

Q.1 As a marble rolls off the horizontal surface of a table, it has a speed of 4.00 m/s. If the table surface is 1.50 m above the horizontal floor below, how fast is the marble moving just before making contact with the floor ?

- (A) 29.4 m/s
- (B) 4.00 m/s
- (C) 9.42 m/s
- (D) 6.74 m/s

Q.2 A car travels 20.0 km directly west in 10.0 minutes. The car then travels 40.0 km in a direction 60.0° east of north in 40.0 minutes. What is the net displacement of the car for the entire trip ?

- (A) 24.8km in a direction 53.8° north of east
- (B) 34.6 km north
- (C) 58.2km in a direction 20.1° north of east
- (D) 60.0 km

Q.3 The x-position of an object as a function of time is given by :

$$x(t) = 2.50 \frac{m}{s^3} t^3 + 8.00m$$

What is the average speed of the object between $t = 2.00$ s and $t = 2.05$ s ?

- (A) 1.54 m/s
- (B) 30.8 m/s
- (C) 14.0 m/s
- (D) 14.2 m/s

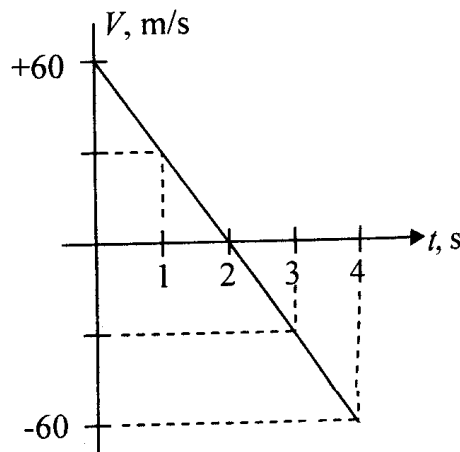
Q.4 Reaching a maximum height of 50.0 m, a cannonball is fired the length of a football field. Ignoring air friction, the shape of the cannonball's trajectory is

- (A) semi-circular
- (B) parabolic
- (C) hyperbolic
- (D) a sine wave

Q.5 A doctor walks 2.00 miles in a direction 60.0° west of north in 30.0 minutes and turns and continues 3.00 miles in a direction 45.0° east of north in 60.0 minutes. What is the total displacement of the doctor ?

- (A) 1.00 miles
- (B) 5.00 miles
- (C) 3.15 miles in a direction 82.9° north of east
- (D) 3.51miles in a direction 39.0° north of east

Q.6 An object moves along the x-axis according to the velocity versus time graph shown to the right. What is the object's acceleration at $t = 2.0$ s ?



- (A) 30 m/s²
- (B) -30 m/s²
- (C) 0 m/s²
- (D) -60 m/s²

Q.7 A projectile is fired at an angle of 30.0° above the horizontal with an initial speed of 20.0 m/s from a height of 20.0 m above the level ground. Assume that the drag force on the projectile is negligible. How much time passes before the projectile reaches the ground ?

- (A) 1.02 s
- (B) 2.04 s
- (C) 3.28 s
- (D) 4.66 s

PHYSICS IIT JEE (CLASS TEST - 1) (KINEMATICS) ANSWER KEY

Name : Roll No. :

	A	B	C	D		A	B	C	D		A	B	C	D
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					

ANSWER KEY

Que.	1	2	3	4	5	6	7
Ans.	D	A	B	B	C	B	C

SOLUTIONS

Sol.1 (D)

Let down be in the direction of the negative y axis, with $y = 0$ at the surface of the table. Let V_{iy} = the initial y component of velocity, V_{fy} = the final y component of velocity, a_y = the y component of acceleration, y_f = the final y position, and y_i = the initial y position. Then, $V_{fy}^2 = V_{iy}^2 + 2a_y(y_f - y_i) = 0^2 + 2(-9.80 \text{ m/s}^2)(-1.50\text{m} - 0)$. Thus $V_{fy} = 5.42 \text{ m/s}$. Since the marble still has an x component of velocity equal to 4.00 m/s , use the Pythagorean Theorem to find the final speed.

$$\text{So, } V_f = \sqrt{V_{fx}^2 + V_{fy}^2}$$

$$V_f = \sqrt{4^2 + 5.42^2} \text{ m/s} = 6.74\text{m/s.}$$

Sol.2 (A)

Using a coordinate system with x east and y north :

$$d_{1x} = -20.0 \text{ km}$$

$$d_{1y} = 0$$

$$d_{2x} = 40.0 \text{ km} \sin 60.0^\circ = 34.64 \text{ km}$$

$$d_{2y} = 40.0 \text{ km} \cos 60.0^\circ = 20.0 \text{ km}$$

$$d_x = d_{1x} + d_{2x}$$

$$d_x = -20.0 \text{ km} + 34.64 = 14.64 \text{ km}$$

$$d_y = d_{2y} + d_{1y}$$

$$d_y = 0 + 20.0 \text{ km} = 20.0 \text{ km}$$

$$d = \sqrt{d_x^2 + d_y^2} = \sqrt{(14.64\text{km})^2 + (20.0\text{km})^2}$$

$$d = 24.8 \text{ km}$$

$$\theta = \tan^{-1} \frac{d_y}{d_x}$$

$$\theta = \tan^{-1} \frac{20.0\text{km}}{14.64\text{km}} = 53.8^\circ \text{ (N of E)}$$

Sol.3 (B)

$$x(2.05\text{s}) = 2.50 \frac{\text{m}}{\text{s}^3} (2.05\text{s})^3 + 8.00\text{m} = 29.54\text{m}$$

$$x(2.00\text{s}) = 2.50 \frac{\text{m}}{\text{s}^3} (2.00\text{s})^3 + 8.00\text{m} = 20.00\text{m}$$

$$V = \frac{x(2.05\text{s}) - x(2.00\text{s})}{(2.05 - 2.00\text{s})}$$

$$V = \frac{29.54 - 20.00\text{m}}{0.05} \text{ m/s} = 30.8 \text{ m/s}$$

Sol.4 (B)

$$y = v_{oy}t - \frac{1}{2}gt^2 \quad x = v_{ox}t$$

Solving the x equation for t and substituting into the y equation, one obtains :

$$y = v_{oy} \left(\frac{x}{v_{ox}} \right) - \frac{1}{2}g \left(\frac{x}{v_{ox}} \right)^2$$

Thus y has a quadratic dependence upon x.

Sol.5 (C)

The total east-west displacement component will be

$$d_x = -(2.00\text{mi}) \sin 60.0^\circ + (3.00 \text{ mi}) \sin 45^\circ = 0.3893 \text{ mi}$$

and the total north-south displacement will be

$$d_x = (2.00\text{mi}) \cos 60.0^\circ + (3.00 \text{ mi}) \cos 45^\circ = 3.121 \text{ mi}$$

The magnitude of the net displacement can be determined by the Pythagorean theorem:

$$d = \sqrt{d_x^2 + d_y^2}$$

$$d = \sqrt{(0.3893 \text{ mi})^2 + (3.121\text{mi})^2} = 3.15 \text{ mi}$$

The direction is found using the inverse tangent function :

$$\theta = \tan^{-1} \frac{d_y}{d_x}$$

$$\theta = \tan^{-1} \frac{3.121\text{mi}}{0.3893\text{mi}} = 82.9^\circ$$

Sol.6 (B)

The acceleration is

$$a = \frac{dv}{dt} = \frac{\Delta v}{\Delta x}$$

$$a = \frac{(-60\text{m/s}) - (60\text{m/s})}{4.0\text{s} - 0.0\text{s}} = -30 \text{ m/s}^2$$

Note that the instantaneous acceleration is equal to the average acceleration as this is a case of constant acceleration .

Sol.7 (C)

Projectile motion is constant acceleration motion.

$$y = y_0 + v_{y0}t + \frac{1}{2} a_y t^2 = y_0 + v_0 \sin \theta t + \frac{1}{2} g t^2$$

$$\Rightarrow y_0 - y + v_0 \sin \theta t - \frac{1}{2} g t^2 = 0$$

$$t = \frac{-v \sin \theta \pm \sqrt{v^2 \sin^2 \theta - 4 \left(-\frac{1}{2} g\right) (y_0 - y)}}{2 \left(-\frac{1}{2} g\right)}$$

$$= \frac{(20 \text{ m/s}) \sin 30^\circ \pm \sqrt{(20 \text{ m/s})^2 \sin^2 30^\circ - 4 \left(-\frac{1}{2} 9.80 \text{ m/s}^2\right) (20 \text{ m} - 0.0 \text{ m})}}{-9.80 \text{ m/s}^2}$$

$$t = 3.28 \text{ s} \text{ or } t = -1.24 \text{ s}$$

obviously, the positive time solution is the one that answers the question.