

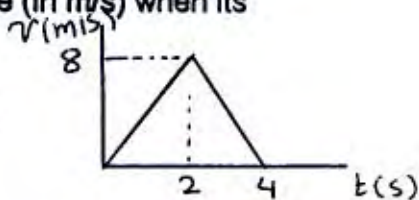
## Physics 101

### Revision Chapters 2, 3, 4, 5

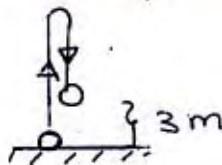
①

1. The position of a particle moving along the x-axis is  $x = (6t + 8t^2 - t^3)$  m, where  $t$  is in seconds. What is the speed of the particle (in m/s) when its acceleration vanishes (i.e.  $a = 0$ )?

2. In the graph shown, what is the average velocity (in m/s) from 0 to 4 s?



3. A stone thrown vertically with a speed of 15 m/s. It is caught on the way down at a point 3 m above the ground. How long (in seconds) did the trip take?



4. Let  $a\mathbf{A} + b\mathbf{B} + \mathbf{C} = 0$ , where  $a$  and  $b$  are constants and

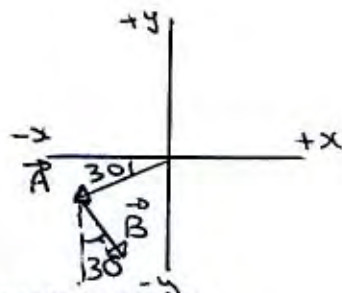
$$\mathbf{A} = 3\mathbf{i} - 4\mathbf{j}$$

$$\mathbf{B} = 4\mathbf{i} + 3\mathbf{j}$$

$$\mathbf{C} = 4\mathbf{i} + 2\mathbf{j}$$

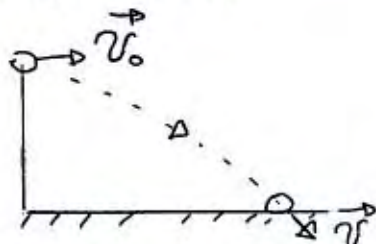
Find the constants ( $a$ ,  $b$ ).

5. Let  $\mathbf{A} = \mathbf{A} - 2\mathbf{B}$ , where  $\mathbf{A} = 5$  and  $\mathbf{B} = 4$  and their directions are as shown. Find the angle (in degrees) between the vector  $\mathbf{R}$  and the positive x-axis.



6. A particle starts from the origin at  $t_1 = 0$  with a velocity of  $(12\mathbf{i} + 16\mathbf{j})$  m/s and moves in the  $xy$  plane with a constant acceleration of  $(-2\mathbf{i} - 4\mathbf{j})$  m/s<sup>2</sup>. Find the distance (in meters) between the particle and the origin at  $t_2 = 2$  s.

7. A ball is thrown horizontally from the top of a building at a height of 30 m and hits the ground with a final speed  $v$  that is 4 times its initial speed  $v_0$ . What was the initial speed (in m/s)?

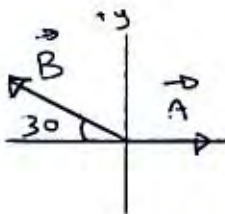


8. If  $\mathbf{A} = 2$ ,  $\mathbf{B} = 4$  find the magnitude of  $\mathbf{A} - \mathbf{B}$ .

9. If  $\mathbf{A} = 2\hat{i} - 3\hat{j} + 4\hat{k}$  and  $\mathbf{B} = -4\hat{i} + 5\hat{j} - \hat{k}$  find the angle (in degrees) between  $\mathbf{A}$  and  $\mathbf{B}$ .

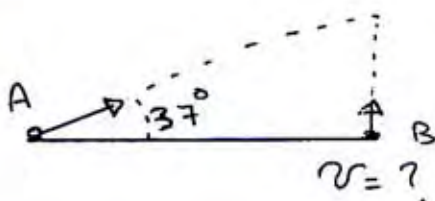
10. Let  $\mathbf{A} = 4\hat{i} + 5\hat{j}$ ,  $\mathbf{B} = 2\hat{i} - 3\hat{j}$ ,  $\mathbf{C} = 3\hat{i} + 5\hat{j}$ , find  $\bar{\mathbf{C}} \cdot (\bar{\mathbf{A}} \times \bar{\mathbf{B}})$ .

11. A car starts motion with an initial velocity of 24 m/s and decelerates at a rate of 8 m/s<sup>2</sup> until it stops. It then accelerates in the same direction until its velocity reaches 12 m/s after 3 s. Find the average velocity (in m/s) during this trip.



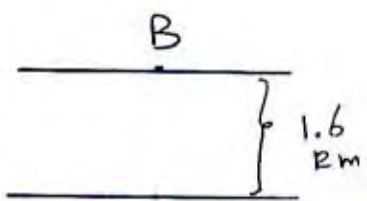
- 12. An object moves in a straight line with constant acceleration  $a$  and covers a distance of 15 m in 3 s. If its final velocity at the end of the 3-sec interval is 20 m/s, what is the value of  $a$  (in  $\text{m/s}^2$ )?
- 13. A stone is projected vertically upward from the edge of a cliff with a speed of 12 m/s. If the stone travels a distance of 19.4 m what is its displacement (in m) at that moment?
- 14. A particle starts motion from a position  $r_0 = 2\hat{i} + 3\hat{j}$  with initial velocity  $v_0 = 3\hat{i} - 4\hat{j}$  and acceleration  $a = 2\hat{j}$ . What is the position of the particle (in m) after 5 s?

- 15. Two particles A and B are thrown at the same instant from points a and b respectively (see figure). A is thrown with velocity of 100 m/s at an angle of  $37^\circ$  above the horizontal. B is thrown vertically upward with velocity  $v$ . If the two particles meet at the maximum height, find the value of  $v$  (in m/s).

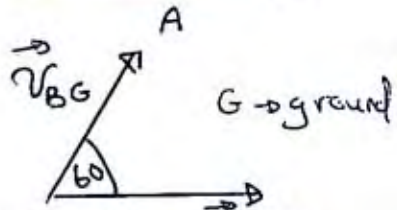


- 16. Let  $A = 3.0\hat{i} + 4.0\hat{j} + 2.9\hat{k}$ ,  
 $B = 2.0\hat{i} + 4.0\hat{j} - 3.0\hat{k}$ ,  
 $C = 4.0\hat{i} - 5.0\hat{j} - 3.0\hat{k}$ ,  
 Find  $A \cdot (B \times C)$

- 17. A boat can move at 10 m/s in still water. If the boat is to travel directly across a river 1.6 km wide (from A to B), how long (in minutes) will it take to cross the river if the water has a speed of 5 m/s?



- 18. A and B are two cars. Car A is moving East with speed 80 km/h and car B is moving  $60^\circ$  North of East with speed 100 km/h. Find the speed (km/h) of car A as measured by car B.



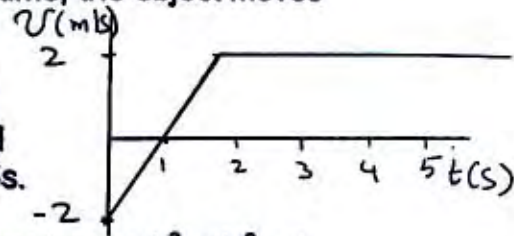
- 19. Let  $C = 8\hat{i} + 3\hat{j} + 2\hat{k}$ . What is the angle (in degrees) between  $C$  and the  $z$ -axis?
- 20. A vector  $A$  is added to  $B = 6\hat{i} - 8\hat{j}$ . The resultant vector is in the positive  $x$ -direction and has a magnitude equal to  $A$ . What is the magnitude of  $A$ ?
- 21. A particle starts from rest and moves with an acceleration  $a = \hat{i} + 2\hat{j}$   $\text{m/s}^2$ . It starts from a point of coordinates (2, 6) m in the  $x$ - $y$  plane. How far (in m) is the particle from the origin after 4 s?



22. A particle leaves the origin with an initial velocity  $\mathbf{v} = (2\mathbf{i})$  m/s. It experiences a constant acceleration  $\mathbf{a} = (-4\mathbf{i} - 1.5\mathbf{j})$  m/s<sup>2</sup>. What is the speed (in m/s) of the particle when it reaches its maximum x-coordinate?

23. The speed of an object moving in a straight line, decreases at a constant rate from  $v_0$  to zero in 4 s. If during that time, the object moves 8 m, find the value of  $v_0$  (in m/s).

24. The velocity of a particle moving along the x-axis varies with time as shown in the figure. If its initial position at  $t = 0$  is  $x_0 = 4$  m, find its position at  $t = 5$  s.

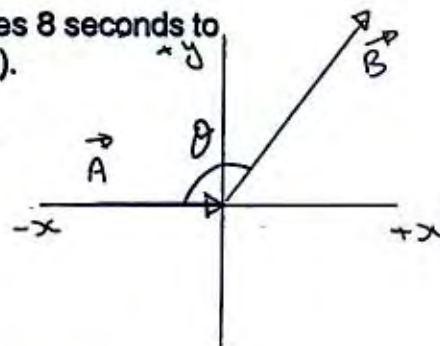


25. The motion of a particle in one dimension is given by  $x = 4t^3 + 3t^2 - 5$  (m/s). Find the average acceleration (in m/s) between  $t_1 = 1$  s and  $t_2 = 4$  s.

26. A hot air balloon is travelling vertically upward at a constant speed of 20 m/s. When it is 25 m above the ground, a package is released from the balloon. What is the speed (in m/s) of the package just before it reaches the ground?

27. A ball is thrown vertically upward from the ground. It takes 8 seconds to come back to the ground. Find the initial velocity (in m/s).

28. In the figure  $A = 10$ ,  $B = 20$ ,  $\theta = 120^\circ$ . What is the angle of the resultant vector  $\mathbf{R} = 2\mathbf{A} - \mathbf{B}$ ?

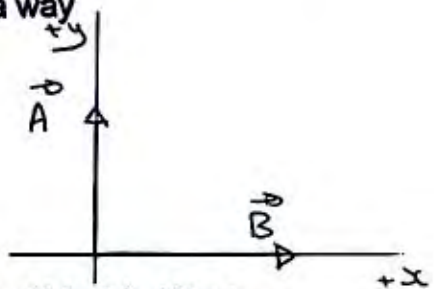


29. Vector  $\mathbf{A} = 4\mathbf{i} - 3\mathbf{j}$   
Vector  $\mathbf{B} = 3\mathbf{i} + 4\mathbf{j}$   
What is the angle between  $\mathbf{A}$  and  $\mathbf{B}$ ?

30. What is the angle between the vectors  $\mathbf{A}$  and  $\mathbf{B}$  in such a way

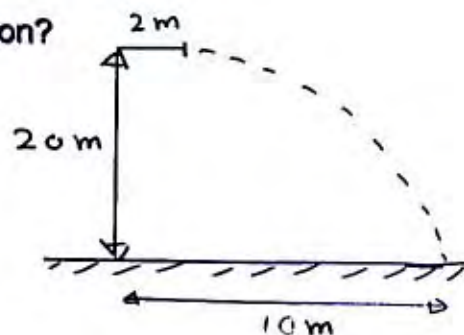
$$|\mathbf{A} \cdot \mathbf{B}| = |\mathbf{A} \times \mathbf{B}|$$

31.  $\mathbf{A}$  and  $\mathbf{B}$  are two vectors as shown in the figure. If  $A = 3$ ,  $B = 2$  and  $\mathbf{D} = \mathbf{A} - 2\mathbf{B}$ , find the angle (in degrees) that  $\mathbf{D}$  makes with the positive x-axis.



32. A particle starts from  $2\mathbf{i} + 4\mathbf{j}$  (m) with initial velocity  $\mathbf{i} - 3\mathbf{j}$  (m/s). What must be the acceleration in such a way the particle passes the origin after 2 second (in m.s<sup>2</sup>)?

33. At an altitude of 20 m, a particle of 1.5 kg mass attached to a 2 m cord rotates in a horizontal circle with constant speed. The cord breaks and the particle flies (as a projectile). It strikes the ground 10 m from the center of rotation. What is the acceleration of the particle during its rotation?





34. A block of mass 8 kg is acted by 3 forces as follows:

$F_1 = 80i - 40j, N$

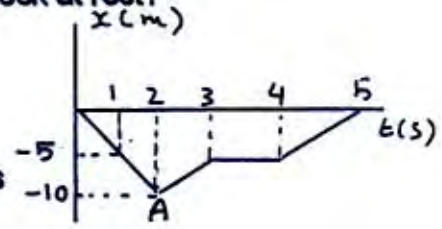
$F_2 = 100N$  and its direction is shown in figure.



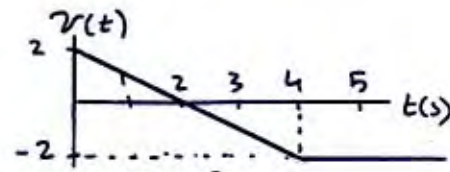
What must be the third force  $F_3$  in order to keep the block at rest?

(Hint:  $\Sigma F = zero$ ).

35. The one dimensional motion of a particle is shown in the x vs graph. (a) Find average velocity in the interval  $t = 3 s$  to  $t = 4s$ . (b) What is the instantaneous velocity at  $t = 2s$ ?

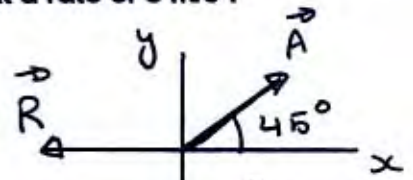


36.  $V_x (m/s)$  is the velocity of the particle moving along the x-axis as shown. If  $x = 4 m$  at  $t = 1s$ , what is the position of the particle at  $t = 4s$ ?



37. A bus moving at a speed of 18 m/s begins to slow at a rate of 3 m/s<sup>2</sup>. Find how far it goes before it stops.

38. If vector A has magnitude of 5 units and the resultant vector  $R = A + 2B$  has a magnitude of 5 units, what is the direction of vector B?

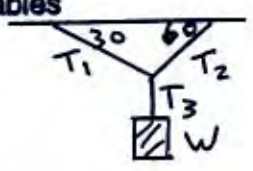


39. A and B are two vectors as shown. The magnitude of A and B are 30 and 50 respectively. If  $R = -2A - (1/2) B$ , what are the components of vector R?

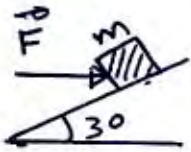


40. If the components of vector A are (12, -16) and the components of vector B are (-24, 10), what is the magnitude of vector  $C = 2A - B$ ?

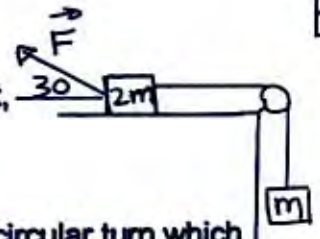
41. A block weighing 200 N hangs from a cable tied to two other cables fastened to a support, as shown in the figure. Find T1.



42. If  $F = 20.0 N$  and  $m = 2.0 kg$ , what is the magnitude of the acceleration? The surface is frictionless.



43. If  $F = 30 N$  and  $M = 2.0 kg$ . If 2 M is moving to the left, find the magnitude of the acceleration, assuming frictionless surface.



44. An airplane travels 80 m/s as it makes a horizontal circular turn which has a 0.8 km radius. What is the magnitude of the resultant force on the 75 kg pilot?

45. A roller coaster car has a mass of 500 kg when fully loaded with passengers. At the bottom of the circular path of radius 40 m the car has a speed of 16 m/s. What is the magnitude of the force of the track on the car at the bottom?