PHYSICS

BOOKS - BHARATI BHAWAN PHYSICS (HINGLISH)

COMPOSITION AND RESOLUTION OF VELOCITIES

Example

1. Three equla force, each of magnitude P, act along the side AB, BC, and CA of a trangle. Calculate the resultant force.

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2. A ship is sailing north at the rate of 4 cm per second, the current is taking it east at the rate of 3 cm per second and a sailor is climbing a vertical pole at the rate of 2 cm per

second. Find the resultant velocity of the sailor in space.

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3. To a man walking at the rate of $3km/h$ the rain appear to fall vetically douwnwards. When he increases his speed $6km/h$ it appears to meet him at an angle of 45° with vertically. Find the speed of rain.

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4. The wind appears to blow form the north to a man movinf in the north -east direction. When he doubles his velocity the wind appears to move in the direction $\cot^{-1} 2$ east of north. Find the actual direction of the wind.

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5. A $2-m$ wide truck is moving with a uniform speed $v_0 = 8ms^{-1}$ along a straight horizontal road. A pedestrian starts to cross the road with a uniform speed v when the

truck is $4m$ away from him, The minimum value of v so that he can cross the road safely is .

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6. Show that the direction of the shortest route is at right angles to the river when the velocity of the swimmer is greater than that of the river. Show also that when the velocity of the swimmer is less than that of the river, the

direction is $\tan^{-1} v/\sqrt{u^2 - v^2}$ where v= velocity of swimmer and u= velocity of river.

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Exercise

1. The greatest an least resultant of two forces acting at a point are 13 N and 5 N. Calculate each force.

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2. A particle is acted on by forces 1, 2,3 and 4 N parallel to the side of a rectangle taken in order. Find resultant.

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3. A pith ball of mass 1.5 g, suspended by a silk fibre, is blown to one side by a horizontal current of air so that the fibre make an angle of 30° with the vertical. Find the force of air current on the ball.

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4. The resultant of two equal velocities is equal to either. What is the angle between them?

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5. A uniform rod of mass 3 kg and length 1 m is suspended from a fixed point by means of two strings of lengths 0.6m and 0.8 which are

attached to the free ends of the rod. Find the tensions in the strings.

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6. A river is $\frac{1}{2}$km wide and flows at the rate of 3 kmph. A man, who can swim in still water at the rate of 5 kmph wishes to reach the other bank of the river. In what direction should he start swimmin to cross the river (a) along the shortest route, (b) in the shortest possible

time ? Calculate how much time he will take to cross the river in the two cases.

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7. To a man walking at 5kmph rain appears to fall vertically, and when he doubles his speed it appears to make an angle of 30° with the vertical. Find the actual velocity of the rain. In what direction will rain appear to fall if the man suddenly turns around when his speed is 5 kmph?

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8. A ship is travelling due east at 10 km/h. A ship heading 30° east of north is always due north from the first ship. The speed of the second ship in km/h is

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9. A motorboat going downstream overcome a raft at a point A, $\tau = 60 \text{ min}$ later it turned back and after some time passed the raft at a

distance $l = 6.0km$ from the point A. Find the flow velocity assuming the duty of the engine to be constant.

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10. A man walking on a road with a velocity of 5 km per hour encounters rain falling vertically with a velocity of 25 km per hour. At what angle should he holds his umbrella in order to protect himself form the rain?

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11. If the resultant of two forces of magnitudes p and $2p$ is perpendicular to p, then the angle between the forces is

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12. Two cars are moving in the same direction with the same speed $30km/hr$. They are separated by a distance of $5km$, the speed of a car moving in the opposite direction of it

meets these two cars at an interval of 4 minutes, will be.

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13. A man wants to cross a river 500 m wide. His rowing speed in still water is 3 kmph. The river flows at a speed of 2 kmph. If the man's walking speed on the shore is 5kmph, (a) find the path he should take to get to the point directly opposite to his starting point in the

shortest time. (b) How long does it take to get there?

14. Find the speed of two objects if ,when they move uniformly towards each other, they get 5 m closer in every second and when they move uniformly in the same direction with their original speed , they get 4m closer every 10s

15. The resultant of two forces of magnitude 5 N and 3 N trisects the angle between them. Calculate the angle between them.

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16. Two bodies were thrown simultaneously from the same point, one, straight up, and the other, at an angle of $\theta = 60^\circ$ to the horizontal. The initial velocity of each body is equal to $v_0 = 25m/s$. Neglecting the air drag,

find the distance between the bodies $t = 1.70s$ later.

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17. Two particles, 1 and 2, move with constant velocities v_1 and v_2 along two mutually perpendicular straight lines toward the intersection point O. At the moment $t = 0$ the particles were located at the distances l_1 and l_2 from the point O. How soon will the distance

between the particles become the smallest? What is it equal to?

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18. An aeroplane has to go from a point O to another point A, at distance d due 37° east of north. A wind is blowing due north at a speed of $20m/s$. The air speed of the plane is v. (a) Find the direction in whihc the pilot should head the plane to reach the point A. (b) Find

the time taken by the plane to go from O to A

.

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19. Two boats A and B moved away from a boy anchored in the middle of a river. A moved along the river and B at right angle to it. Having moves off equal distances from the boy, the boats returned. Find the ratio of the times of motion of the boats, if the velocity of

each boat with respect to still water is η times greater than the velocity of water current.

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20. A boat moves relative to water with a velocity which is $n = 2.0$ times less than the river flow velocity. At what angle to the stream direction must the boat move to minimize drifting?

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21. A car window pane of length 25 cm is hinged at the top and 5 cm of its lower portion is covered by a fixed pane. Calculate the maximum anlgle by which the window pane can be raised outward without letting rain water enter into the car when it races through rain (falling vertically at 20 kmph) at 60 kmph.

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22. On a two lane road , car (A) is travelling with a speed of $36kmh^{-1}$. Tho car B and C approach car (A) in opposite directions with a speed of $54kmh^{-1}$ each . At a certain instant , when the distance (AB) is equal to (AC), both being $1km$, $(B)decides \rightarrow overtake$ A before C does , What minimum accelration of car (B) is required to avoid and accident.

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23. A train of length $l = 350m$ starts moving rectilinearly with constant acceleration $w = 3.0 \cdot 10^{-2} m/s^2$, $t = 30s$ after the start the locomotive headlight is switched on (event 1), and $\tau = 60s$ after that event the tail signal light is switched on (event 2). Find the distance between these events in the reference frames fixed to be train and to the Earth. How and at what constant velocity V relative to the Earth must a certain reference frame K move for the two events to occur in it at the same point?

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24. A short fired at a moving train (u=30 km/h) at an angle $\theta =$ arc sin1/5 with the track enters a compartment of dimension $a \times b = 12m \times 14m$ through a corner away form the engine and passes out through the diagonally opposite corner. Calculate the speed of the shot.

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25. The velocity of water current in a river changes with distance along the perpendicular to the river according to the law $u = \frac{2u_0}{d}y$ for $0 \leq y \leq \frac{d}{2}$ where u_0= velocity in the mid-stream d= width of the river $= \frac{2u_0}{d}(d-y)$ for $\frac{d}{2} \leq y \leq d.$

A boat travels from a point O on one block of the river to the opposite bank and its steering angle is constantly changed to keep its relative velocity perpendicular to the river current. Calculate the time in which the boat

will reach the other bank. The velocity of the boat in still water is u_0.

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