Alice and Tom dive from an overhang into the lake below. Tom simply drops straight down from the edge, but Alice takes a running start and jumps with an initial horizontal velocity of *25 m/s*. Neither person experiences any significant air resistance. Compare the time it takes each of them to reach the lake below.

A) Alice reaches the surface of the lake first.

B) Tom reaches the surface of the lake first.

C) Alice and Tom will reach the surface of the lake at the same time.

Alice and Tom dive from an overhang into the lake below. Tom simply drops straight down from the edge, but Alice takes a running start and jumps with an initial horizontal velocity of 25 m/s. Neither person experiences any significant air resistance. Just as they reach the lake below,

A) **the speed of Alice is larger than that of Tom.**

B) the splashdown speed of Alice is larger than that of Tom.

C) they will both have the same speed.

D) the speed of Tom will always be 9.8 m/s larger than that of Alice.

E) the speed of Alice will always be 25 m/s larger than that of Tom.

While an object is in projectile motion (with upward being positive) with no air resistance, (assume up is positive y-axis)

A) the horizontal component of its velocity remains constant and the horizontal component of its acceleration is equal to -g.

B) **the horizontal component of its velocity remains constant and the vertical component of its acceleration is equal to -g.**

C) the horizontal component of its velocity remains constant and the vertical component of its acceleration is equal to zero.

D) the vertical component of both its velocity and its acceleration remain constant.

E) the vertical component of its velocity remains constant and the vertical component of its acceleration is equal to -g.

For general projectile motion, when the projectile is at the highest point of its trajectory,

A) its acceleration is zero.

B) **its velocity is perpendicular to the acceleration**.

C) its velocity and acceleration are both zero.

D) the horizontal component of its velocity is zero.

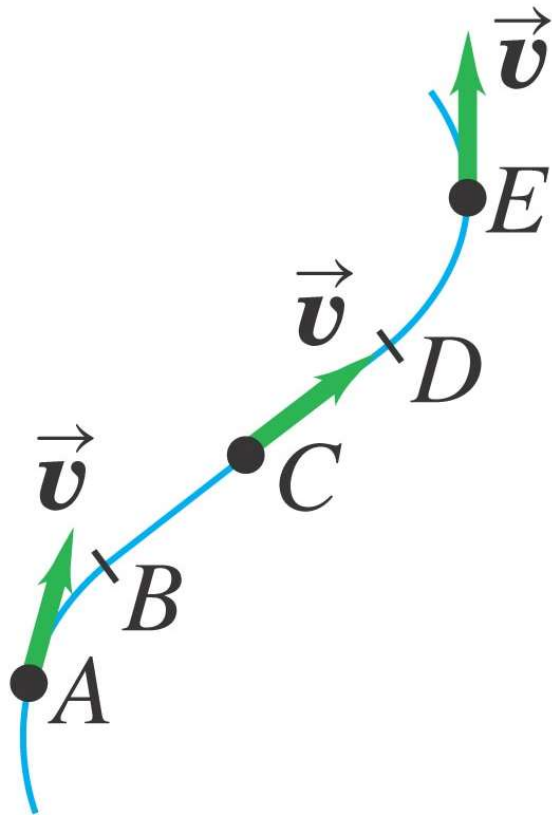E) the horizontal and vertical components of its velocity are zero.

Q3.13

An object is dropped from an airplane flying at a constant speed in a straight line at a constant altitude. If there is no air resistance, the falling object will (as seen from the ground)

    A. lag behind the airplane, but still move forward.

    B. lag behind the airplane and fall straight down.

    C. lag behind the airplane and move backward.

    D. remain directly under the airplane.

    E. move ahead of the airplane.

Q3.4

The motion diagram shows an object moving along a curved path at constant speed. At which of the points A, C, and E does the object have *zero* acceleration?

A. point A only

B. point C only

C. point E only

D. points A and C only

E. points A, C, and E

If an object travels at a constant speed in a circular path, the acceleration of the object is

A) larger in magnitude the smaller the radius of the circle.

B) in the same direction as the velocity of the object.

C) smaller in magnitude the smaller the radius of the circle.

D) in the opposite direction of the velocity of the object.
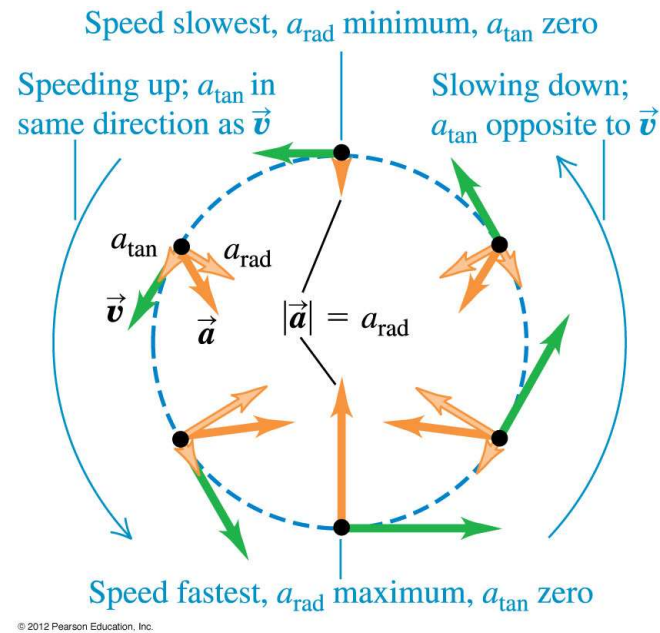
E) zero.

Q3.16

You drive a race car around a circular track of radius 100 m at a constant speed of 100 km/h. If you then drive the same car around a different circular track of radius 200 m at a constant speed of 200 km/h, your acceleration will be
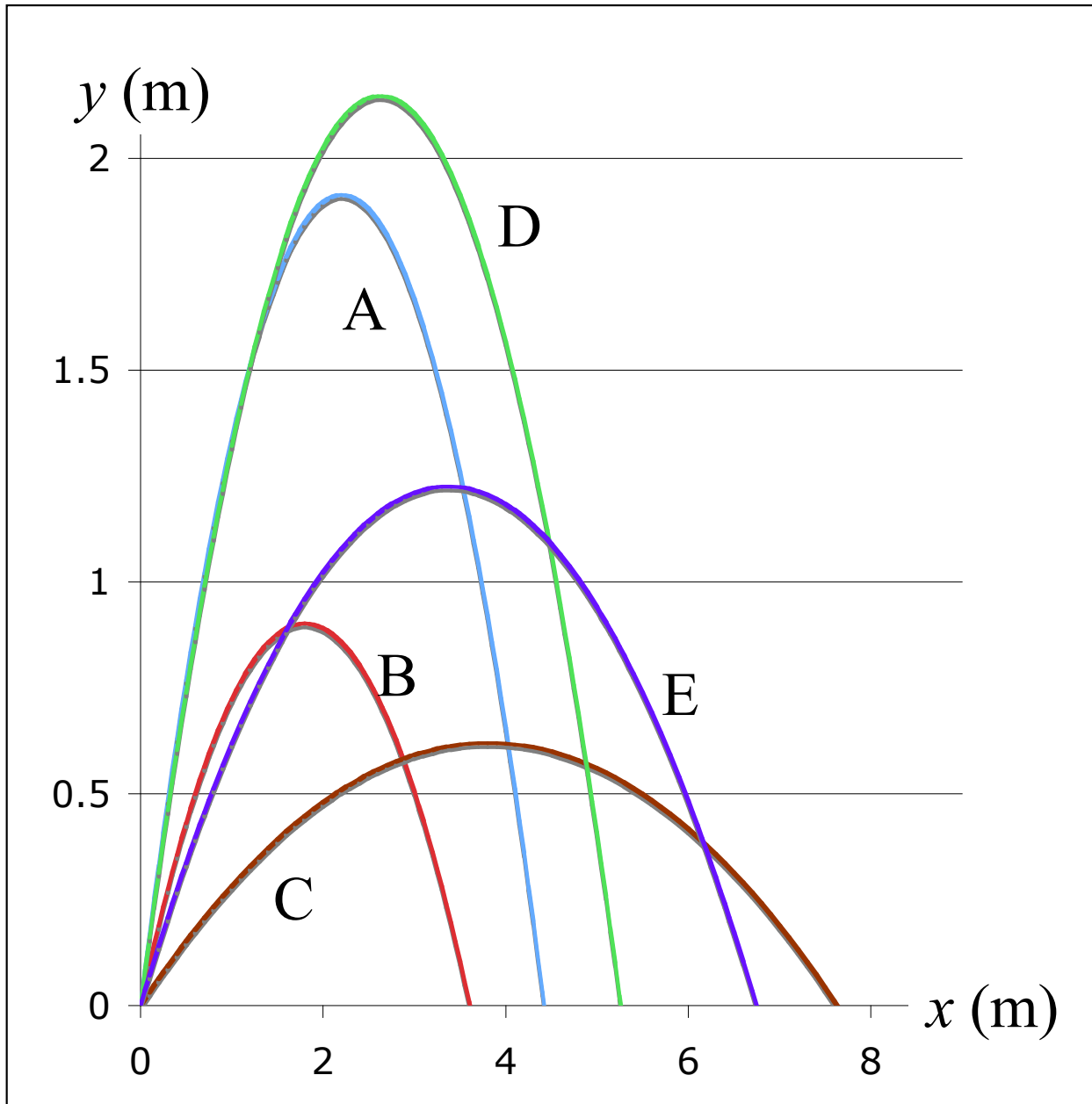
A. eight times greater.

B. four times greater.

C. twice as great.

D. the same.

E. half as great.

Test understanding 3.4: Suppose that the particle shown has four times the acceleration at the bottom of the loop as it does at the top. Compared to its speed at the top, its speed at the bottom is:

a) $\sqrt{2}$ × as great

b) **2 × as great**

c) $2\sqrt{2}$ × as great

d) 4 × as great

e) 16 × as great

Speed slowest, a_{rad} minimum, a_{tan} zero

Speeding up; a_{tan} in same direction as $\vec{v}$

Slowing down; a_{tan} opposite to $\vec{v}$

a_{tan}

a_{rad}

$\vec{v}$

$\vec{a}$

$|\vec{a}| = a_{rad}$

a_{rad}

Speed fastest, a_{rad} maximum, a_{tan} zero
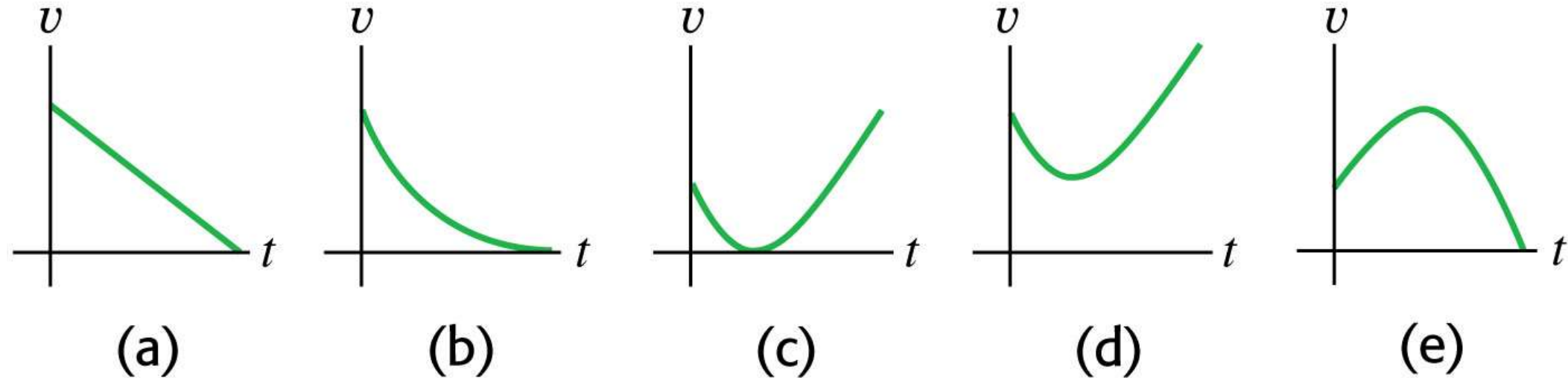
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A-RT3.2

Five identical objects, A through E, are launched simultaneously from the ground. Air resistance can be ignored. **Rank the objects** in order of when they hit the ground, from first to last.

Answer: CBEAD

A stone is thrown into the air at an angle above the horizontal and feels negligible air resistance. Which graph best depicts the stone's speed, v, as a function of time while it is in the air?

(a)   (b)   (c)   (d)   (e)

Answer: (d)

Because there is always a horizontal component of the velocity that doesn't change. If this question were asked as a thrown vertically upwards then (a) would be the answer.

Bob on the shore sees Alice on the water in a boat. Bob notes that relative to him, Alice is moving $15 \text{ m/s } \hat{\imath}$ and the boat has a speed $10 \text{ m/s } \hat{\imath}$.

What is Alice's velocity as seen by her dog Chloe sitting on the boat?

a) −5 m/s

b) **+5 m/s**

c) +15 m/s

d) −25 m/s

e) +25 m/s

Q3.14

A zookeeper fires a tranquilizer dart directly at a monkey. The monkey lets go of the branch from which he is hanging at the same instant that the dart leaves the gun barrel. The dart reaches a maximum height P before striking the monkey. Ignore air resistance.

When the dart is at P, the monkey is

A. at A (higher than P).

B. at B (at the same height as P).

C. at C (lower than P).

D. at unknown height because not enough information is given to decide.