



# **PHYSICS**

# **BOOKS - DHANPAT RAI & CO PHYSICS (HINGLISH)**

# VECTORS



# 1. ABCDE is a pentagon prove that vec(AB+

(vec(BC)+vec(CD)+vec(DE)+vec(EA)=vec0`

**2.** ABCD is a parallelogram Fig. 2 (c ) .64. AC and (BD) are its

diagonals. Show that

$$(a)\overrightarrow{AC} + \overrightarrow{BD} = 2\overrightarrow{BC}$$
(b)  $\overrightarrow{AC} - \overrightarrow{BD} = 2\overrightarrow{AB}$ 



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Example

1. A boy travels 10 m due north and then 7m due east. Find

the displacement of the boy.



2. A particle has a displacement of 12 m towards east and 5m

towards the north and then 6m vertically upward. Find the

magnitude of the sum of these displacements.



3. Find the resultant of two forces, one 6N due east and

other 8N due north.



**4.** Two vectors, both equal in magnitude, have their resultant equal in magnitude of the either. Find the angle between the two vectors.

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**5.** Two forces equal to P and 2P newton act on a particle. If the first be doubled and the second be increased by 20 newton, the direction of the resultant is unaltered. Find the value of P.



6. The resultant vector of  $\overrightarrow{P}$  and  $\overrightarrow{Q}$  is  $\overrightarrow{R}$ . On reversing the direction of  $\overrightarrow{Q}$ , the resultant vector becomes  $\overrightarrow{S}$ . Show that :  $R^2 + S^2 = 2(P^2 + Q^2)$ 

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7. Calculate the angle between a 2N force and a 3N force so

that their resultant is 4N.



8. The greatest and the least resultant of two force acting at

a point are 29N and 5N respectively. If each force is increased

by 3N, find the resultant of two new forces acting at right

angle of each other.



**9.** The sum of the magnitudes of two forces acting at a point is 18 and the magnitude of their resultant is 12. If the resultant is at  $90^{\circ}$  with the force of smaller magnitude, What are the magnitudes of forces?

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**10.** Establish the following inequalities geometrically or otherwise,

(a) 
$$\left| \overrightarrow{A} + \overrightarrow{B} \right| \leq \left| \overrightarrow{A} \right| + \left| \overrightarrow{B} \right|$$

When does the equality sign above apply ?

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**11.** Establish the following vector in equalities:

(i) 
$$\left| \overrightarrow{a} - \overrightarrow{b} \right| \leq \left| \overrightarrow{a} \right| + \left| \overrightarrow{b} \right|$$
  
(ii)  $\left| \overrightarrow{a} - \overrightarrow{b} \right| \geq \left| \overrightarrow{a} \right| - \left| \overrightarrow{b} \right|$ 

What does the equality sign apply ?

12. Rain is falling vertically with a speed of  $30ms^{-1}$ . A woman rides a bicycle with a speed of  $10ms^{-1}$  in the North to South direction. What is the direction in which she should hold her umbrella ?

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**13.** A man can swim with a speed of  $4kmh^{-1}$  in still water. He crosses a river 1km wise that flows steadly at  $3kmh^{-1}$ . If he makes his strokes normal to the river current, how far down the river does he go when he reaches the other bank?



**14.** A river 800 m wide flows at the rate of  $5kmh^{-1}$ . A swimmer who can swim at  $10kmh^{-1}$  in still water, wishes to cross the river straight. (i) Along what direction must be strike ? (ii) What should be his resultant velocity ? (iii) How much time he would take ?



**15.** A boat man can row with a speed of  $10kmh^{-1}$  in still water. If the river flows steadily at 5km/h, in which direction should the boatman row in order to reach a point on the other bank directly opposite to the point from where he stared ? The width of the river is 2km.



**16.** Rain is falling vertically with a speed of  $30ms^{-1}$ . A woman rides a bicycle with a speed of  $10ms^{-1}$  in the North to South direction. What is the direction in which she should hold her umbrella ?

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**17.** To a person moving eastwards with a velocity of  $4.8kmh^{-1}$ , rain appears to fall vertically downwards with a speed of  $6.4kmh^{-1}$ . Find the actual speed and direction of the rain.



**18.** A ship is steaming towards east at a speed of 12 ms–1. A woman runs across the deck at a speed of 5 ms–1 in the direction at right angles to the direction of motion of the ship i.e. towards north. What is the velocity of the woman relative to sea ?

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**19.** In a harbour, wind is blowing at the speed of 72km/hand the flag on the mast of a boat anchored in the harbour flutters along the N-Edirection. If the boat starts moving at a speed of 51km/h to the North, what is the direction of flag on the mast of the bat ?



**20.** To a man walking due east at the rate of  $2kmh^{-1}$ , rain appears to fall vertically. When he increases his speed to  $4kmh^{-1}$ , its appears to meet him at an angle of  $45^{\circ}$ . Find the real direction and speed of rain.

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**21.** Find unit vector parallel to the resultant of the vectors  $\overrightarrow{A} = \hat{i} + 4\hat{j} + 2\hat{k}$  and  $\overrightarrow{B} = 3\hat{i} - 5\hat{j} + \hat{k}$ .

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22. A vector  $\overrightarrow{X}$ , when added to the resultant of the vectors  $\overrightarrow{A} = 3\hat{i} - 5\hat{j} + 7\hat{k}$  and  $\overrightarrow{B} = 2\hat{i} + 4\hat{j} - 3\hat{k}$  gives a unit

vector along Y-axis. Find the vector  $\overrightarrow{X}$ .



**23.** Two forces 
$$\overrightarrow{F}_1 = 3\hat{i} + 4\hat{j}$$
 and  $\overrightarrow{F}_2 = 3\hat{j} + 4\hat{k}$  are acting simultaneously at a point. What is the magnitude of the resultant force ?

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**24.** If  $\overrightarrow{A} = 3\hat{i} + 4\hat{j}$  and  $\overrightarrow{B} = 7\hat{I} + 24\hat{j}$ , find a vector having the same magnitude as  $\overrightarrow{B}$  and parallel to  $\overrightarrow{A}$ .

**25.** A boat is moving with a velocity  $(3\hat{i} + \hat{j})$  with respect to ground. The water in the river is moving with a velocity  $-3\hat{i} - 4\hat{j}$  with respect to ground. What is the relative velocity of boat with respect to river ?

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**26.** A bird moves with velocity 20m/s in a direction making an angle of  $60^{\circ}$  with the eastern line and  $60^{\circ}$  with the vertical upward. Represent the velocity vector in rectangular form.



27. A force is inclined at  $50^{\circ}$  to the horizontal. If its rectangular component in the horizontal direction be

50N,find the magnitude of theforce and its vertical component.



**28.** An aeroplane takes off at angle of  $30^{\circ}$  to the horizontal. If the component of its velocity along the horizontal is  $250kmh^{-1}$ , what is the actual velocity ? Find also the vertical component of the velocity.

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**29.** A man rows a boat with a speed of 18 km/hr in northwest direction. The shoeline makes an angle of  $15^{\circ}$  south of west.

Obtain the component of the velocity of the boat along the

shoreline:

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**30.** Two billiard balls are rolling on a flat table. One has the velocity components  $v_x = 1ms^{-1}$ ,  $v_y = \sqrt{3}ms^{-1}$  and the other has components  $v'_x = 2ms^{-1}$  and  $v'_y = 2ms^{-1}$ . If both the balls start moving from the same point, what is the angle between their paths ?

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**31.** Four persons K,L,M,N are initially at the four corners of a square of side d. Each person now moves with a uniform

speed v in such a way that K always moves directly towards L,

L directly towards M, M directly towards N, and N directly

towards K. The four persons will meet at a time.............



32. Calculate the resultant of the following forces acting at a

point, making use of resoluation process.

- (i)  $100\sqrt{2}$  dyne alond north-east
- (ii) 980  $\sqrt{2}$  dyne along north-west
- (iii) 1960 dyne along south.



**33.** Prove that the vectors  $\overrightarrow{A} = \hat{i} + 2\hat{j} + 3\hat{k}$  and  $\overrightarrow{B} = 2\hat{i} - \hat{j}$  are perpendicular to each other.

**34.** Find the value of  $\lambda$  so that the vectors  $\overrightarrow{A}=2\hat{i}+\lambda\hat{j}+\hat{k}$  and  $\overrightarrow{B}=4\hat{i}-2\hat{j}-2\hat{k}$  are

perpendicular to each other.

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**35.** If the magnitudes of two vectors are 3 and 4 and their scalar product is 6, then find the angle between the two vectors.



**36.** A body acted upon by a force of 50N is displaced through a distance of 10m in a direction making an angle of  $60^{\circ}$  with the force. Calculate the work done by the force.



**37.** A body constrained to move along the z-axis of a coordinate system is subjected to a constant force  $\overrightarrow{F}$  given by  $\overrightarrow{F} = -\hat{i} + 2\hat{j} + 3\hat{k}$  newton, where  $\hat{i}, \hat{j}$  and  $\hat{k}$  represen unit vectors along x,y- and z-axis of the system respectively. Calculate the work done by force in displacing the body through a distance of 4m along the z-axis.

**38.** A forc of  $7\hat{i} + 6\hat{k}$  newton makes a body move on a rough plane with a velocity of  $3\hat{j} + 4\hat{k}ms^{-1}$ . Calculate the power in watt.

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**39.** Three vectors  $\overrightarrow{A}$ ,  $\overrightarrow{B}$  and  $\overrightarrow{C}$  are such that  $\overrightarrow{A} = \overrightarrow{B} + \overrightarrow{C}$ and their magnitude are 5,4 and 3 respectively. Find the angle between  $\overrightarrow{A}$  and  $\overrightarrow{C}$ .

**40.** If 
$$\left| \overrightarrow{A} + \overrightarrow{B} \right| = \left| \overrightarrow{A} - \overrightarrow{B} \right|$$
, find the angle between  $\overrightarrow{A}$  and  $\overrightarrow{B}$ .



**41.** If vector P, Q and R have magnitude 5,12,and 13 units and  $\overrightarrow{P} + \overrightarrow{Q} = \overrightarrow{R}$ , the angle between Q and R is



- **42.** Determine the angles which the vector
- $\stackrel{
  ightarrow}{A}=5\hat{i}+0\hat{j}+5\hat{k}$  makes with X-,Y- ad Z-axes.

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**43.** If  $\hat{i}$  and  $\hat{j}$  are unit vectors along X-and Y-axis respective, then what is the magnitude and direction of  $\hat{i} + \hat{j}$  and  $\hat{i} - \hat{j}$ 



**44.** Find the components of  $\overrightarrow{a} = 2\hat{i} + 3\hat{j}$  along the direction of vectors  $\hat{i} + \hat{j}$  and  $\hat{i} - \hat{j}$ .

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**45.** If unit vectors  $\hat{a}$  and  $\hat{b}$  are inclined at angle  $\theta$ , then prove

that

$$\left. \overrightarrow{a} - \overrightarrow{b} \right| = 2 \sin \cdot \frac{ heta}{2}.$$

**46.** If  $\overrightarrow{A} + \overrightarrow{B} = \overrightarrow{C}$  and  $A^2 + B^2 = C^2$ , then prove that  $\overrightarrow{A}$  and  $\overrightarrow{B}$  are perpendicular to each other.

47. Calculate the area of the parallelogram whose two adjacent sides are formed by the vectors  $\overrightarrow{A} = 3\hat{i} + 4\hat{j}$  and  $\overrightarrow{B} = -3\hat{i} + 7\hat{j}$ .

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**48.** If  $\overrightarrow{A}$  and  $\overrightarrow{B}$  denpte the sides of a parallelogram and its area is AB/2, find the angle between  $\overrightarrow{A}$  and  $\overrightarrow{B}$ .

49. Determine a unit vecor perpendicular to both $\overrightarrow{A}=2\hat{i}+\hat{j}+\hat{k}$  and  $\overrightarrow{B}=\hat{i}-\hat{j}+2\hat{k}$ 

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**50.** Find a vector whose length is 7 and which is perpendicular to each of the vectors,  $\overrightarrow{}$ 

 $\overrightarrow{A}=2\hat{i}-3\hat{j}+6\hat{k}$  and  $\overrightarrow{B}=\hat{i}+\hat{j}-\hat{k}$ 

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**51.** Determine the sine of the angle between the vectors  $3\hat{i} + \hat{j} + 2\hat{k}$  and  $2\hat{i} - 2\hat{j} + 4\hat{k}$ .

**52.** Show that 
$$\left(\overrightarrow{A} - \overrightarrow{B}\right) \times \left(\overrightarrow{A} + \overrightarrow{B}\right) = 2\left(\overrightarrow{A} \times \overrightarrow{B}\right)$$



**53.** For any three vectors 
$$\overrightarrow{A}, \overrightarrow{B}$$
 and  $\overrightarrow{C}$  prove that

$$\overrightarrow{A} \times \left(\overrightarrow{B} + \overrightarrow{C}\right) + \overrightarrow{B} \times \left(\overrightarrow{C} + \overrightarrow{A}\right) + \overrightarrow{C} \times \left(\overrightarrow{A} + \overrightarrow{B}\right) = \overrightarrow{O}$$

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**54.** For any to vectors 
$$\overrightarrow{A}$$
 and  $\overrightarrow{B}$ , prove that  $\left|\overrightarrow{A} \times \overrightarrow{B}\right|^2 = A^2 B^2 - \left(\overrightarrow{A} \cdot \overrightarrow{B}\right)^2$ .

**55.** Find 
$$\left| \overrightarrow{A} \times \overrightarrow{B} \right|$$
 if  $\left| \overrightarrow{A} \right| = 10 \left| \overrightarrow{B} \right| = 2$  and  $\overrightarrow{A} \cdot \overrightarrow{B} = 12$ 

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**56.** Find 
$$\overrightarrow{A}$$
.  $\overrightarrow{B}$  if  $\left|\overrightarrow{A}\right| = 2$ ,  $\left|\overrightarrow{B}\right| = 5$  and  $\left|\overrightarrow{A} \times \overrightarrow{B}\right| = 8$ 

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57. Find the area of the triangle formed by the tips of the

vectors  $\overrightarrow{a}=\hat{i}-\hat{j}-3\hat{k}, \, \overrightarrow{b}=4\hat{i}-3\hat{j}+\hat{k}$  and  $\overrightarrow{c}=3\hat{i}-\hat{j}+2\hat{k}.$ 

58. Find the moment about the point (1,-1,-1) of the force  $3\hat{i} + 4\hat{j} - 5\hat{k}$  acting at the point (1,0,-1)

**59.** The diagonals of a parallelogram are gives by the vectors 
$$3\hat{i} + \hat{j} + 2\hat{k}$$
 and  $\hat{i} - 3\hat{j} + 4\hat{k}$ . Find the area of the

parallogram.



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**61.** Let  $\overrightarrow{a}, \overrightarrow{b}$  and  $\overrightarrow{c}$  be three vectors such that  $\overrightarrow{a} + \overrightarrow{b} + \overrightarrow{c} = 0$  and  $|\overrightarrow{a}| = 10, |\overrightarrow{b}| = 6$  and  $|\overrightarrow{c}| = 14$ . What is the angle between  $\overrightarrow{a}$  and  $\overrightarrow{b}$ ?

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**62.** If 
$$\overrightarrow{a} = \hat{i} - 2\hat{j} - 3\hat{k}, \overrightarrow{b} = 2\hat{i} + \hat{j} - \hat{k}$$
 and  $\overrightarrow{c} = \hat{i} + 3\hat{j} - 2\hat{k}$  then find  $\overrightarrow{a} \times (\overrightarrow{b} \times \overrightarrow{c})$ .

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Туре В

**1.** A particle P is moving along a straight line with a velocity of  $3ms^{-1}$  and another particle Q has a velocity of  $4ms^{-1}$  at an angle of  $30^{\circ}$  to the path of P. Find the speed of Q relative to P.

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**2.** The velocity of particle P due east is  $4ms^{-1}$  and that of Q is  $3ms^{-1}$  due north. What is the relative velocity of P w.r.t. Q.



**1.** Find the vector  $\overrightarrow{AB}$  and its magnitude if it has initial point

A(1,2,-1) and final point B(3,2,2).

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2. If 
$$\overrightarrow{A} = 3\hat{i} + 2\hat{j}$$
 and  $\overrightarrow{B} = \hat{i} - 2\hat{j} + 3\hat{k}$ , find the magnitudes of  $\overrightarrow{A} + \overrightarrow{B}$  and  $\overrightarrow{A} - \overrightarrow{B}$ .

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#### Type D

**1.** One of the rectangular components of a velocity of  $80kmh^{-1}$  is  $40kmh^{-1}$ . Find the other component.



**2.** A force is inclined at  $30^{\circ}$  to the horizontal. If its rectangular component in the horizontal direction is 50N, find the magnitude of the force and its vertical component.



### Туре Е

1. Find the angle between the vertors  $\overrightarrow{A} = \hat{i} + 2\hat{j} - \hat{k}$  and  $\overrightarrow{B} = -\hat{i} + \hat{j} - 2\hat{k}$ .

2. Find the angle between the vectors  $\overrightarrow{A}=2\hat{i}-4\hat{j}+6\hat{k}$ and  $\overrightarrow{B}=3\hat{i}+\hat{j}+2\hat{k}.$ 

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# Type F

1. Prove that the vectors  $\overrightarrow{A} = 2\hat{i} - 3\hat{j} - \hat{k}$  and  $\overrightarrow{B} = -6\hat{i} + 9\hat{j} + 3\hat{k}$  are parallel.

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2. If  $\overrightarrow{A} = \hat{i} + 3\hat{j} + 2\hat{k}$  and  $\overrightarrow{B} = 3\hat{i} + \hat{j} + 2\hat{k}$ , then find the vector product  $\overrightarrow{A} \times \overrightarrow{B}$ .





(a) its x and y-components

(b) its length

(c) the angle it makes with x-axis.

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**3.** A biard is at a point P(4m, -1m, 5m) and sees two points  $P_1(-1m, -1m, 0m)$  and  $P_2(3m, -1m, -3m)$ . At time t = 0, it starts flying in a plane of the three positions, with a constant speed of 2m/s in a direction perpendicular to the straight line  $P_1P_2$  till it sees  $P_1 \& P_2$ collinear at time t. Find the time t.



**4.** A particle is moving eastwards with a velocity of  $5ms_{-1}$ . In  $10 \sec onds$  the velocity changes to  $5ms^{-1}$  northwards. The average acceleration in this time is

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5. In Fig. a particle is moving in a circle of radius r centred at

O with constant speed v. what is the change in velocity in

moving from A to B ? Given  $\angle AOB = 40^{\circ}$ .

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**6.** A boat which has a spped of  $5kmh^{-1}$  in still water crosses a river of width 1 km along the shortest possible path in 15 minutes. Calculate the velocity of river water. 7. A river is flowing from west to east at a speed of 5metresper min ute. A man on the south bank of the river , capable of swimming at 10metresper min ute, in still water , wants to swim across the river in the shortest time . He should swim in a direction



**8.** A person travelling eastward with a speed of  $3kmh^{-1}$  finds that wind seems to blow from north. On doubling his speed, the wind appears to flow from north-east. Find the magnitude of the actual velocity of the wind.

**9.** A man directly crosses a river in time  $t_1$  and swims down the current a distance equal to the width of the river I time  $t_2$ . If u and v be the speed of the current and the man respectively, show that  $t_1: t_2: : \sqrt{v+u} : \sqrt{v-u}$ .



**10.** Consider a collection of a large number of particles each with speed v. The direction of velocity is randomly distributed in the collection. Show that the magnitude of the relative velocity between a pair of particles averaged over all the pairs in the collection is greater than v.



1. Two forces of 5N and 7N act on a aprticle with an angle of

 $60\,^\circ\,$  between them. Find the resultant force.

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2. Find the magnitude and direction of the resultant of the velocities of  $100ms^{-1}$  and  $60ms^{-1}$  inclined to each other at angle of  $60^{\circ}$ .



**3.** A body is simultaneously given two velocities, one  $10ms^{-1}$  due east and other  $20ms^{-1}$  due north-west. Calculate the resultant velocity.

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4. Two forces whose magnitudes are in the ratio 3:5 give a resultant of 35N. If the angle between them is  $60^{\circ}$ , the magnitude of each force is

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**5.** Two equal forces act at a point. The square of their resultant is 3 times their product, Find the angle between

them.



is  $2\pi/3$ , prove that tha magnitude of the resultant is equal to either.



8. AT what angle two forces (P +Q) and (P-Q) act so that resultant is

(i) 
$$\sqrt{3P^2+Q^2}$$
 (ii)  $\sqrt{2ig(P^2+Q^2ig)}$  (iii)  $\sqrt{P^2+Q^2}$  .

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9. The resultant of two equal forces acting at right angles to

each other is 1414 dyne. Find the magnitude of either force.



10. A particle is being acted upon by four forces of 30N due

east ,  $20N~{\rm due}$  north ,  $50N~{\rm due}$  west and  $40N~{\rm due}$  south.

The resultant force will be

**11.** Two persons are raising a load pulling at an angle of each other. If they exert forces of 30N and 60N respectively and their effective pull is at right angles to the direction of the pull of the first person, what is the angle between their pulling forces ? What is the effective pull

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**12.** A ship is steaming towards east at a speed of 12 ms-1. A woman runs across the deck at a speed of 5 ms-1 in the direction at right angles to the direction of motion of the ship i.e. towards north. What is the velocity of the woman relative to sea ?



**13.** A car travelling a  $20ms^{-1}$  due north along the highway makes a right turn on to a side road that heads due east. It takes 50s for the car to complete the turn. At the end of 50 second, the car has a speed of  $15ms^{-1}$  along the side road. Determine the magnitude of average acceleration over the 50 second interval.



**14.** A train is moving with a velocity of  $30kmh^{-1}$  due East and a car is moving with a veloicty of  $40kmh^{-1}$  due North . What is the velocity of car as appears to a passenger in the train ?



**15.** A man is going due east with a velocity of  $3kmh^{-1}$ . Rain falls vertically downwards at a speed of  $10kmh^{-1}$ . Calculate the angle at which he should hold his umbrella so as to protect himself from rain.

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**16.** A boy is moving due east with a velocity 50m min.<sup>-1</sup>. The rain is falling vertically with a velocity of 250m min.<sup>-1</sup>. At what angle and with what velocity rain appears to fall to the person ?

**17.** To a driver going east in a car with a velocity of  $40kmh^{-1}$ , a bus appears to move towards north with a velocity of  $40\sqrt{3}kmh^{-1}$ . What is the actual velocity and direction of motion of the bus ?

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**18.** A cyclist is moving due east with a velocity of  $10kmh^{-1}$ . There is no wind and rain appoars to fall at an angle of  $10^{\circ}$  to the vertical. Calculate the actual speed of the rain.



**19.** A plane is travelling eastward at a speed of  $500kmh^{-1}$ . But a  $90kmh^{-1}$  wind is blowing southward. What is the direction and speed of the plane relative to the ground ?

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**20.** A reackless drunk is playing with a gun in an airplane that is going directly east at  $500kmh^{-1}$ . The drunk shoots the gun straight up at the ceiling of the plane. The bullet leaves the gun at a speed of  $1000kmh^{-1}$ . Relative to an observer on earth, what angle does the bullet make with the vertical ?

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**21.** Find the unit vector parallel to the resultant of the unit vectors  $\overrightarrow{A} = 2\hat{i} - 6\hat{j} - 3\hat{k}$  and  $\overrightarrow{B} = 4\hat{i} + 3\hat{j} - \hat{k}$ .



22. Determine the vector which when added to the resultant of  $\overrightarrow{A}=2\hat{i}-4\hat{j}-6\hat{k}$  and  $\overrightarrow{B}=4\hat{i}+3\hat{j}+3\hat{k}$  gives the unit

vector along z-axis.

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**23.** Find the value of  $\lambda$  in the unit vector  $0.4\hat{i} + 0.8\hat{j} + \lambda\hat{k}$ .

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24. Given the three coplaner vectors  $\vec{a} = 4\hat{i} - \hat{j}, \vec{b} = -3\hat{i} + 2\hat{j}$  and  $\vec{c} = -3\hat{j}$ . Find the

magnitude of the sum of the three vectors.



horizontal. If the component of its velocity along the horizontal is  $200 kmh^{-1}$ , what is its actual velocity ? Also find the vertical component of its velocity.



**27.** A child pulls a rope attached to a stone with a force of 80N. The rope makes and angle of  $40^{\circ}$  to the ground. (i) Calculate the effective value of the pull tending to move the stone along the ground. (ii) Calculate the force tending to lift the stone.

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28. Show that the vector  $\overrightarrow{A} = \hat{i} + \hat{j} + \hat{k}$  is perpendicular to the vector  $\overrightarrow{B} = -\hat{i} - \hat{j} + 2\hat{k}.$ 

**29.** Find the value of m so that the vector  $3\hat{i} - 2\hat{j} + \hat{k}$  is perpendicular to the vector.  $2\hat{i} + 6\hat{j} + m\hat{k}$ .

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30. For what value of a are the vectors 
$$\vec{A} = a\hat{i} - 2\hat{j} + \hat{k}$$
  
and  $\vec{B} = 2a\hat{i} + a\hat{j} - 4\hat{k}$  perpendicular to each other ?  
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**31.** Find the angles between the following pairs of vectors:  
(i) 
$$\overrightarrow{A} = \hat{i} + \hat{j} + \hat{k}$$
 and  $\overrightarrow{B} = -2\hat{i} - \hat{j} - 2\hat{k}$ .  
(ii)  $\overrightarrow{A} = -2\hat{i} + 2\hat{j} - \hat{k}$  and  $\overrightarrow{B} = 3\hat{i} + 6\hat{j} + 2\hat{k}$   
(iii)  $\overrightarrow{A} = 4\hat{i} + 6\hat{j} - 3\hat{k}$  and  $\overrightarrow{B} = -2\hat{i} - 5\hat{j} + 7\hat{k}$ 

**32.** Calculate the values of (i)  $\hat{j}.\left(2\hat{i}-3\hat{j}+\hat{k}
ight)$  and (ii)  $\left(2\hat{i}-\hat{j}
ight)\left(3\hat{i}+\hat{k}
ight)$ 

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**33.** A force  $\overrightarrow{F} = 4\hat{i} + \hat{j} + 3\hat{k}$  newton acts on a particle and displaces it through displacement  $\overrightarrow{S} = 11\hat{i} + 11\hat{j} + 15\hat{j}$  metre. Calculate the work done by the force.

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**34.** Under a force of  $10\hat{i} - 3\hat{j} + 6\hat{k}$  newton, a body of mass 5 kg is displaced from the position  $6\hat{i} + 5\hat{j} - 3\hat{k}$  to the

position  $10 \hat{i} - 2 \hat{j} + 7 \hat{k}$ . Calculate the work done.



the magnitude of each vector and their scalar product  $\overrightarrow{AB}$ .

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**36.** A force  $\overrightarrow{F}=5\hat{i}+4\hat{j}$  newton displaces a body through  $\overrightarrow{S}=3\hat{i}+4\hat{k}$  metre in 3s. Find the power.

**37.** If the resultant of the vectors  $3\hat{i} + 4\hat{j} + 5\hat{k}$  and  $5\hat{i} + 3\hat{j} + 4\hat{k}$  makes an angle  $\theta$  with x-axis, then find  $\cos \theta$ .



form a right angled triangle.

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**39.** If vectors  $\overrightarrow{A}$ ,  $\overrightarrow{B}$  and  $\overrightarrow{C}$  have magnitudes 8,15 and 17 units and  $\overrightarrow{A} + \overrightarrow{B} = \overrightarrow{C}$ , find the angle between  $\overrightarrow{A}$  and  $\overrightarrow{B}$ .

**40.** If  $\overrightarrow{A} = \overrightarrow{B} - \overrightarrow{C}$ , then determine the angle between  $\overrightarrow{A}$  and  $\overrightarrow{B}$ .

**41.** For two vectors 
$$\overrightarrow{A}$$
 and  $\overrightarrow{B}$  if  $\overrightarrow{A} + \overrightarrow{B} = \overrightarrow{C}$  and  $A + B = C$ , then prove that  $\overrightarrow{A}$  and  $\overrightarrow{B}$  are parallel to each other.

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42. Prove that  

$$\left(\overrightarrow{A} + 2\overrightarrow{B}\right) \cdot \left(2\overrightarrow{A} - 3\overrightarrow{B}\right) = 2A^2 + AB\cos\theta - 6B^2.$$
  
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**43.** Prove that the vectors  $\overrightarrow{A} = 4\hat{i} + 3\hat{j} + \hat{k}$  and  $\overrightarrow{B} = 12\hat{i} + 9\hat{j} + 3\hat{k}$  are parallel to each other.

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**44.** If 
$$\overrightarrow{A} = 2\hat{i} + 3\hat{j} + \hat{k}$$
 and  $\overrightarrow{B} = 3\hat{i} + 2\hat{j} + 4\hat{k}$ , then find the value of  $\left(\overrightarrow{A} + \overrightarrow{B}\right) \times \left(\overrightarrow{A} - \overrightarrow{B}\right)$ 

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**45.** Find the value of a for which the vectors  $3\hat{i} + 3\hat{j} + 9\hat{k}$ and  $\hat{i} + a\hat{j} + 3\hat{k}$  are parallel. 46. Find a unit vector perpendicular the vectors  $\overrightarrow{A}=4\hat{i}=\hat{j}+3\hat{k}$  and  $\overrightarrow{B}=-2\hat{i}+\hat{j}-2\hat{k}.$ 

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47. Find the sine of the angle between the vectors  $\overrightarrow{A}=3\hat{i}-4\hat{j}+5\hat{k}$  and  $\overrightarrow{B}=\hat{i}-\hat{j}+\hat{k}.$ 

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48. Find a vector of magnitude 18 which is perpendicular to

both the vectors  $4\hat{i}-\hat{j}+3\hat{k}$  and  $-2\hat{i}+\hat{j}-2\hat{k}.$ 

**49.** Determine the area of the parallelogram whose adjacent sides are formed by the vectors  $\overrightarrow{A} = \hat{i} - 3\hat{j} + \hat{k}$  and  $\overrightarrow{B} = \hat{i} + \hat{j} + \hat{k}$ .

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**50.** Find the area of the triangle formed by points O,A and B such that  $\overrightarrow{OA} = \hat{i} + 2\hat{j} + 3\hat{k}$  and  $\overrightarrow{OB} = -3\hat{i} - 2\hat{j} + \hat{k}$ 

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51. Find with the help of vectors, the area of the triangle with

vertices A(3, -1, 2), B(1, -1, -3) and C(4, -3, 1)

**52.** If  $\overrightarrow{A}$  and  $\overrightarrow{B}$  are two such vectors that  $\left|\overrightarrow{A}\right| = 2$ ,  $\left|\overrightarrow{B}\right| = 7$ and  $\overrightarrow{A} \times \overrightarrow{B} = 3\hat{i} + 2\hat{j} + 6\hat{k}$ , find the angle between  $\overrightarrow{A}$ and  $\overrightarrow{B}$ .



53. Find the moment about the point  $\hat{i} + 2\hat{j} - \hat{k}$  of a force represented by  $3\hat{i} + \hat{k}$  acting through the point  $2\hat{i} - \hat{j} + 3\hat{k}$ 

**54.** Prove that 
$$\left(\overrightarrow{a} + \overrightarrow{b}\right) imes \left(\overrightarrow{a} - \overrightarrow{b}\right) = 2\left(\overrightarrow{b} imes \overrightarrow{a}\right)$$



**55.** Prove that 
$$\left| \overrightarrow{a} \times \overrightarrow{b} \right| = \sqrt{a^2 b^2 - \left( \overrightarrow{a} - \overrightarrow{b} \right)^2}$$

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56. If 
$$\overrightarrow{a} = \hat{i} - 2\hat{j} - 3\hat{k}, \ \overrightarrow{b} = 2\hat{i} - \hat{j} - \hat{k}$$
 and

$$\overrightarrow{c} = \hat{i} + 3\hat{j} - 2\hat{k}$$
 find  $\left(\overrightarrow{a} imes\overrightarrow{b}
ight) imes\overrightarrow{c}$ 

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