125 (*c*) Rs. 150 (*d*) Rs. 167.50

5. How much time will it take for an amount of Rs. 450 to yield Rs. 81 as interest at 4.5% per annum of simple interest ? **(IGNOU, 2003)**

(*a*) 3.5 years (*b*) 4 years (*c*) 4.5 years (*d*) 5 years

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 ? **(Bank P.O. 2003)**

(*a*) 3% (*b*) 4% (*c*) 5% (*d*) 6% (*e*) None of these

7. A sum of Rs. 1600 gives a simple interest of Rs. 252 in 2 years and 4 months. The rate of interest per annum is :

(*a*) 6% (*b*) $6\frac{1}{4}$% (*c*) $6\frac{1}{2}$% (*d*) $6\frac{3}{4}$%

8. Reena took a loan of Rs. 1200 with simple interest for as many years as the rate of interest. If she paid Rs. 432 as interest at the end of the loan period, what was the rate of interest ? **(R.B.I. 2003)**

(*a*) 3.6 (*b*) 6 (*c*) 18

(*d*) Cannot be determined (*e*) None of these

9. A man took a 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 : **(S.S.C. 2004)**

(*a*) Rs. 2000 (*b*) Rs. 10,000 (*c*) Rs. 15,000 (*d*) Rs. 20,000

10. What is the present worth of Rs. 132 due in 2 years at 5% simple interest per annum ?

(*a*) Rs. 112 (*b*) Rs. 118.80 (*c*) Rs. 120 (*d*) Rs. 122

(C.B.I. 1997)

11. A sum fetched a total simple interest of Rs. 4016.25 at the rate of 9 p.c.p.a. in 5 years. What is the sum ? **(NABARD, 2002)**

(*a*) Rs. 4462.50 (*b*) Rs. 8032.50 (*c*) Rs. 8900

(*d*) Rs. 8925 (*e*) None of these

12. The simple interest at x% for x years will be Rs. x on a sum of :

(*a*) Rs. x (*b*) Rs. $\left(\frac{100}{x}\right)$ (*c*) Rs. $100x$ (*d*) Rs. $\left(\frac{100}{x^2}\right)$

13. Rs. 800 becomes Rs. 956 in 3 years at a certain rate of simple interest. If the rate of interest is increased by 4%, what amount will Rs. 800 become in 3 years ?

(*a*) Rs. 1020.80 (*b*) Rs. 1025 (*c*) Rs. 1052

(*d*) Data inadequate (*e*) None of these **(Bank P.O. 2000)**

14. 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 ? **(Bank P.O. 2003)**

(*a*) Rs. 35 (*b*) Rs. 245 (*c*) Rs. 350

(*d*) Cannot be determined (*e*) None of these

15. In how many years, Rs. 150 will produce the same interest @ 8% as Rs. 800 produce in 3 years @ $4\frac{1}{2}$% ? **(R.R.B. 2001)**

(*a*) 6 (*b*) 8 (*c*) 9 (*d*) 12

16. If Rs. 64 amounts to Rs. 83.20 in 2 years, what will Rs. 86 amount to in 4 years at the same rate percent per annum ?

(*a*) Rs. 114.80 (*b*) Rs. 124.70 (*c*) Rs. 127.40 (*d*) Rs. 137.60

17. The simple interest on a certain sum of money at the rate of 5% p.a. for 8 years is Rs. 840. At what rate of interest the same amount of interest can be received on the same sum after 5 years ?

(*a*) 6% (*b*) 8% (*c*) 9% (*d*) 10%

18. The interest on a certain deposit at 4.5% p.a. is Rs. 202.50 in one year. How much will the additional interest in one year be on the same deposit at 5% p.a. ?

(*a*) Rs. 20.25 (*b*) Rs. 22.50 (*c*) Rs. 25 (*d*) Rs. 42.75

19. A sum invested at 5% simple interest per annum grows to Rs. 504 in 4 years. The same amount at 10% simple interest per annum in $2\frac{1}{2}$ years will grow to :

(*a*) Rs. 420 (*b*) Rs. 450 (*c*) Rs. 525 (*d*) Rs. 550

(C.D.S. 2003)

20. 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 ? **(Bank P.O. 1998)**

(*a*) 1 : 3 (*b*) 1 : 4 (*c*) 2 : 3

(*d*) Data inadequate (*e*) None of these

21. Nitin borrowed some money at the rate of 6% p.a. for the first three years, 9% p.a. for the next five years and 13% p.a. for the period beyond eight years. If the total interest paid by him at the end of eleven years is Rs. 8160, how much money did he borrow ? **(Bank P.O. 2000)**

(*a*) Rs. 8000 (*b*) Rs. 10,000 (*c*) Rs. 12,000

(*d*) Data inadequate (*e*) None of these

22. The simple interest on a sum of money will be Rs. 600 after 10 years. If the principal is trebled after 5 years, what will be the total interest at the end of the tenth year ?

(*a*) Rs. 600 (*b*) Rs. 900 (*c*) Rs. 1200

(*d*) Rs. 1500 (*e*) Data inadequate

23. The simple interest on Rs. 10 for 4 months at the rate of 3 paise per rupee per month is :

(*a*) Rs. 1.20 (*b*) Rs. 1.60 (*c*) Rs. 2.40 (*d*) Rs. 3.60

24. 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 : **(N.I.F.T. 2000)**

(*a*) 10% (*b*) 10.25% (*c*) 10.5% (*d*) None of these

25. A sum of money at simple interest amounts to Rs. 815 in 3 years and to Rs. 854 in 4 years. The sum is : **(Section Officers', 2001)**

(*a*) Rs. 650 (*b*) Rs. 690 (*c*) Rs. 698 (*d*) Rs. 700

26. A sum of money lent out at simple interest amounts to Rs. 720 after 2 years and to Rs. 1020 after a further period of 5 years. The sum is : **(S.S.C. 2004)**

(*a*) Rs. 500 (*b*) Rs. 600 (*c*) Rs. 700 (*d*) Rs. 710

27. 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 : **(S.S.C. 2003)**

(*a*) 5% (*b*) 8% (*c*) 12% (*d*) 15%

28. A certain sum of money at simple interest amounts to Rs. 1012 in $2\frac{1}{2}$ years and to Rs. 1067.20 in 4 years. The rate of interest per annum is :

(*a*) 2.5% (*b*) 3% (*c*) 4% (*d*) 5%

29. In how many years will a sum of money double itself at 12% per annum ?

(*a*) 6 years 9 months (*b*) 7 years 6 months
(*c*) 8 years 3 months (*d*) 8 years 4 months

30. At what rate percent of simple interest will a sum of money double itself in 12 years ?

(*a*) $8\frac{1}{4}\%$ (*b*) $8\frac{1}{3}\%$ (*c*) $8\frac{1}{2}\%$ (*d*) $9\frac{1}{2}\%$

(S.S.C. 2000)

31. The rate at which a sum becomes four times of itself in 15 years at S.I., will be :

(*a*) 15% (*b*) $17\frac{1}{2}\%$ (*c*) 20% (*d*) 25%

32. If a sum of money at simple interest doubles in 6 years, it will become 4 times in :

(*a*) 12 years (*b*) 14 years (*c*) 16 years (*d*) 18 years

33. A sum of money trebles itself in 15 years 6 months. In how many years would it double itself ?

(*a*) 6 years 3 months (*b*) 7 years 9 months
(*c*) 8 years 3 months (*d*) 9 years 6 months.

34. Consider the following statements :

If a sum of money is lent at simple interest, then the

1. money gets doubled in 5 years if the rate of interest is $16\frac{2}{3}\%$.
2. money gets doubled in 5 years if the rate of interest is 20%.
3. money becomes four times in 10 years if it gets doubled in 5 years.

Of these statements,

(*a*) 1 and 3 are correct (*b*) 2 alone is correct
(*c*) 3 alone is correct (*d*) 2 and 3 are correct

35. The simple interest on a sum of money at 8% per annum for 6 years is half the sum. The sum is :

(*a*) Rs. 4800 (*b*) Rs. 6000 (*c*) Rs. 8000 (*d*) Data inadequate

36. At what rate percent per annum will the simple interest on a sum of money be $\frac{2}{5}$ of the amount in 10 years ? **(S.S.C. 2002)**

(*a*) 4% (*b*) $5\frac{2}{3}\%$ (*c*) 6% (*d*) $6\frac{2}{3}\%$

37. In how much time would the simple interest on a certain sum be 0.125 times the principal at 10% per annum ? **(Assistant Grade, 1997)**

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

38. How long will it take a sum of money invested at 5% p.a. S.I. to increase its value by 40% ?

(*a*) 5 years (*b*) 6 years (*c*) 7 years (*d*) 8 years

39. A sum of money becomes $\frac{7}{6}$ of itself in 3 years at a certain rate of simple interest. The rate per annum is : **(S.S.C. 1999)**

(*a*) $5\frac{5}{9}\%$ (*b*) $6\frac{5}{9}\%$ (*c*) 18% (*d*) 25%

40. Simple interest on a certain sum at a certain annual rate of interest is $\frac{1}{9}$ of the sum. If the numbers representing rate percent and time in years be equal, then the rate of interest is :

(*a*) $3\frac{1}{3}\%$ (*b*) 5% (*c*) $6\frac{2}{3}\%$ (*d*) 10%

41. Simple interest on a certain amount is $\frac{9}{16}$ of the principal. If the numbers representing the rate of interest in percent and time in years be equal, then time, for which the principal is lent out, is : **(R.R.B. 2003)**

(*a*) $5\frac{1}{2}$ years (*b*) $6\frac{1}{2}$ years (*c*) 7 years (*d*) $7\frac{1}{2}$ years

42. A lends Rs. 2500 to B and a certain sum to C at the same time at 7% p.a. simple interest. If after 4 years, A altogether receives Rs. 1120 as interest from B and C, then the sum lent to C is : **(S.S.C. 2003)**

(*a*) Rs. 700 (*b*) Rs. 1500 (*c*) Rs. 4000 (*d*) Rs. 6500

43. Two equal sums of money were lent at simple interest at 11% p.a. for $3\frac{1}{2}$ years and $4\frac{1}{2}$ years respectively. If the difference in interests for two periods was Rs. 412.50, then each sum is :

(*a*) Rs. 3250 (*b*) Rs. 3500 (*c*) Rs. 3750 (*d*) Rs. 4250

44. If the simple interest on a certain sum for 15 months at $7\frac{1}{2}\%$ per annum exceeds the simple interest on the same sum for 8 months at $12\frac{1}{2}\%$ per annum by Rs. 32.50, then the sum (in Rs.) is :

(*a*) Rs. 3000 (*b*) Rs. 3060 (*c*) Rs. 3120 (*d*) Rs. 3250

45. A man invests a certain sum of money at 6% p.a. simple interest and another sum at 7% p.a. simple interest. His income from interest after 2 years was Rs. 354. One-fourth of the first sum is equal to one-fifth of the second sum. The total sum invested was :

(*a*) Rs. 2600 (*b*) Rs. 2700 (*c*) Rs. 2880 (*d*) Rs. 2900

46. A borrowed some money from B at 12% p.a. S.I. for 3 years. He then added some more money to the borrowed sum and lent it to C for the same period at 14% p.a. rate of interest. If A gains Rs. 93.90 in the whole transaction, how much money did he add from his side ?

(*a*) Rs. 35 (*b*) Rs. 55 (*c*) Rs. 80 (*d*) Rs. 105

47. A person borrowed Rs. 500 @ 3% per annum S.I. and Rs. 600 @ $4\frac{1}{2}\%$ per annum on the agreement that the whole sum will be returned only when the total interest becomes Rs. 126. The number of years, after which the borrowed sum is to be returned, is :

(*a*) 2 (*b*) 3 (*c*) 4 (*d*) 5

48. 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 : **(C.B.I. 2003)**

(*a*) 5% (*b*) 7% (*c*) $7\frac{1}{8}\%$ (*d*) 10%

49. 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 ? **(Bank P.O. 2003)**

(*a*) 3.6% (*b*) 4.5% (*c*) 5% (*d*) 6% (*e*) None of these

50. The difference between the simple interest received from two different sources on Rs. 1500 for 3 years is Rs. 13.50. The difference between their rates of interest is :

(*a*) 0.1% (*b*) 0.2% (*c*) 0.3% (*d*) 0.4% (*e*) None of these

(S.S.C. 1999)

51. Peter invested an amount of Rs. 12,000 at the rate of 10 p.c.p.a. simple interest and another amount at the rate of 20 p.c.p.a. simple interest. The total interest earned at the end of one year on the total amount invested became 14 p.c.p.a. Find the total amount invested. **(S.B.I.P.O. 1999)**

(*a*) Rs. 20,000 (*b*) Rs. 22,000 (*c*) Rs. 24,000 (*d*) Rs. 25,000 (*e*) None of these

52. What should be the least number of years in which the simple interest on Rs. 2600 at $6\frac{2}{3}\%$ will be an exact number of rupees ?

(*a*) 2 (*b*) 3 (*c*) 4 (*d*) 5

53. The rates of simple interest in two banks A and B are in the ratio 5 : 4. A person wants to deposit his total savings in two banks in such a way that he received equal half-yearly interest from both. He should deposit the savings in banks A and B in the ratio :

(*a*) 2 : 5 (*b*) 4 : 5 (*c*) 5 : 2 (*d*) 5 : 4

54. A sum was put at simple interest at a certain rate for 2 years. Had it been put at 3% higher rate, it would have fetched Rs. 72 more. The sum is :

(*a*) Rs. 1200 (*b*) Rs. 1500 (*c*) Rs. 1600 (*d*) Rs. 1800

55. If the annual rate of simple interest increases from 10% to $12\frac{1}{2}\%$, a man's yearly income increases by Rs. 1250. His principal (in Rs.) is : **(S.S.C. 2004)**

(*a*) 45,000 (*b*) 50,000 (*c*) 60,000 (*d*) 65,000

56. A moneylender finds that due to a fall in the annual rate of interest from 8% to $7\frac{3}{4}\%$, his yearly income diminishes by Rs. 61.50. His capital is : **(S.S.C. 2003)**

(*a*) Rs. 22,400 (*b*) Rs. 23,800 (*c*) Rs. 24,600 (*d*) Rs. 26,000

57. What annual payment will discharge a debt of Rs. 6450 due in 4 years at 5% simple interest ?

(*a*) Rs. 1400 (*b*) Rs. 1500 (*c*) Rs. 1550 (*d*) Rs. 1600

58. A sum of Rs. 10 is lent to be returned in 11 monthly instalments of Re. 1 each, interest being simple. The rate of interest is :

(*a*) $9\frac{1}{11}\%$ (*b*) 10% (*c*) 11% (*d*) $21\frac{9}{11}\%$

59. A person takes a loan of Rs. 200 at 5% simple interest. He returns Rs. 100 at the end of 1 year. In order to clear his dues at the end of 2 years, he would pay :

(*a*) Rs. 105 (*b*) Rs. 110 (*c*) Rs. 115 (*d*) Rs. 115.50

60. The price of a T.V. set worth Rs. 20,000 is to be paid in 20 instalments of Rs. 1000 each. If the rate of interest be 6% per annum, and the first instalment be paid at the time of purchase, then the value of the last instalment covering the interest as well will be : **(Hotel Management, 1998)**

(*a*) Rs. 1050 (*b*) Rs. 2050 (*c*) Rs. 3000 (*d*) None of these

61. If the rate increases by 2%, the simple interest received on a sum of money increases by Rs. 108. If the time period is increased by 2 years, the simple interest on the same sum increases by Rs. 180. The sum is :

(*a*) Rs. 1800 (*b*) Rs. 3600 (*c*) Rs. 5400
(*d*) Data inadequate (*e*) None of these

62. Mr. Thomas invested an amount of Rs. 13,900 divided in two different schemes A and B at the simple interest rate of 14% p.a. and 11% p.a. respectively. If the total amount of simple interest earned in 2 years be Rs. 3508, what was the amount invested in Scheme B ? **(R.B.I. 2003)**

(*a*) Rs. 6400 (*b*) Rs. 6500 (*c*) Rs. 7200
(*d*) Rs. 7500 (*e*) None of these

63. A sum of Rs. 2600 is lent out in two parts in such a way that the interest on one part at 10% for 5 years is equal to that on another at 9% for 6 years. The sum lent out at 10% is :

(*a*) Rs. 1150 (*b*) Rs. 1250 (*c*) Rs. 1350 (*d*) Rs. 1450

64. A sum of Rs. 1550 was lent partly at 5% and partly at 8% p.a. simple interest. The total interest received after 3 years was Rs. 300. The ratio of the money lent at 5% to that lent at 8% is :

(*a*) 5 : 8 (*b*) 8 : 5 (*c*) 16 : 15 (*d*) 31 : 6

65. A man lends Rs. 10,000 in four parts. If he gets 8% on Rs. 2000; $7\frac{1}{2}$% on Rs. 4000 and $8\frac{1}{2}$% on Rs. 1400; what percent must he get for the remainder, if his average annual interest is 8.13% ?

(*a*) 7% (*b*) 9% (*c*) $9\frac{1}{4}$% (*d*) $10\frac{1}{2}$%

66. An amount of Rs. 1,00,000 is invested in two types of shares. The first yields an interest of 9% p.a. and the second, 11% p.a. If the total interest at the end of one year is $9\frac{3}{4}$%, then the amount invested in each share was : **(M.B.A. 2002)**

(*a*) Rs. 52,500; Rs. 47,500 (*b*) Rs. 62,500; Rs. 37,500
(*c*) Rs. 72,500; Rs. 27,500 (*d*) Rs. 82,500; Rs. 17,500

67. David invested certain amount in three different schemes A, B and C with the rate of interest 10% p.a., 12% p.a. and 15% p.a. respectively. If the total interest accrued in one year was Rs. 3200 and the amount invested in Scheme C was 150% of the amount invested in Scheme A and 240% of the amount invested in Scheme B, what was the amount invested in Scheme B ? **(Bank P.O. 2003)**

(*a*) Rs. 5000 (*b*) Rs. 6500 (*c*) Rs. 8000
(*d*) Cannot be determined (*e*) None of these

68. A person invested in all Rs. 2600 at 4%, 6% and 8% per annum simple interest. At the end of the year, he got the same interest in all the three cases. The money invested at 4% is : **(S.S.C. 2003)**

(*a*) Rs. 200 (*b*) Rs. 600 (*c*) Rs. 800 (*d*) Rs. 1200

69. Divide Rs. 2379 into 3 parts so that their amounts after 2, 3 and 4 years respectively may be equal, the rate of interest being 5% per annum at simple interest. The first part is : **(C.B.I. 1997)**

(*a*) Rs. 759 (*b*) Rs. 792 (*c*) Rs. 818 (*d*) Rs. 828

70. A man invested $\frac{1}{3}$ of his capital at 7%; $\frac{1}{4}$ at 8% and the remainder at 10%. If his annual income is Rs. 561, the capital is :

(*a*) Rs. 5400 (*b*) Rs. 6000 (*c*) Rs. 6600 (*d*) Rs. 7200

ANSWERS

1. (c)	2. (a)	3. (b)	4. (a)	5. (b)	6. (d)	7. (d)	8. (b)	9. (c)
10. (c)	11. (d)	12. (b)	13. (c)	14. (d)	15. (c)	16. (d)	17. (b)	18. (b)
19. (c)	20. (c)	21. (a)	22. (c)	23. (a)	24. (b)	25. (c)	26. (b)	27. (c)
28. (c)	29. (d)	30. (b)	31. (c)	32. (d)	33. (b)	34. (b)	35. (d)	36. (a)
37. (a)	38. (d)	39. (a)	40. (a)	41. (d)	42. (b)	43. (c)	44. (c)	45. (b)
46. (d)	47. (b)	48. (d)	49. (e)	50. (c)	51. (a)	52. (b)	53. (b)	54. (a)
55. (b)	56. (c)	57. (b)	58. (d)	59. (c)	60. (d)	61. (d)	62. (a)	63. (c)
64. (c)	65. (b)	66. (b)	67. (a)	68. (d)	69. (d)	70. (c)		

SOLUTIONS

1. Time = 2 yrs 3 mths = $2\frac{1}{4}$ yrs = $\frac{9}{4}$ yrs.

$\therefore$ S.I. = Rs. $\left(4800 \times \frac{17}{2} \times \frac{9}{4} \times \frac{1}{100}\right)$ = Rs. 918.

2. Time = 9 months = $\frac{3}{4}$ year.

$\therefore$ S.I. = Rs. $\left(16800 \times \frac{25}{4} \times \frac{3}{4} \times \frac{1}{100}\right)$ = Rs. 787.50.

3. Time = (22 + 30 + 21) days = 73 days = $\frac{1}{5}$ year.

$\therefore$ S.I. = Rs. $\left(1820 \times \frac{15}{2} \times \frac{1}{5} \times \frac{1}{100}\right)$ = Rs. 27.30.

4. Gain in 2 yrs. = Rs. $\left[\left(5000 \times \frac{25}{4} \times \frac{2}{100}\right) - \left(\frac{5000 \times 4 \times 2}{100}\right)\right]$ = Rs. (625 – 400) = Rs. 225.

$\therefore$ Gain in 1 year = Rs. $\left(\frac{225}{2}\right)$ = Rs. 112.50.

5. Time = $\left(\frac{100 \times 81}{450 \times 4.5}\right)$ years = 4 years.

6. S.I. = Rs. (15500 – 12500) = Rs. 3000.

Rate = $\left(\frac{100 \times 3000}{12500 \times 4}\right)\%$ = 6%.

7. Time = 2 years 4 months = $2\frac{1}{3}$ years = $\frac{7}{3}$ years.

Rate = $\left(\frac{100 \times 252 \times 3}{1600 \times 7}\right)\%$ = $6\frac{3}{4}\%$.

8. Let rate = R% and time = R years. Then,

$\left(\frac{1200 \times R \times R}{100}\right) = 432 \Leftrightarrow 12R^2 = 432 \Leftrightarrow R^2 = 36 \Leftrightarrow R = 6.$

9. Principal = Rs. $\left(\frac{100 \times 5400}{12 \times 3}\right)$ = Rs. 15000.

10. Let the present worth be Rs. x. Then, S.I. = Rs. $(132 - x)$.

$\therefore \left(\frac{x \times 5 \times 2}{100}\right) = 132 - x \Leftrightarrow 10x = 13200 - 100x \Leftrightarrow 110x = 13200 \Leftrightarrow x = 120.$

11. Principal = Rs. $\left(\frac{100 \times 4016.25}{9 \times 5}\right)$ = Rs. $\left(\frac{401625}{45}\right)$ = Rs. 8925.

12. Sum = $\left(\frac{100 \times \text{S.I.}}{\text{R} \times \text{T}}\right)$ = Rs. $\left(\frac{100 \times x}{x \times x}\right)$ = Rs. $\left(\frac{100}{x}\right)$.

13. S.I. = Rs. (956 − 800) = Rs. 156.

Rate = $\left(\frac{100 \times 156}{800 \times 3}\right)\% = 6\frac{1}{2}\%$.

New rate = $\left(6\frac{1}{2} + 4\right)\% = 10\frac{1}{2}\%$.

New S.I. = Rs. $\left(800 \times \frac{21}{2} \times \frac{3}{100}\right)$ = Rs. 252.

$\therefore$ New amount = Rs. (800 + 252) = Rs. 1052.

14. We need to know the S.I., principal and time to find the rate. Since the principal is not given, so data is inadequate.

15. P = Rs. 800, R = $4\frac{1}{2}\% = \frac{9}{2}\%$, T = 3 years. Then,

S.I. = Rs. $\left(800 \times \frac{9}{2} \times \frac{3}{100}\right)$ = Rs. 108.

Now, P = Rs. 150, S.I. = Rs. 108, R = 8%.

$\therefore$ Time = $\left(\frac{100 \times 108}{150 \times 8}\right)$ years = 9 years.

16. P = Rs. 64, S.I. = Rs. (83.20 − 64) = Rs. 19.20, T = 2 years.

So, rate = $\left(\frac{100 \times 19.20}{64 \times 2}\right)\% = 15\%$.

Now, P = Rs. 86, R = 15%, T = 4 years.

$\therefore$ S.I. = Rs. $\left(\frac{86 \times 15 \times 4}{100}\right)$ = Rs. 51.60.

17. S.I. = Rs. 840, R = 5%, T = 8 years.

Principal = Rs. $\left(\frac{100 \times 840}{5 \times 8}\right)$ = Rs. 2100.

Now, P = Rs. 2100, S.I. = Rs. 840, T = 5 years.

$\therefore$ Rate = $\left(\frac{100 \times 840}{2100 \times 5}\right)\% = 8\%$.

18. S.I. = Rs. 202.50, R = 4.5%, T = 1 year.

Principal = Rs. $\left(\frac{100 \times 202.50}{4.5 \times 1}\right)$ = Rs. 4500.

Now, P = Rs. 4500, R = 5%, T = 1 year.

S.I. = Rs. $\left(\frac{4500 \times 5 \times 1}{100}\right)$ = Rs. 225.

$\therefore$ Difference in interest = Rs. (225 − 202.50) = Rs. 22.50.

19. Let the sum be Rs. x. Then, S.I. = Rs. $(504 - x)$.

$$\therefore \left(\frac{x \times 5 \times 4}{100}\right) = 504 - x \Leftrightarrow 20x = 50400 - 100x \Leftrightarrow 120x = 50400 \Leftrightarrow x = 420.$$

Now, P = Rs. 420, R = 10%, T = $\frac{5}{2}$ years.

$$\text{S.I.} = \text{Rs.} \left(\frac{420 \times 10}{100} \times \frac{5}{2}\right) = \text{Rs. } 105.$$

$\therefore$ Amount = Rs. (420 + 105) = Rs. 525.

20. Let the principal be P and rate of interest be R%.

$$\therefore \text{Required ratio} = \left[\frac{\left(\frac{P \times R \times 6}{100}\right)}{\left(\frac{P \times R \times 9}{100}\right)}\right] = \frac{6PR}{9PR} = \frac{6}{9} = 2 : 3.$$

21. Let the sum be Rs. x. Then,

$$\left(\frac{x \times 6 \times 3}{100}\right) + \left(\frac{x \times 9 \times 5}{100}\right) + \left(\frac{x \times 13 \times 3}{100}\right) = 8160$$

$$\Leftrightarrow 18x + 45x + 39x = (8160 \times 100) \Leftrightarrow 102x = 816000 \Leftrightarrow x = 8000.$$

22. Let the sum be Rs. x. Now, S.I. = Rs. 600, T = 10 years.

$$\text{Rate} = \left(\frac{100 \times 600}{x \times 10}\right)\% = \left(\frac{6000}{x}\right)\%.$$

$$\text{S.I. for first 5 years} = \text{Rs.} \left(\frac{x \times 5 \times 6000}{x \times 100}\right) = \text{Rs. } 300.$$

$$\text{S.I. for last 5 years} = \text{Rs.} \left(3x \times 5 \times \frac{6000}{x \times 100}\right) = \text{Rs. } 900.$$

$\therefore$ Total interest = Rs. 1200.

23. $\text{S.I.} = \text{Rs.} \left(10 \times \frac{3}{100} \times 4\right) = \text{Rs. } 1.20.$

24. Let the sum be Rs. 100. Then,

$$\text{S.I. for first 6 months} = \text{Rs.} \left(\frac{100 \times 10 \times 1}{100 \times 2}\right) = \text{Rs. } 5.$$

$$\text{S.I. for last 6 months} = \text{Rs.} \left(\frac{105 \times 10 \times 1}{100 \times 2}\right) = \text{Rs. } 5.25.$$

So, amount at the end of 1 year = Rs. (100 + 5 + 5.25) = Rs. 110.25.

$\therefore$ Effective rate = (110.25 − 100) = 10.25%.

25. S.I. for 1 year = Rs. (854 − 815) = Rs. 39.

S.I. for 3 years = Rs. (39 × 3) = Rs. 117.

$\therefore$ Principal = Rs. (815 − 117) = Rs. 698.

26. S.I. for 5 years = Rs. (1020 − 720) = Rs. 300.

$$\text{S.I. for 2 years} = \text{Rs.} \left(\frac{300}{5} \times 2\right) = \text{Rs. } 120.$$

$\therefore$ Principal = Rs. (720 − 120) = Rs. 600.

27. S.I. for 3 years = Rs. (12005 − 9800) = Rs. 2205.

S.I. for 5 years = Rs. $\left(\frac{2205}{3} \times 5\right)$ = Rs. 3675.

∴ Principal = Rs. (9800 − 3675) = Rs. 6125.

Hence, rate = $\left(\frac{100 \times 3675}{6125 \times 5}\right)\% = 12\%$.

28. S.I. for $1\frac{1}{2}$ years = Rs. (1067.20 − 1012) = Rs. 55.20.

S.I. for $2\frac{1}{2}$ years = Rs. $\left(55.20 \times \frac{2}{3} \times \frac{5}{2}\right)$ = Rs. 92.

∴ Principal = Rs. (1012 − 92) = Rs. 920.

Hence, rate = $\left(\frac{100 \times 92 \times 2}{920 \times 5}\right)\% = 4\%$.

29. Let sum = x. Then, S.I. = x.

∴ Time = $\left(\frac{100 \times \text{S.I.}}{\text{P} \times \text{R}}\right) = \left(\frac{100 \times x}{x \times 12}\right)$ years = $8\frac{1}{3}$ years = 8 years 4 months.

30. Let sum = x. Then, S.I. = x.

∴ Rate = $\left(\frac{100 \times \text{S.I.}}{\text{P} \times \text{T}}\right) = \left(\frac{100 \times x}{x \times 12}\right)\% = \frac{25}{3}\% = 8\frac{1}{3}\%$.

31. Let sum = x. Then, S.I. = $3x$.

∴ Rate = $\left(\frac{100 \times \text{S.I.}}{\text{P} \times \text{T}}\right) = \left(\frac{100 \times 3x}{x \times 15}\right)\% = 20\%$.

32. Let sum = x. Then, S.I. = x.

∴ Rate = $\left(\frac{100 \times x}{x \times 6}\right)\% = \frac{50}{3}\%$.

Now, sum = x, S.I. = $3x$, Rate = $\frac{50}{3}\%$.

∴ Time = $\frac{100 \times 3x}{x \times \frac{50}{3}}$ = 18 years.

33. Let sum = x. Then, S.I. = $2x$, Time = $15\frac{1}{2}$ years = $\frac{31}{2}$ years.

∴ Rate = $\left(\frac{100 \times 2x}{x \times \frac{31}{2}}\right)\% = \frac{400}{31}\%$.

Now, sum = x, S.I. = x, Rate = $\frac{400}{31}\%$.

∴ Time = $\frac{100 \times x}{x \times \frac{400}{31}} = \frac{31}{4}$ years = 7 years 9 months.

34. Let sum be x. Then, S.I. = x.

1. Time = $\frac{100 \times x}{x \times \frac{50}{3}}$ = 6 years (False)

2. Time $= \dfrac{100 \times x}{x \times 20} = 5$ years (True)

3. Suppose sum = x. Then, S.I. = x and Time = 5 years.

Rate $= \left(\dfrac{100 \times x}{x \times 5}\right)\% = 20\%$

Now, sum = x, S.I. = $3x$ and Rate = 20%.

$\therefore$ Time $= \left(\dfrac{100 \times 3x}{x \times 20}\right)$ years = 15 years (False)

So, 2 alone is correct.

35. Let sum = x. Then, S.I. $= \dfrac{x}{2}$.

$\therefore \quad \dfrac{x}{2} = \dfrac{x \times 8 \times 6}{100}$. Clearly, data is inadequate.

36. Let sum = x. Then, S.I. $= \dfrac{2x}{5}$, Time = 10 years.

$\therefore$ Rate $= \left(\dfrac{100 \times 2x}{x \times 5 \times 10}\right)\% = 4\%$.

37. Let sum = x. Then, S.I. $= 0.125x = \dfrac{1}{8}x$, R = 10%.

$\therefore$ Time $= \left(\dfrac{100 \times x}{x \times 8 \times 10}\right)$ years $= \dfrac{5}{4}$ years $= 1\dfrac{1}{4}$ years.

38. Let the sum be x. Then, S.I. = 40% of $x = \dfrac{2x}{5}$; Rate = 5%.

$\therefore$ Time $= \left(100 \times \dfrac{2x}{5} \times \dfrac{1}{x \times 5}\right) = 8$ years.

39. Let sum = x. Then, amount $= \dfrac{7x}{6}$.

S.I. $= \left(\dfrac{7x}{6} - x\right) = \dfrac{x}{6}$; Time = 3 years.

$\therefore$ Rate $= \left(\dfrac{100 \times x}{x \times 6 \times 3}\right)\% = \dfrac{50}{9}\% = 5\dfrac{5}{9}\%$.

40. Let sum = x. Then, S.I. $= \dfrac{x}{9}$.

Let rate = R% and time = R years.

$\therefore \quad \left(\dfrac{x \times R \times R}{100}\right) = \dfrac{x}{9} \Leftrightarrow R^2 = \dfrac{100}{9} \Leftrightarrow R = \dfrac{10}{3} = 3\dfrac{1}{3}$.

Hence, rate $= 3\dfrac{1}{3}\%$.

41. Let sum = x. Then, S.I. $= \dfrac{9}{16}x$.

Let rate = R% and time = R years.

$\therefore \quad \left(\dfrac{x \times R \times R}{100}\right) = \dfrac{9x}{16} \Leftrightarrow R^2 = \dfrac{900}{16} \Leftrightarrow R = \dfrac{30}{4} = 7\dfrac{1}{2}$.

Hence, time $= 7\dfrac{1}{2}$ years.

42. Let the sum lent to C be Rs. x. Then, $\left(\frac{2500 \times 7 \times 4}{100}\right) + \left(\frac{x \times 7 \times 4}{100}\right) = 1120$

$\Leftrightarrow \frac{7}{25}x = (1120 - 700) \Rightarrow x = \left(\frac{420 \times 25}{7}\right) = 1500.$

43. Let each sum be Rs. x. Then, $\left(\frac{x \times 11 \times 9}{100 \times 2}\right) - \left(\frac{x \times 11 \times 7}{100 \times 2}\right) = 412.50$

$\Leftrightarrow (99x - 77x) = 82500 \Leftrightarrow 22x = 82500 \Leftrightarrow x = 3750.$

44. Let the sum be Rs. x. Then, $\left(x \times \frac{15}{2} \times \frac{5}{4} \times \frac{1}{100}\right) - \left(x \times \frac{25}{2} \times \frac{2}{3} \times \frac{1}{100}\right) = 32.50$

$\Leftrightarrow \frac{75x}{8} - \frac{25x}{3} = 3250 \Leftrightarrow 25x = (3250 \times 24) \Leftrightarrow x = \left(\frac{3250 \times 24}{25}\right) = 3120.$

45. Let the sums be x and y.

$\frac{x \times 6 \times 2}{100} + \frac{y \times 7 \times 2}{100} = 354$ or $6x + 7y = 17700.$ ...(*i*)

Also, $\frac{x}{4} = \frac{y}{5}$ or $5x - 4y = 0$ ...(*ii*)

Solving (*i*) and (*ii*), we get : $x = 1200$ and $y = 1500$.

$\therefore$ Total sum = Rs. 2700.

46. Let the money added be Rs. x. Then, $\frac{(830 + x) \times 14 \times 3}{100} - \frac{830 \times 12 \times 3}{100} = 93.90$

$\Leftrightarrow 830 \times 42 + 42x - 830 \times 36 = 9390 \Leftrightarrow 42x + 830 \times (42 - 36) = 9390$

$\Leftrightarrow 42x = 9390 - 4980 \Leftrightarrow x = \frac{4410}{42} = 105.$

$\therefore$ Money added = Rs. 105.

47. Let the time be x years. Then, $\left(\frac{500 \times 3 \times x}{100}\right) + \left(\frac{600 \times 9 \times x}{100 \times 2}\right) = 126$

$\Leftrightarrow 15x + 27x = 126 \Leftrightarrow 42x = 126 \Leftrightarrow x = 3.$

$\therefore$ Required time = 3 years.

48. Let the rate be R% p.a. Then, $\left(\frac{5000 \times R \times 2}{100}\right) + \left(\frac{3000 \times R \times 4}{100}\right) = 2200$

$\Leftrightarrow 100R + 120R = 2200 \Leftrightarrow R = \left(\frac{2200}{220}\right) = 10.$

$\therefore$ Rate = 10%.

49. Let the original rate be R%. Then, new rate = (2R)%.

$\therefore \left(\frac{725 \times R \times 1}{100}\right) + \left(\frac{362.50 \times 2R \times 1}{100 \times 3}\right) = 33.50$

$\Leftrightarrow (2175 + 725)\, R = 33.50 \times 100 \times 3 = 10050$

$\Leftrightarrow R = \frac{10050}{2900} = 3.46.$

$\therefore$ Original rate = 3.46%.

50. $\left(\frac{1500 \times R_1 \times 3}{100}\right) - \left(\frac{1500 \times R_2 \times 3}{100}\right) = 13.50$

$\Leftrightarrow 4500\,(R_1 - R_2) = 1350 \Leftrightarrow R_1 - R_2 = \frac{1350}{4500} = 0.3\%.$

51. Let the second amount be Rs. x. Then,

$$\left(\frac{12000 \times 10 \times 1}{100}\right) + \left(\frac{x \times 20 \times 1}{100}\right) = \left[\frac{(12000 + x) \times 14 \times 1}{100}\right]$$

$\Leftrightarrow$ $12000 + 20x = 168000 + 14x$ $\Leftrightarrow$ $6x = 48000$ $\Leftrightarrow$ $x = 8000$.

$\therefore$ Total investment = Rs. (12000 + 8000) = Rs. 20000.

52. S.I. = Rs. $\left(2600 \times \frac{20}{3} \times \frac{1}{100} \times T\right)$ = Rs. $\left(\frac{520}{3} \times T\right)$,

which is an exact number of rupees when T = 3.

53. Let the savings be X and Y and the rates of simple interest be $5x$ and $4x$ respectively.

Then, $X \times 5x \times \frac{1}{2} \times \frac{1}{100} = Y \times 4x \times \frac{1}{2} \times \frac{1}{100}$ or $\frac{X}{Y} = \frac{4}{5}$, *i.e.*, X : Y = 4 : 5.

54. Let the sum be Rs. x and original rate be R%. Then, $\frac{x \times (R + 3) \times 2}{100} - \frac{x \times R \times 2}{100} = 72$

$\Leftrightarrow$ $2Rx + 6x - 2Rx = 7200$ $\Leftrightarrow$ $x = 1200$.

55. Let the sum be Rs. x. Then, $\left(x \times \frac{25}{2} \times \frac{1}{100}\right) - \left(\frac{x \times 10 \times 1}{100}\right) = 1250$

$\Leftrightarrow$ $25x - 20x = 250000$ $\Leftrightarrow$ $5x = 250000$ $\Leftrightarrow$ $x = 50000$.

56. Let the capital be Rs. x. Then, $\left(\frac{x \times 8 \times 1}{100}\right) - \left(x \times \frac{31}{4} \times \frac{1}{100}\right) = 61.50$

$\Leftrightarrow$ $32x - 31x = 6150 \times 4$ $\Leftrightarrow$ $x = 24600$.

57. Let the annual instalment be Rs. x. Then,

$$\left[x + \left(\frac{x \times 3 \times 5}{100}\right)\right] + \left[x + \left(\frac{x \times 2 \times 5}{100}\right)\right] + \left[x + \left(\frac{x \times 1 \times 5}{100}\right)\right] + x = 6450$$

$\Leftrightarrow$ $\frac{23x}{20} + \frac{22x}{20} + \frac{21x}{20} + x = 6450$ $\Leftrightarrow$ $86x = 6450 \times 20$ $\Leftrightarrow$ $x = 1500$.

58. Rs. 10 + S.I. on Rs. 10 for 11 months

= Rs. 11 + S.I. on Re. 1 for (1 + 2 + 3 + 4 + ... + 10) months

$\Rightarrow$ Rs. 10 + S.I. on Re. 1 for 110 months = Rs. 11 + S.I. on Re. 1 for 55 months

$\Rightarrow$ S.I. on Re. 1 for 55 months = Re. 1.

$\therefore$ Rate = $\left(\frac{100 \times 12}{1 \times 55}\right)\% = 21\frac{9}{11}\%$.

59. Amount to be paid = Rs. $\left(100 + \frac{200 \times 5 \times 1}{100} + \frac{100 \times 5 \times 1}{100}\right)$ = Rs. 115.

60. Money paid in cash = Rs. 1000.

Balance payment = Rs. (20000 – 1000) = Rs. 19000.

61. Let the sum be Rs. x, rate be R% p.a. and time be T years.

Then, $\left[\frac{x \times (R + 2) \times T}{100}\right] - \left(\frac{x \times R \times T}{100}\right) = 108$ $\Leftrightarrow$ $2xT = 10800$ ...(*i*)

And, $\left[\frac{x \times R \times (T + 2)}{100}\right] - \left(\frac{x \times R \times T}{100}\right) = 180$ $\Leftrightarrow$ $2xR = 18000$ ...(*ii*)

Clearly, from (*i*) and (*ii*), we cannot find the value of x.

So, the data is inadequate.

62. Let the sum invested in Scheme A be Rs. x and that in Scheme B be Rs. $(13900 - x)$.

Then, $\left(\frac{x \times 14 \times 2}{100}\right) + \left[\frac{(13900 - x) \times 11 \times 2}{100}\right] = 3508$

$\Leftrightarrow \quad 28x - 22x = 350800 - (13900 \times 22) \quad \Leftrightarrow \quad 6x = 45000 \quad \Leftrightarrow \quad x = 7500.$

So, sum invested in Scheme B = Rs. (13900 − 7500) = Rs. 6400.

63. Let the sum lent at 10% be Rs. x and that lent at 9% be Rs. $(2600 - x)$. Then,

$$\left(\frac{x \times 10 \times 5}{100}\right) = \frac{(2600 - x) \times 9 \times 6}{100}$$

$\Leftrightarrow \quad 50x = (2600 \times 54) - 54x \quad \Rightarrow \quad x = \left(\frac{2600 \times 54}{104}\right) = 1350.$

$\therefore$ Sum lent at 10% = Rs. 1350.

64. Let the sum lent at 5% be Rs. x and that lent at 8% be Rs. $(1550 - x)$. Then,

$$\left(\frac{x \times 5 \times 3}{100}\right) + \left[\frac{(1550 - x) \times 8 \times 3}{100}\right] = 300$$

$\Leftrightarrow \quad 15x - 24x + (1550 \times 24) = 30000 \quad \Leftrightarrow \quad 9x = 7200 \quad \Leftrightarrow \quad x = 800.$

$\therefore$ Required ratio = 800 : 750 = 16 : 15.

65. Let the required rate be R. Then,

$$\left(\frac{20000 \times 8 \times 1}{100}\right) + \left(4000 \times \frac{15}{2} \times \frac{1}{100}\right) + \left(1400 \times \frac{17}{2} \times \frac{1}{100}\right) + \left(2600 \times R \times \frac{1}{100}\right) = \left(\frac{813}{10000} \times 10000\right)$$

$\Leftrightarrow \quad 160 + 300 + 119 + 26R = 813 \quad \Leftrightarrow \quad R = 9.$

66. Let the sum invested at 9% be Rs. x and that invested at 11% be Rs. $(100000 - x)$.

Then, $\left(\frac{x \times 9 \times 1}{100}\right) + \left[\frac{(100000 - x) \times 11 \times 1}{100}\right] = \left(100000 \times \frac{39}{4} \times \frac{1}{100}\right)$

$\Leftrightarrow \quad \frac{9x + 1100000 - 11x}{100} = \frac{39000}{4} = 9750$

$\Leftrightarrow \quad 2x = (1100000 - 975000) = 125000 \quad \Leftrightarrow \quad x = 62500.$

$\therefore$ Sum invested at 9% = Rs. 62500.

Sum invested at 11% = Rs. (100000 − 62500) = Rs. 37500.

67. Let x, y and z be the amounts invested in schemes A, B and C respectively. Then,

$$\left(\frac{x \times 10 \times 1}{100}\right) + \left(\frac{y \times 12 \times 1}{100}\right) + \left(\frac{z \times 15 \times 1}{100}\right) = 3200$$

$\Leftrightarrow \quad 10x + 12y + 15z = 320000 \quad ...(i)$

Now, $z = 240\%$ of $y = \frac{12}{5}y \quad ...(ii)$

And, $z = 150\%$ of $x = \frac{3}{2}x \quad \Rightarrow \quad x = \frac{2}{3}z = \left(\frac{2}{3} \times \frac{12}{5}\right)y = \frac{8}{5}y \quad ...(iii)$

From (*i*), (*ii*) and (*iii*), we have :

$16y + 12y + 36y = 320000 \quad \Leftrightarrow \quad 64y = 320000 \quad \Leftrightarrow \quad y = 5000.$

$\therefore$ Sum invested in Scheme B = Rs. 5000.

68. Let the parts be x, y and $[2600 - (x + y)]$. Then,

$$\frac{x \times 4 \times 1}{100} = \frac{y \times 6 \times 1}{100} = \frac{[2600 - (x + y)] \times 8 \times 1}{100}$$

$\therefore \quad \frac{y}{x} = \frac{4}{6} = \frac{2}{3}$ or $y = \frac{2}{3}x$.

So, $\frac{x \times 4 \times 1}{100} = \frac{\left(2600 - \frac{5}{3}x\right) \times 8}{100}$

$\Leftrightarrow \quad 4x = \frac{(7800 - 5x) \times 8}{3} \quad \Leftrightarrow \quad 52x = (7800 \times 8) \quad \Leftrightarrow \quad x = \left(\frac{7800 \times 8}{52}\right) = 1200.$

$\therefore$ Money invested at 4% = Rs. 1200.

69. Let the parts be x, y and $[2379 - (x + y)]$.

$$x + \left(x \times 2 \times \frac{5}{100}\right) = y + \left(y \times 3 \times \frac{5}{100}\right) = z + \left(z \times 4 \times \frac{5}{100}\right)$$

$$\Rightarrow \frac{11x}{10} = \frac{23y}{20} = \frac{6z}{5} = k \Rightarrow x = \frac{10k}{11}, y = \frac{20k}{23}, z = \frac{5k}{6}$$

But $x + y + z = 2379$

$$\Rightarrow \frac{10k}{11} + \frac{20k}{23} + \frac{5k}{6} = 2379 \quad \Rightarrow \quad 1380k + 1320k + 1265k = 2379 \times 11 \times 23 \times 6$$

$$\Rightarrow k = \frac{2379 \times 11 \times 23 \times 6}{3965} = \frac{3 \times 11 \times 23 \times 6}{5}$$

$$\therefore \quad x = \left(\frac{10}{11} \times \frac{3 \times 11 \times 23 \times 6}{5}\right) = 828.$$

Hence, the first part is Rs. 828.

70. Let total capital be Rs. x. Then, $\left(\frac{x}{3} \times \frac{7}{100} \times 1\right) + \left(\frac{x}{4} \times \frac{8}{100} \times 1\right) + \left(\frac{5x}{12} \times \frac{10}{100} \times 1\right) = 561$

$$\Leftrightarrow \frac{7x}{300} + \frac{x}{50} + \frac{x}{24} = 561 \quad \Leftrightarrow \quad 51x = (561 \times 600) \quad \Leftrightarrow \quad x = \left(\frac{561 \times 600}{51}\right) = 6600.$$

71. Let the sum be Rs. 100 be invested for 1 year. Then,

$$\text{S.I.} = \text{Rs.} \left[\left(\frac{40 \times 15 \times 1}{100}\right) + \left(\frac{30 \times 10 \times 1}{100}\right) + \left(\frac{30 \times 18 \times 1}{100}\right)\right] = \text{Rs. } 14.40.$$

$\therefore$ Effective rate = 14.4%.

EXERCISE 21B

(DATA SUFFICIENCY TYPE QUESTIONS)

Directions (*Questions 1 to 6*) : *Each of the questions given below consists of a statement and/or a question and two statements numbered I and II given below it. You have to decide whether the data provided in the statement(s) is/are sufficient to answer the question. Read both the statements and*

Give answer (a) if the data in Statement I alone are sufficient to answer the question, while the data in Statement II alone are not sufficient to answer the question;

Give answer (b) if the data in Statement II alone are sufficient to answer the question, while the data in Statement I alone are not sufficient to answer the question;

Give answer (c) if the data either in Statement I or in Statement II alone are sufficient to answer the question;

Give answer (d) if the data in both Statements I and II together are not sufficient to answer the question;

Give answer (e) if the data in both Statements I and II together are necessary to answer the question.

1. What is the rate of simple interest ? **(Bank P.O. 2003)**
   I. The total interest earned was Rs. 4000.
   II. The sum was invested for 4 years.
2. The simple interest on a sum of money is Rs. 50. What is the sum ? **(R.B.I. 2003)**
   I. The interest rate is 10% p.a.
   II. The sum earned simple interest in 10 years.
3. How much money did X invest ?
   I. An increase in the rate of interest from $4\frac{7}{8}\%$ to $5\frac{1}{8}\%$ per annum increases his yearly income by Rs. 25.
   II. The sum invested gets doubled, when invested at 8% p.a. for $12\frac{1}{2}$ years.
4. What percentage of simple interest per annum did Anand pay to Deepak ?
   I. Anand borrowed Rs. 8000 from Deepak for four years.
   II. Anand returned Rs. 8800 to Deepak at the end of two years and settled the loan.
   (I.B.P.S. 2002)
5. A man borrowed a total sum of Rs. 24000 from two moneylenders. For one loan, he paid interest @ $7\frac{1}{2}\%$ p.a. and for the other 9% p.a. How much money did he borrow at each rate ?
   I. The sum of the interests after one year was Rs. 2025.
   II. The interest on one sum was twice that on the other.
6. What is the sum which earned interest ? **(NABARD, 2002)**
   I. The total simple interest was Rs. 7000 after 7 years.
   II. The total of sum and simple interest was double of the sum after 5 years.

Directions (*Questions 7-8*) : *Each of the questions given below consists of a question followed by three statements. You have to study the question and the statements and decide which of the statement(s) is/are necessary to answer the question.*

7. What is the principal sum ?
   I. The sum amounts to Rs. 690 in 3 years at S.I.
   II. The sum amounts to Rs. 750 in 5 years at S.I.
   III. The rate of interest is 5% p.a.
   (*a*) I and III only (*b*) II and III only
   (*c*) I and II only (*d*) I and III only, or II and III only
   (*e*) Any two of the three
8. In how many years will a sum of money put at simple interest treble itself ?
   I. The interest earned in 4 years is half the sum.
   II. The rate of interest is $12\frac{1}{2}\%$.
   III. The sum doubles itself in 8 years at simple interest.
   (*a*) Any one of the three (*b*) Any two of the three
   (*c*) All I, II and III (*d*) II and III only
   (*e*) I and II only

ANSWERS

1. (*d*) 2. (*e*) 3. (*a*) 4. (*e*) 5. (*c*) 6. (*e*) 7. (*e*) 8. (*a*)

SOLUTIONS

1. We know that, $R = \left(\frac{100 \times S.I.}{P \times T}\right)$.

Now, I gives, S.I. = Rs. 4000.

II gives, T = 4 years.

But, P is unknown. So, we cannot find R.

So, given data is insufficient to get R.

∴ Correct answer is (*d*).

2. Given : S.I. = Rs. 50.

I gives, R = 10% p.a.

II gives, T = 10 years.

$$\therefore \quad \text{Sum} = \left(\frac{100 \times S.I.}{T \times R}\right) = \text{Rs.}\left(\frac{100 \times 50}{10 \times 10}\right) = \text{Rs. } 50.$$

Thus, I and II together give the answer.

∴ Correct answer is (*e*).

3. Suppose X invests Rs. x.

I gives : $R_1 = \frac{39}{8}\%$, $R_2 = \frac{41}{8}\%$.

Increase in S.I. = Rs. 25.

$$\Rightarrow \left(\frac{x \times 1 \times \frac{41}{8}}{100}\right) - \left(\frac{x \times 1 \times \frac{39}{8}}{100}\right) = 25$$

$$\Rightarrow (41x - 39x) = (25 \times 800) \Rightarrow x = \left(\frac{25 \times 800}{2}\right) = 10000.$$

Thus, I only gives the answer.

II gives, S.I. = Rs. x, R = 8% and $T = \frac{25}{2}$ years.

$$P = \frac{100 \times S.I.}{R \times T} = \left(\frac{100 \times x}{8 \times 25} \times 2\right)$$

Thus, P is not obtained.

∴ I alone is sufficient to get the answer and II is not sufficient to get the answer.

∴ Correct answer is (*a*).

4. Let the rate be R% p.a.

I gives, P = Rs. 8000 and T = 4 years.

II gives, S.I. = Rs. (8800 – 8000) = Rs. 800.

$$\therefore \quad R = \frac{100 \times S.I.}{P \times T} = \left(\frac{100 \times 800}{8000 \times 4}\right)\% = 2\frac{1}{2}\% \text{ p.a.}$$

Thus, I and II both are needed to get the answer.

∴ Correct answer is (*e*).

5. Suppose he borrowed Rs. x at $7\frac{1}{2}\%$ p.a. and Rs. $(24000 - x)$ at 9% p.a.

I gives, total interest = Rs. 2025.

$\therefore \quad \left(x \times 1 \times \frac{15}{2} \times \frac{1}{100}\right) + \left\{(24000 - x) \times 1 \times \frac{9}{100}\right\} = 2025.$

This gives x.

II gives Interest on Rs. $(24000 - x) = 2 \times$ (interest on Rs. x)

$\Rightarrow \quad (24000 - x) \times \frac{9}{100} \times 1 = \left(2 \times x \times \frac{15}{2} \times \frac{1}{100}\right)$

This gives x.

Thus, data in I as well as well as in II are sufficient to answer the question.

$\therefore$ Correct answer is (*c*).

6. Let the sum be Rs. x.

I gives, S.I. = Rs. 7000 and T = 7 years.

II gives, Sum + S.I. for 5 years = 2 × Sum $\Rightarrow$ Sum = S.I. for 5 years

Now, S.I. for 7 years = Rs. 7000

$\therefore$ S.I. for 1 year = Rs. $\frac{7000}{7}$ = Rs. 1000.

S.I. for 5 years = Rs. (1000 × 5) = Rs. 5000.

Thus, I and II both are needed to get the answer.

$\therefore$ Correct answer is (*e*).

7. Clearly, any of the three will give us the answer.

$\therefore$ Correct answer is (*e*).

8. Let sum be Rs. x. Then, S.I. = Rs. $(3x - x)$ = Rs. $2x$, T = ?

I gives : When T = 4, then S.I. = Rs. $\frac{x}{2}$.

$\therefore \quad R = \frac{100 \times \text{S.I.}}{P \times T} = \left(100 \times \frac{x}{2} \times \frac{1}{x} \times \frac{1}{4}\right) = 12\frac{1}{2}\%$ p.a.

Now, Sum = Rs. x, S.I. = Rs. $2x$, R = $\frac{25}{2}\%$ p.a., T = ?

$\therefore \quad T = \frac{100 \times \text{S.I.}}{P \times R} = \left(\frac{100 \times 2x}{x \times 25} \times 2\right) = 16$ years.

Thus, I only gives the answer.

II gives, R = $\frac{25}{2}\%$ p.a.

$\therefore \quad T = \frac{100 \times \text{S.I.}}{P \times R} = \left(\frac{100 \times 2x}{x \times 25} \times 2\right) = 16$ years.

Thus, II only also gives the answer.

III gives, R = 5% p.a.

$\therefore \quad T = \frac{100 \times \text{S.I.}}{P \times R} = \left(\frac{100 \times 2x}{x \times 5}\right) = 40$ years.

Thus, III only also gives the answer.

$\therefore$ Correct answer is (*a*).

22. COMPOUND INTEREST

Compound Interest : Sometimes it so happens that the borrower and the lender agree to fix up a certain unit of time, say *yearly* or *half-yearly* or *quarterly* to settle the previous account.

In such cases, the amount after first unit of time becomes the principal for the second unit, the amount after second unit becomes the principal for the third unit and so on.

After a specified period, *the difference between the amount and the money borrowed is called the* ***Compound Interest*** *(abbreviated as C.I.) for that period.*

IMPORTANT FACTS AND FORMULAE

Let Principal = P, Rate = R% per annum, Time = n years.

I. When interest is compound Annually :

$$\text{Amount} = P\left(1+\frac{R}{100}\right)^n$$

II. When interest is compounded Half-yearly :

$$\text{Amount} = P\left[1+\frac{(R/2)}{100}\right]^{2n}$$

III. When interest is compounded Quarterly :

$$\text{Amount} = P\left[1+\frac{(R/4)}{100}\right]^{4n}$$

IV. When interest is compounded Annually but time is in fraction, say $3\frac{2}{5}$ years.

$$\text{Amount} = P\left(1+\frac{R}{100}\right)^3 \times \left(1+\frac{\frac{2}{5}R}{100}\right)$$

V. When Rates are different for different years, say $R_1\%$, $R_2\%$, $R_3\%$ for 1st, 2nd and 3rd year respectively.

$$\text{Then, Amount} = P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right).$$

VI. Present worth of Rs. x due n years hence is given by :

$$\text{Present Worth} = \frac{x}{\left(1+\frac{R}{100}\right)^n}.$$

SOLVED EXAMPLES

Ex. 1. ***Find compound interest on Rs. 7500 at 4% per annum for 2 years, compounded annually.***

Sol. Amount = Rs. $\left[7500\times\left(1+\frac{4}{100}\right)^2\right]$ = Rs. $\left(7500\times\frac{26}{25}\times\frac{26}{25}\right)$ = Rs. 8112.

$\therefore$ C.I. = Rs. (8112 − 7500) = Rs. 612.

Ex. 2. ***Find compound interest on Rs. 8000 at 15% per annum for 2 years 4 months, compounded annually.***

Sol. Time = 2 years 4 months = $2\frac{4}{12}$ years = $2\frac{1}{3}$ years.

Amount = Rs. $\left[8000\times\left(1+\frac{15}{100}\right)^2\times\left(1+\frac{\frac{1}{3}\times 15}{100}\right)\right]$ = Rs. $\left(8000\times\frac{23}{20}\times\frac{23}{20}\times\frac{21}{20}\right)$

= Rs. 11109.

$\therefore$ C.I. = Rs. (11109 − 8000) = Rs. 3109.

Ex. 3. ***Find the compound interest on Rs. 10,000 in 2 years at 4% per annum, the interest being compounded half-yearly.*** **(S.S.C. 2000)**

Sol. Principal = Rs. 10000; Rate = 2% per half-year; Time = 2 years = 4 half-years.

$\therefore$ Amount = Rs. $\left[10000\times\left(1+\frac{2}{100}\right)^4\right]$ = Rs. $\left(10000\times\frac{51}{50}\times\frac{51}{50}\times\frac{51}{50}\times\frac{51}{50}\right)$

= Rs. 10824.32.

$\therefore$ C.I. = Rs. (10824.32 − 10000) = Rs. 824.32.

Ex. 4. ***Find the compound interest on Rs. 16,000 at 20% per annum for 9 months, compounded quarterly.***

Sol. Principal = Rs. 16000; Time = 9 months = 3 quarters;

Rate = 20% per annum = 5% per quarter.

$\therefore$ Amount = Rs. $\left[16000\times\left(1+\frac{5}{100}\right)^3\right]$ = Rs. $\left(16000\times\frac{21}{20}\times\frac{21}{20}\times\frac{21}{20}\right)$ = Rs. 18522.

$\therefore$ C.I. = Rs. (18522 − 16000) = Rs. 2522.

Ex. 5. ***If the simple interest on a sum of money at 5% per annum for 3 years is Rs. 1200, find the compound interest on the same sum for the same period at the same rate.***

Sol. Clearly, Rate = 5% p.a., Time = 3 years, S.I. = Rs. 1200.

So, Principal = Rs. $\left(\frac{100\times 1200}{3\times 5}\right)$ = Rs. 8000.

Amount = Rs. $\left[8000\times\left(1+\frac{5}{100}\right)^3\right]$ = Rs. $\left(8000\times\frac{21}{20}\times\frac{21}{20}\times\frac{21}{20}\right)$ = Rs. 9261.

$\therefore$ C.I. = Rs. (9261 − 8000) = Rs. 1261.

Ex. 6. ***In what time will Rs. 1000 become Rs. 1331 at 10% per annum compounded annually ?*** **(S.S.C. 2004)**

Sol. Principal = Rs. 1000; Amount = Rs. 1331; Rate = 10% p.a.

Let the time be n years. Then,

$$\left[1000\left(1+\frac{10}{100}\right)^n\right] = 1331 \text{ or } \left(\frac{11}{10}\right)^n = \left(\frac{1331}{1000}\right) = \left(\frac{11}{10}\right)^3$$

$\therefore$ $n = 3$ years.

Ex. 7. ***If Rs. 500 amounts to Rs. 583.20 in two years compounded annually, find the rate of interest per annum.***

Sol. Principal = Rs. 500; Amount = Rs. 583.20; Time = 2 years.

Let the rate be R% per annum. Then,

$$\left[500\left(1+\frac{R}{100}\right)^2\right] = 583.20 \text{ or } \left(1+\frac{R}{100}\right)^2 = \frac{5832}{5000} = \frac{11664}{10000}$$

$$\therefore \left(1+\frac{R}{100}\right)^2 = \left(\frac{108}{100}\right)^2 \text{ or } 1+\frac{R}{100} = \frac{108}{100} \text{ or } R = 8.$$

So, rate = 8% p.a.

Ex. 8. ***If the compound interest on a certain sum at $16\frac{2}{3}\%$ for 3 years is Rs. 1270, find the simple interest on the same sum at the same rate and for the same period.***

Sol. Let the sum be Rs. x. Then,

$$\text{C.I.} = \left[x\times\left(1+\frac{50}{3\times 100}\right)^3 - x\right] = \left(\frac{343x}{216} - x\right) = \frac{127x}{216}.$$

$$\therefore \frac{127x}{216} = 1270 \text{ or } x = \frac{1270\times 216}{127} = 2160.$$

Thus, the sum is Rs. 2160.

$$\therefore \text{S.I.} = \text{Rs.}\left(2160\times\frac{50}{3}\times 3\times\frac{1}{100}\right) = \text{Rs. } 1080.$$

Ex. 9. ***The difference between the compound interest and simple interest on a certain sum at 10% per annum for 2 years is Rs. 631. Find the sum.***

Sol. Let the sum be Rs. x. Then,

$$\text{C.I.} = x\left(1+\frac{10}{100}\right)^2 - x = \frac{21x}{100}, \quad \text{S.I.} = \left(\frac{x\times 10\times 2}{100}\right) = \frac{x}{5}.$$

$$\therefore (\text{C.I.}) - (\text{S.I.}) = \left(\frac{21x}{100} - \frac{x}{5}\right) = \frac{x}{100}.$$

$$\therefore \frac{x}{100} = 631 \Leftrightarrow x = 63100.$$

Hence, the sum is Rs. 63,100.

Ex. 10. ***The difference between the compound interest and the simple interest accrued on an amount of Rs. 18,000 in 2 years was Rs. 405. What was the rate of interest p.c.p.a.?*** **(Bank P.O. 2003)**

Sol. Let the rate be R% p.a. Then,

$$\left[18000\left(1+\frac{R}{100}\right)^2 - 18000\right] - \left(\frac{18000\times R\times 2}{100}\right) = 405$$

$$\Leftrightarrow 18000\left[\frac{(100+R)^2}{10000} - 1 - \frac{2R}{100}\right] = 405$$

$$\Leftrightarrow \quad 18000\left[\frac{(100+R)^2-10000-200R}{10000}\right] = 405$$

$$\Leftrightarrow \quad \frac{9}{5}R^2 = 405 \Leftrightarrow R^2 = \left(\frac{405\times 5}{9}\right) = 225 \Leftrightarrow R = 15.$$

$\therefore$ Rate = 15%.

Ex. 11. ***Divide Rs. 1301 between A and B, so that the amount of A after 7 years is equal to the amount of B after 9 years, the interest being compounded at 4% per annum.***

Sol. Let the two parts be Rs. x and Rs. $(1301 - x)$.

$$x\left(1+\frac{4}{100}\right)^7 = (1301-x)\left(1+\frac{4}{100}\right)^9 \Leftrightarrow \frac{x}{(1301-x)} = \left(1+\frac{4}{100}\right)^2 = \left(\frac{26}{25}\times\frac{26}{25}\right).$$

$\Leftrightarrow \quad 625x = 676\,(1301 - x) \Leftrightarrow 1301x = 676 \times 1301 \Leftrightarrow x = 676.$

So, the two parts are Rs. 676 and Rs. (1301 – 676) *i.e.* Rs. 676 and Rs. 625.

Ex. 12. ***A certain sum amounts to Rs. 7350 in 2 years and to Rs. 8575 in 3 years. Find the sum and rate percent.***

Sol. S.I. on Rs. 7350 for 1 year = Rs. (8575 – 7350) = Rs. 1225.

$$\therefore \quad \text{Rate} = \left(\frac{100\times 1225}{7350\times 1}\right)\% = 16\frac{2}{3}\%.$$

Let the sum be Rs. x. Then,

$$x\left(1+\frac{50}{3\times 100}\right)^2 = 7350 \Leftrightarrow x\times\frac{7}{6}\times\frac{7}{6} = 7350 \Leftrightarrow x = \left(7350\times\frac{36}{49}\right) = 5400.$$

$\therefore$ Sum = Rs. 5400.

Ex. 13. ***A sum of money amounts to Rs. 6690 after 3 years and to Rs. 10,035 after 6 years on compound interest. Find the sum.***

Sol. Let the sum be Rs. P. Then,

$$P\left(1+\frac{R}{100}\right)^3 = 6690 \quad ...(i) \qquad \text{and } P\left(1+\frac{R}{100}\right)^6 = 10035 \quad ...(ii)$$

On dividing, we get $\left(1+\frac{R}{100}\right)^3 = \frac{10035}{6690} = \frac{3}{2}$.

Substituting this value in (*i*), we get :

$$P\times\frac{3}{2} = 6690 \text{ or } P = \left(6690\times\frac{2}{3}\right) = 4460.$$

Hence, the sum is Rs. 4460.

Ex. 14. ***A sum of money doubles itself at compound interest in 15 years. In how many years will it become eight times ?***

Sol. $P\left(1+\frac{R}{100}\right)^{15} = 2P \Rightarrow \left(1+\frac{R}{100}\right)^{15} = \frac{2P}{P} = 2 \quad ...(i)$

Let $P\left(1+\frac{R}{100}\right)^n = 8P \Rightarrow \left(1+\frac{R}{100}\right)^n = 8 = 2^3 = \left\{\left(1+\frac{R}{100}\right)^{15}\right\}^3$ [*using* (*i*)]

$$\Rightarrow \left(1+\frac{R}{100}\right)^n = \left(1+\frac{R}{100}\right)^{45} \Rightarrow n = 45.$$

Thus, the required time = 45 years.