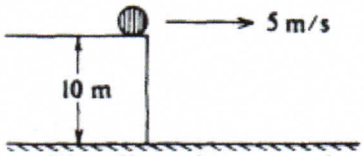
Use $g = 10$!

KINEMATICS PRACTICE MULTIPLE CHOICE

1984:

$-10 = \frac{1}{2}(-10)(t^2)$

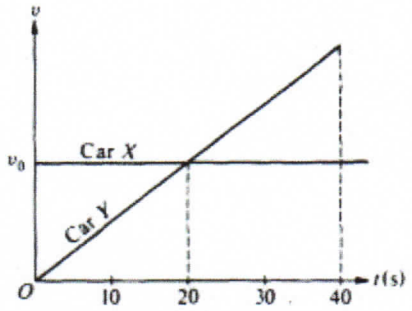
$t = \sqrt{2}$



2. An object slides off a roof 10 meters above the ground with an initial horizontal speed of 5 meters per second as shown above. The time between the object's leaving the roof and hitting the ground is most nearly

(A) $\frac{1}{2}$ s (B) $\frac{1}{\sqrt{2}}$ s (C) $\sqrt{2}$ s (D) 2 s (E) $5\sqrt{2}$ s

Questions 4-5



At time t = 0, car X traveling with speed v_0 passes car Y, which is just starting to move. Both cars then travel on two parallel lanes of the same straight road. The graphs of speed v versus time t for both cars are shown above.

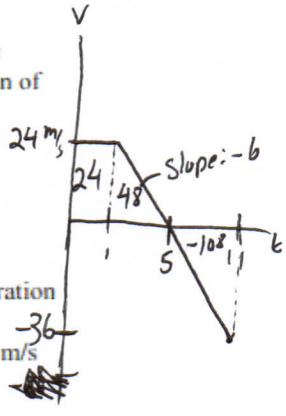
Area under Car Y < Area under Car X

4. Which of the following is true at time t = 20 seconds?
(A) Car Y is behind car X. (B) Car Y is passing car X. (C) Car Y is in front of car X.
(D) Both cars have the same acceleration. (E) Car X is accelerating fester then car Y.

Same area, same displacement

5. From time t = 0 to time t = 40 seconds, the areas under both curves are equal. Therefore, which of the following is true at time t = 40 seconds?
(A) Car Y is behind car X. (B) Car Y is passing car X. (C) Car Y is in front of car X.
(D) Both cars have the same acceleration. (E) Car X is accelerating faster than car Y.

28. A body moving in the positive x direction passes the origin at time t = 0. Between t = 0 and t = 1 second, the body has a constant speed of 24 meters per second. At t = 1 second, the body is given a constant acceleration of 6 meters per second squared in the negative x direction. The position x of the body at t = 11 seconds is
(A) +99 m (B) +36 m (C) -36 m (D) -75 m (E) -99 m



1993:

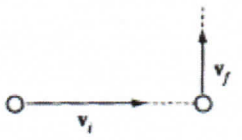
1. In the absence of air friction, an object dropped near the surface of the Earth experiences a constant acceleration of about 9.8 m/s^2. This means that the
(A) speed of the object increases 9.8 m/s during each second (B) speed of the object as it falls is 9.8 m/s
(C) object falls 9.8 meters during each second (D) object falls 9.8 meters during the first second only
(E) derivative of the distance with respect to time for the object equals 9.8 m/s^2

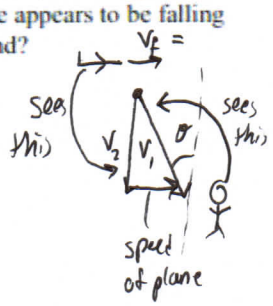
definition

2. A 500-kilogram sports car accelerates uniformly from rest, reaching a speed of 30 meters per second in 6 seconds. During the 6 seconds, the car has traveled a distance of
(A) 15 m (B) 30 m (C) 60 m (D) 90 m (E) 180 m

$30 = a(6s)$
$a = 5\ m/s^2$
$\Delta x = \frac{1}{2}(5)(36) + 0$
$\Delta x = 90$

3. At a particular instant, a stationary observer on the ground sees a package falling with speed v_1 at an angle to the vertical. To a pilot flying horizontally at constant speed relative to the ground, the package appears to be falling vertically with a speed v_2 at that instant. What is the speed of the pilot relative to the ground?





(A) $v_1 + v_2$ (B) $v_1 - v_2$ (C) $v_2 - v_1$ (D) $\sqrt{v_1^2 - v_2^2}$ (E) $\sqrt{v_1^2 + v_2^2}$

16. A balloon of mass M is floating motionless in the air. A person of mass less than M is on a rope ladder hanging from the balloon. The person begins to climb the ladder at a uniform speed v relative to the ground. How does the balloon move relative to the ground?
(A) Up with speed v (B) Up with a speed less than v (C) Down with speed v
(D) Down with a speed less than v (E) The balloon does not move.

conservation of momentum.

19. An object is shot vertically upward into the air with a positive initial velocity. Which of the following correctly describes the velocity and acceleration of the object at its maximum elevation?

	Velocity	Acceleration
(A)	Positive	Positive
(B)	Zero	Zero
(C)	Negative	Negative
(D)	Zero	Negative
(E)	Positive	Negative

25. A spring-loaded gun can fire a projectile to a height h if it is fired straight up. If the same gun is pointed at an angle of 45° from the vertical, what maximum height can now be reached by the projectile?
(A) h/4 (B) $\frac{h}{2\sqrt{2}}$ (C) h/2 (D) $\frac{h}{\sqrt{2}}$ (E) h

$h = \frac{1}{2}(-10)(t^2) + V_0 t$

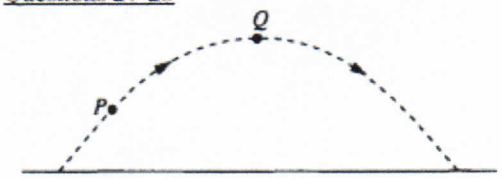
$0 = (-10)(t) + V_0$

Height of projectile

$H = \frac{V_0^2 \sin^2\theta}{2g}$ When $\theta = 90$ $H = \frac{V_0^2}{2g}$

When $\theta = 45$ $H = \frac{(V_0^2)\left(\frac{\sqrt{2}}{2}\right)^2}{2g} = \left(\frac{1}{2}\right)\left(\frac{V_0^2}{2g}\right)$ or $\frac{1}{2}h$

Questions 27-28



A ball is thrown and follows a parabolic path, as shown above. Air friction is negligible. Point Q is the highest point on the path.

Eq points down always

27. Which of the following best indicates the direction of the acceleration, if any, of the ball at point Q ?

(A) → (B) ↘ (C) ↓ (D) ←

(E) There is no acceleration of the ball at point Q.

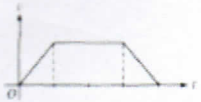
28. Which of the following best indicates the direction of the net force on the ball at point P ?

(A) ↗ (B) → (C) ↘ (D) ↓ (E) ←

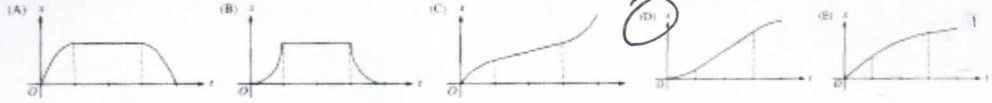
1998:

2. The velocity of a projectile at launch has a horizontal component v_h and a vertical component v_v. Air resistance is negligible. When the projectile is at the highest point of its trajectory, which of the following show the vertical and horizontal components of its velocity and the vertical component of its acceleration?

	Vertical Velocity	Horizontal Velocity	Vertical Acceleration
(A)	v_v	v_h	0
(B)	v_v	0	0
(C)	0	v_h	0
(D)	0	0	g
(E)	0	v_h	g



3. The graph above shows the velocity v as a function of time t for an object moving in a straight line. Which of the following graphs shows the corresponding displacement x as a function of time t for the same time interval?



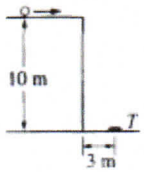
Basic Calc

$-10 = \frac{1}{2}(-10)(t^2)$

$t = \sqrt{2}\ s$

$3 = (v)(\sqrt{2})$

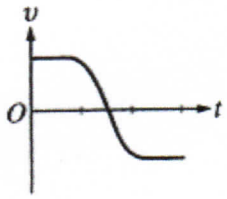
$v = \frac{3}{\sqrt{2}} = \frac{3\sqrt{2}}{2}$



26. A target T lies flat on the ground 3 m from the side of a building that is 10 m tall, as shown above. A student rolls a ball off the horizontal roof of the building in the direction of the target. Air resistance is negligible. The horizontal speed with which the ball must leave the roof if it is to strike the target is most nearly

(A) 3/10 m/s (B) $\sqrt{2}$ m/s (C) $\frac{3}{\sqrt{2}}$ m/s (D) 3 m/s (E) $10\sqrt{\frac{5}{3}}$ m/s

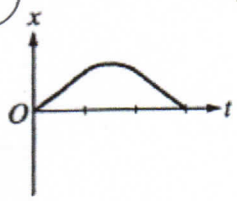
2004:



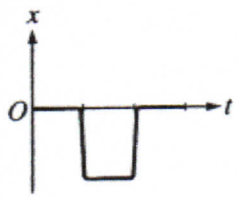
1. The graph above shows velocity v *versus* time t for an object in linear motion. Which of the following is a possible graph of position x *versus* time t for this object?

Calc

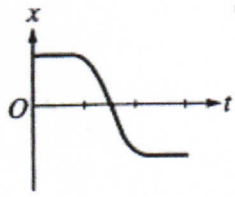
(A)



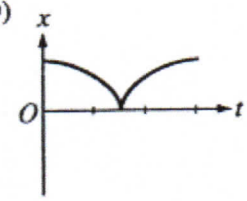
(B)



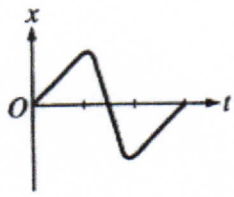
(C)



(D)



(E)

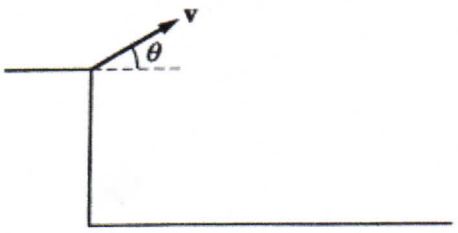


2. An object is dropped from rest from the top of a 400 m cliff on Earth. If air resistance is negligible, what is the distance the object travels during the first 6 s of its fall?

(A) 30 m
(B) 60 m
(C) 120 m
(D) 180 m
(E) 360 m

$\Delta x = \frac{1}{2}(-10)(6s)^2$

$\Delta x = -180m$



Note: Figure not drawn to scale.

33. An object is thrown with velocity v from the edge of a cliff above level ground. Neglect air resistance. In order for the object to travel a maximum horizontal distance from the cliff before hitting the ground, the throw should be at an angle θ with respect to the horizontal of

(A) greater than 60° above the horizontal
(B) greater than 45° but less than 60° above the horizontal
(C) greater than zero but less than 45° above the horizontal
D) zero
(E) greater than zero but less than 45° below the horizontal

largest range

24. The position of an object is given by the equation $x = 3.0t^2 + 1.5t + 4.5$, where x is in meters and t is in seconds. What is the instantaneous acceleration of the object at $t = 3.0$ s?

(A) 3.0 m/s^2
(B) 6.0 m/s^2
(C) 9.0 m/s^2
(D) 19.5 m/s^2
(E) 36 m/s^2

take second derivative

$\frac{d}{dx} = 6t + 1.5$

$\frac{d^2}{d^2x} = 6$

2009:

Starting from rest, a vehicle accelerates on a straight level road at the rate of 4.0 m/s^2 for 5.0 s.

1. What is the speed of the vehicle at the end of this time interval?

(A) 1.3 m/s
(B) 10 m/s
(C) 20 m/s
(D) 80 m/s
(E) 100 m/s

$V = (4\ m/s^2)(5) = 20$

2. What is the total distance the vehicle travels during this time interval?

(A) 10 m
(B) 20 m
(C) 25 m
(D) 40 m
(E) 50 m

$\Delta x = \frac{1}{2}(4)(5)^2 = 50m$

6. If air resistance is negligible, the speed of a 2 kg sphere that falls from rest through a vertical displacement of 0.2 m is most nearly

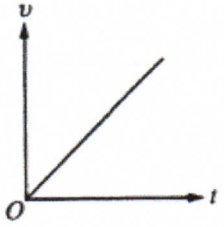
(A) 1 m/s
(B) 2 m/s
(C) 3 m/s
(D) 4 m/s
(E) 5 m/s

$V^2 = 2(-10)(-0.2) = 4$

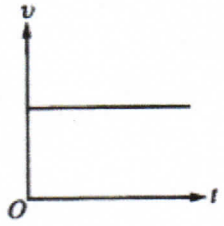
$V = 2$

5. An object is thrown vertically upward in a region where g is constant and air resistance is negligible. Its speed is recorded from the moment it leaves the thrower's hand until it reaches its maximum height. Which of the following graphs best represents the object's speed v versus time t ?

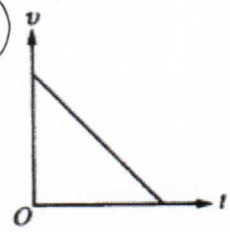
(A)



(B)

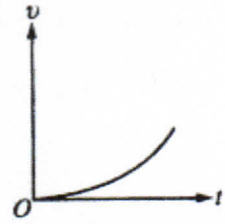


(C)

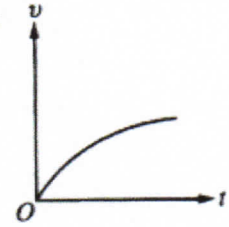


constant slope

(D)



(E)



29. A projectile is launched from level ground with an initial speed v_0 at an angle θ with the horizontal. If air resistance is negligible, how long will the projectile remain in the air?

(A) $2v_0/g$
(B) $2v_0 \cos\theta/g$
(C) $v_0 \cos\theta/g$
(D) $v_0 \sin\theta/g$
(E) $2v_0 \sin\theta/g$

$\Delta x = 0$

$0 = \frac{1}{2}(-g)(t^2) + V_0 \sin\theta t$

$\frac{1}{2}gt^2 = V_0 \sin\theta t$

$t = \frac{2V_0 \sin\theta}{g}$

31. An object of unknown mass is initially at rest and dropped from a height h. It reaches the ground with a velocity v_1. The same object is then raised again to the same height h but this time is thrown downward with velocity v_1. It now reaches the ground with a new velocity v_2. How is v_2 related to v_1 ?

(A) $v_2 = v_1/2$
(B) $v_2 = v_1$
(C) $v_2 = \sqrt{2}\, v_1$
(D) $v_2 = 2v_1$
(E) $v_2 = 4v_1$

$V_1^2 = 2(-10)(-h)$

$V_1^2 = 20h$

$V_2^2 = V_1^2 + 2(-10)(-h)$

$V_2^2 = 2V_1^2$

$V_2 = \sqrt{2}\, V_1$