Chapter 10

Projectile and Satellite Motion

Which of these expresses a vector quantity?

a. 10 kg
b. 10 kg to the north
c. 10 m/s
d. 10 m/s to the north

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Explanation: Velocity, not mass, is a vector quantity. 10 kg to the north has no physical meaning.

A cannonball is fired horizontally at 10 m/s from a cliff. Its speed 1 second after being fired is about

a. 10 m/s.
b. 14 m/s.
c. 16 m/s.
d. 20 m/s.

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a. 10 m/s.
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Explanation: One second after being fired both its horizontal and vertical components of velocity are 10 m/s. By the Pythagorean theorem, the resultant is 14.1 m/s, a bit more than 14 m/s.

Relative to the ground, an airplane gains speed when it encounters wind from behind and loses speed when it encounters wind head-on. When it encounters wind at a right angle to the direction it is pointing, its speed relative to the ground below

a. increases.
b. decreases.
c. is the same as if there were no wind.
d. Need more information.

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A wingsuit flyer traveling downward and leveling off to 40 km/h in a 30-km/h crosswind (at right angles) has a groundspeed of

a. 30 km/h.
b. 40 km/h.
c. 50 km/h.
d. 60 km/h.

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A ball launched into the air at 45° to the horizontal initially has

a. equal horizontal and vertical components.
b. components that do not change in flight.
c. components that affect each other throughout flight.
d. a greater horizontal component of velocity than vertically.

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When no air resistance acts on a fast-moving baseball, its acceleration is

a. downward, *g*.
b. due to a combination of constant horizontal motion and accelerated downward motion.
c. opposite to the force of gravity.
d. centripetal.

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When no air resistance acts on a projectile, its horizontal acceleration is

a. *g*.
b. at right angles to *g*.
c. centripetal.
d. zero.

When no air resistance acts on a projectile, its horizontal acceleration is

a. g.
b. at right angles to g.
c. centripetal.
d. zero.

Without air resistance, the time for a vertically tossed ball to return to where it was thrown is

a. 10 m/s for every second in the air.
b. the same as the time going upward.
c. less than the time going upward.
d. more than the time going upward.

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At the top of its trajectory, the velocity of a tossed baseball when air drag is negligible is ________ its initial horizontal component of velocity. With air drag, this speed at the top is _______.

a. less than; the same
b. equal to; less
c. greater than; less
d. equal to; a bit greater

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Toss a baseball horizontally and with no gravity it would continue in a straight line. With gravity it falls about

a. 1 m below that line.
b. 5 m below that line.
c. 10 m below that line.
d. None of these.

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When you toss a projectile horizontally, it curves as it falls. It will be an Earth satellite if the curve it makes

a. matches the curve of Planet Earth.
b. results in a straight line.
c. spirals out indefinitely.
d. None of these.

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Explanation: For an 8-km tangent, Earth curves downward 5 m. So a projectile traveling horizontally at 8 km/s will fall 5 m in 1 second and follow the curve of the Earth.

A satellite in circular orbit travels at a ________ speed, and a satellite in an elliptical orbit travels at a ___________ speed.

a. fast; slow
b. slow; fast
c. constant; variable
d. variable; constant

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b. slow; fast
c. constant; variable
d. variable; constant

A satellite in elliptical orbit about Earth travels fastest when it moves

a. close to Earth.
b. far from Earth.
c. the same everywhere.
d. halfway between the near and far points from Earth.

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A focal point of the elliptical path that a satellite follows is

a. Earth's surface.
b. Earth's center.
c. midway between the apogee and perigee.
d. affected by tides.

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a. circles.

b. ellipses.

c. straight lines most of the time.

d. spirals.

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Kepler is famous for finding an important relationship between a satellite's radial distance and its

a. speed.
b. time to complete an orbit.
c. kinetic energy.
d. potential energy.

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Explanation: Kepler's third law is $T2 \sim R3$, a relation between radial distance from the Sun or body about which orbiting occurs, and period (time to complete an orbit).

Energy is conserved when an Earth satellite travels in a

a. circular orbit.
b. elliptical orbit.
c. Both of these.
d. None of these.

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The work done by gravity is zero for a satellite traveling in a

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b. elliptical orbit.
c. Both of these.
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Explanation: Recall that no work is done by a force at right angles to motion, which occurs in a circle.

When a projectile achieves escape speed from Earth, it

a. forever leaves Earth's gravitational field.
b. outruns the influence of Earth's gravity but is never beyond it.
c. comes to an eventual stop, eventually returning to Earth at some future time.
d. All of these.

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A space shuttle orbits about 200 km above Earth’s surface so as to be above Earth’s

a. atmosphere.
b. gravitational field.
c. Both of these.
d. None of these.

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a. atmosphere.
b. gravitational field.
c. Both of these.
d. None of these.

Explanation: Careful! Don't say both of these, for there is plenty of gravitational field in satellite territory. What would be a satellite's path with no gravity?