PROBLEMS ON TRAINS

IMPORTANT FACTS AND FORMULAE

1. *a km/hr= (a** 5/18) m/s.

2. a m / s = (a*18/5) km/hr.

3 Time taken by a train of length *1* metres to pass a pole or a standing man or a signal post is equal to the time taken by the train to cover *1* metres.

4. Time taken by a train of length *1* metres to pass a stationary object of length *b*metres is the time taken by the train to cover *(1 + b)* metres.

5. Suppose two trains or two bodies are moving in the same direction at u m / s and*v m/s,* where u >*v,* then their relatives speed = (u - *v)* m / s.

6. Suppose two trains or two bodies are moving in opposite directions at u m / s and*v m/s,* then their relative speed is = (u + *v)* m/s.

7. If two trains of length *a* metres and *b* metres are moving in opposite directions atu m / s and *v* m/s, then time taken by the trains to cross each other = *(a + b)/(u+v)* sec.

8.If two trains of length a metres and *b* metres are moving in the same direction at u m / s and *v* m / s, then the time taken by the faster train to cross the slower train =(a+b)/(u-v) sec.

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

(A's speet) :(B's speed) = $(b^{1/2}: a^{1/2})$.

SOLVED EXAMPLES

Ex.I. A train 100 m long is running at the speed of 30 km / hr. Find the time taken by it to pass a man standing near the railway line. (S.S.C. 2001)

Sol. Speed of the train = (30 x 5/18) m / sec = (25/3) m/ sec.

Distance moved in passing the standing man = 100 m.

Required time taken = *100/(25/3)* = (100 *(3/25)) sec = 12 sec

Ex. 2. A train is moving at a speed of 132 km/br. If the length of the train is 110 metres, how long will it take to cross a railway platform 165 metres long? (Section Officers', 2003)

Sol. Speed of train = 132 *(5/18)m/sec = 110/3 m/sec.

Distance covered in passing the platform = (110 + 165) m = 275 m.

Time taken =275 *(3/110) sec =15/2 sec = 7 ½ sec

Ex. 3. A man is standing on a railway bridge which is 180 m long. He finds that a train crosses the bridge in 20 seconds but himself in 8 seconds. Find the length of the train and its speed?

Sol. Let the length of the train be x metres,

Then, the train covers x metres in 8 seconds and (x + 180) metres in 20 sec

x/8=(x+180)/20 ⇔20x = 8 *(x* + 180)<=> *x* = 120.

Length of the train = 120 m.

Speed of the train = (120/8) m /sec = m /sec = (15 *18/5) kmph = 54 km

Ex. 4. A train 150 m long is running with a speed of 68 kmph. In what time will it pass a man who is running at 8 kmph in the same direction in which the train is going?

Sol: Speed of the train relative to man = (68 - 8) kmph

= (60*5/18)m/sec = (50/3)m/sec

Time taken by the train to cross the man I
= Time taken by It to cover 150 m at 50/3 m/sec = 150 *3/50 sec = 9sec

Ex. 5. A train 220 m long is running with a speed of 59 kmph..In what will it pass a man who is running at 7 kmph in the direction opposite to that in which the train is going?

sol. Speed of the train relative to man = (59 + 7) kmph
= 66 *5/18 *m/sec* = 55/3 m/sec.

Time taken by the train to cross the man= Time taken by it to cover 220 m at (55/3)m /sec = (220 *3/55)sec = 12 sec

Ex. 6. Two trains 137 metres and 163metres in length are running towards eachother on parallel lines, one at the rate of 42 kmph and another at 48 kmpb. In what time will they be clear of each other from the moment they meet?

Sol. Relative speed of the trains = (42 + 48) kmph = 90 kmph
=(90*5/18) m /sec = 25 m /sec.

Time taken by the trainsto'pass each other
= Time taken to *cover*(137 + 163) m at 25 m*/sec* =(300/25) sec = 12 sec

Ex. 7. Two trains 100 metres and 120 metres long are running in the same direction with speeds of 72 km/hr,Inhowmuch time will the first train cross the second?

Sol: Relative speed of the trains = (72 - 54) km/hr = 18 *km/hr*
= (18 *5/18) *m/sec* = 5 *m/sec.*

Time taken by the trains to cross each other
= Time taken to cover (100 + 120) m at 5 m /sec = (220/5) sec = 44 sec.

Ex. 8. A train 100metres long takes 6 seconds to cross a man walking at 5 kmph in the direction opposite to that of the train. Find the speed of the train.?

Sol:Let the speed of the train be x kmph.

Speed of the train relative to man = (x + 5) kmph = $(x + 5) * 5/18$ m/sec.

Therefore $100/((x+5)*5/18)=6 <=> 30 (x + 5) = 1800 <=> x = 55$

Speed of the train is 55 kmph.

Ex9. A train running at 54 kmph takes 20 seconds to pass a platform. Next it takes.12 sec to pass a man walking at 6 kmph in the same direction in which the train is going . Find the length of the train and the length of the platform.

Sol: Let the length of train be x metres and length of platform be *y* metres.

Speed of the train relative to man = (54 - 6) kmph = 48 kmph

= 48*(5/18) m/sec = 40/3 m/sec.

In passing a man, the train covers its own length with relative speed.

Length of train = (Relative speed * Time) = (40/3)*12 m = 160 m.

Also, speed of the train = 54 *(5/18)m / sec = 15 m / sec.

$(x+y)/15 = 20 <=> x + y = 300 <=> Y$ = (300 - 160) m = 140 m.

Ex10. A man sitting in a train which is traveling at 50 kmph observes that agoods train, traveling in opposite direction, takes 9 seconds to pass him. If the goods train is 280 m long, find its speed.?

Sol: Relative speed = 280/9m / sec = ((280/9)*(18/5))kmph = 112 kmph.

Speed of goods train = (112 - 50) kmph = 62 kmph.

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:
speed downstream=(u+v)km/hr.
speed upstream=(u-v)km/hr.

3.If the speed downstream is a km/hr and the speed upstream is b km/hr,then :
speed in still water=1/2(a+b)km/hr
rate of stream=1/2(a-b)km/hr

SOLVED EXAMPLES

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

Sol. Rate in still water=1/2(10+7)km/hr=8.5 km/hr.
Rate of current=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 2hours30minutes to cover a distance of 5km upstream. find the speed of the river current in km/hr.

Sol. rate downstream=(15/3 ¾)km/hr=(15*4/15)km/hr=4km/hr.
Rate upstream=(5/2 ½)km/hr=(5*2/5)km/hr=2km/hr.
Speed of current=1/2(4-2)km/hr=1km/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=3xkmph.
So,2x=18 or x=9.
Rate upstream=9 km/hr,rate downstream=27 km/hr.
Hence,rate of stream=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 placeA first?

Sol. Clearly the cyclist moves both ways at a speed of 12 km/hr.
The boat sailor moves downstream @ (10+4)i.e.,14 km/hr and upstream @ (10-4)i.e., 6km/hr.
So,average speed of the boat sailor=(2*14*6/14+6)km/hr
=42/5 km/hr=8.4 km/hr.
since the average speed of the cyclist is greater ,he will return ta A first.

EX.5. A man can row 7 ½ kmph in still water.if in a river running at 1.5 km/hr an hour,it takes him 50 minutes to row to a place and back,how far off is the place?

Sol. Speed downstream =(7.5+1.5)km/hr=9 km/hr;
Speed upstream=(7.5-1.5)kmph=6kmph.
Let the required distance be x km.then,
x/9+x/6=50/60.
2x+3x=(5/6*18)
5x=15
x=3.
Hence,the required distance is 3km.

EX.6. In a stream running at 2kmph,a motar boat goes 6km upstream and back again to the starting point in 33 minutes.find the speed of the motarboat in still water.

Sol.let the speed of the motarboat in still water be x kmph.then,
6/x+2 +6/x-2=33/60
$11x^2$-240x-44=0
$11x^2$-242x+2x-44=0
(x-22)(11x+2)=0
x=22.

EX.7.A man can row 40km upstream and 55km downstream in 13 hours also, he can row 30km upstream and 44km 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,40/x +55/y =13…(i) and 30/x +44/y =10
Multiplying (ii) by 4 and (i) by 3 and subtracting ,we get:11/y=1 or y=11.
Substituting y=11 in (i),weget:x=5.
Rate in still water =1/2(11+5)kmph=8kmph.
Rate of current=1/2(11-5)kmph=3kmph