Physics 11

Chapter 4 Quiz Solutions

	a.	b.	c.	d.
1.	☐	☒		
2.	☒	☐		
3.	☒	☐		
4.	☐	☒	☐	☐
5.	☐	☐	☒	☐
6.	☐	☐	☒	☐
7.	☐	☐	☒	☐
8.	☐	☐	☐	☒
9.	☒	☐	☐	☐
10.	☐	☒	☐	☐
11.	☐	☐	☒	☐
12.	☐	☐	☒	☐
13.	☐	☒	☐	☐
14.	☐	☐	☒	☐
15.	☒	☐	☐	☐

1. **Problem**
   True or false? When a ball is thrown straight up, its acceleration at the top is zero.

   a. True
   b. False

   Solution
   False. The acceleration of the ball is always $9.8\,\mathrm{m/s^2}$ down.

2. **Problem**
   True or false? It is possible to have zero acceleration and still be moving.

   a. True
   b. False

   Solution
   True. An object with a constant nonzero velocity has zero acceleration and is still moving.

3. **Problem**
   True or false? When a ball is thrown straight up, its velocity at the top is zero.

   a. True
   b. False

   Solution
   True. The velocity must be zero for an instant at the top as the velocity changes from up to down.

4. **Problem**
   A ball is thrown straight up, reaches a maximum height, then falls back down to its initial height. Which of the following is true while the ball is going down?

   a. Its velocity and acceleration both point up.
   b. Its velocity and acceleration both point down.
   c. Its velocity points up while its acceleration points down.
   d. Its velocity points down while its acceleration points up.

   Solution
   Both velocity and acceleration point down when the ball is going down.

5. **Problem**
   Consider a ball that is thrown upwards and which then falls back down. If up is the positive direction, then the ball's velocity

   a. is always positive.
   b. is always negative.
   c. starts positive, then becomes negative.
   d. starts negative, then becomes positive.

   Solution
   When the ball is moving upwards, its velocity is positive. When the ball is moving downwards, its velocity is negative.

6. **Problem**
   Can an object's velocity change direction when its acceleration is constant?
   a. No, because the object is always speeding up.
   b. No, because the object is always speeding up or slowing down, but it can never turn around.
   c. Yes, a rock thrown straight up is an example.
   d. Yes, a car that starts from rest, speeds up, slows to a stop, and then backs up is an example.

   Solution
   Yes, a rock thrown straight up is an example. The direction of the rock's velocity changes from up to down while its acceleration is always $9.8\,\text{m/s}^2$ down.

7. **Problem**
   Two balls are launched straight up. The first ball is launched with 3 times the initial speed of the second. Ignore air resistance. How many times higher does the first ball rise compared to the second?
   a. $\sqrt{3}$ times as high
   b. 3 times as high
   c. 3^2 times as high
   d. Impossible to determine without knowing the initial speeds

   Solution
   Use the formula $v_f^2 = v_i^2 + 2ad$ with $v_f = 0$ and solve for d:
   $$d = -\frac{v_i^2}{2a}$$
   The distance scales with the square of the initial velocity. Therefore, the first ball rises $3^2 = 9$ times as high as the second ball.

8. **Problem**
   A 5 kg ball and a 10 kg ball are both dropped off a cliff at the same time. If air drag can be ignored, then the 10 kg ball falls
   a. 50 % faster than the 5 kg ball.
   b. with double the velocity of the 5 kg ball.
   c. with double the acceleration of the 5 kg ball.
   d. with the same acceleration as the 5 kg ball.

   Solution
   The acceleration due to gravity on the surface of the Earth does not depend on the object's mass. All objects in free fall move with the same acceleration if air drag can be ignored.

9. **Problem**
   An object is released from rest and falls straight down without air resistance. Which of the following is true concerning its motion?
   a. Its acceleration is constant.
   b. Its velocity is constant.
   c. Neither its acceleration nor its velocity is constant.
   d. Both its acceleration and its velocity are constant.

   Solution
   Only acceleration is constant for an object in free fall.

10. **Problem**
A ball tossed straight up returns to its starting point in 2.39 s. What was its initial speed? Ignore air resistance.

   a. 17.1 m/s
   b. 11.7 m/s
   c. 12.7 m/s
   d. 13.8 m/s

Solution
The final velocity is equal to the initial velocity, but in the opposite direction ($v_f = -v_i$). Substitute this into the equation $v_f = v_i + at$ and solve for vi:

$$-v_i = v_i + at$$
$$-2v_i = at$$
$$vi = -\frac{at}{2} = -\frac{(-9.8\,\mathrm{m/s^2})(2.39\,\mathrm{s})}{2} = 11.7\,\mathrm{m/s}$$

11. **Problem**
An airplane increases its speed from 104 m/s to 232 m/s, at an average rate of 3 m/s^2. How much time does it take to complete this speed increase?

   a. 0.02 s
   b. 133 s
   c. 42.7 s
   d. 384 s

Solution
Use the formula for constant acceleration motion.

$$t = \frac{v_f - v_i}{a} = \frac{232\,\mathrm{m/s} - 104\,\mathrm{m/s}}{3\,\mathrm{m/s^2}} = 42.7\,\mathrm{s}$$

12. **Problem**
A person throws a rock straight down from a bridge with an initial speed of 7.07 m/s. It falls 10.9 m to the water below. How much time does it take for the rock to hit the water?

   a. 0.73 s
   b. 1.35 s
   c. 0.94 s
   d. 1.03 s

Solution
Use the quadratic formula to solve the equation $h = \frac{1}{2}gt^2 + v_i t$ for t.

$$\frac{1}{2}gt^2 + v_i t - h = 0$$
$$a = \frac{1}{2}g = \frac{1}{2}(9.8\,\mathrm{m/s^2}) = 4.9\,\mathrm{m/s^2}, b = v_i = 7.07\,\mathrm{m/s}, c = -h = -10.9\,\mathrm{m}$$

$$t = \frac{-b + \sqrt{b^2 - 4ac}}{2a} = 0.94\,\text{s}$$

13. **Problem**
A car with good tires on a dry road can decelerate at about $5.0\,\text{m/s}^2$ when braking. If the car travels with an initial velocity of $114\,\text{km/h}$ and brakes under such conditions, what distance would it travel before it stops?

 a. 3 m
 b. 100 m
 c. 1300 m
 d. 1071 m

Solution
First, convert the initial velocity to m/s:

$$114\,\text{km/h} \times \frac{1000\,\text{m}}{1\,\text{km}} \times \frac{1\,\text{h}}{3600\,\text{s}} = 31.6666667\,\text{m/s}$$

Then, use the formula $v_f^2 = v_i^2 + 2ad$ with $v_f = 0$ and $a = -5\,\text{m/s}^2$.

$$d = \frac{-v_i^2}{2a} = \frac{-(31.6666667\,\text{m/s})^2}{2(-5.0\,\text{m/s}^2)} = 100\,\text{m}$$

14. **Problem**
An F1 car accelerates from 0 to 60 miles per hour in 2.55 s. What is the acceleration of the car in SI units? (1 u = 1609.34 m)

 a. $9.22\,\text{m/s}^2$
 b. $5.86\,\text{m/s}^2$
 c. $10.5\,\text{m/s}^2$
 d. $13.1\,\text{m/s}^2$

Solution
First, convert 60 mph to m/s.

$$60\,\text{mph} \times \frac{1609.34\,\text{m}}{1\,\text{mi}} \times \frac{1\,\text{h}}{3600\,\text{s}} = 26.8223\,\text{m/s}$$

Then, divide by the time.

$$a = \frac{v_f - v_i}{t} = \frac{26.8223\,\text{m/s} - 0}{2.55\,\text{s}} = 10.5\,\text{m/s}^2$$

15. **Problem**
A car slows down uniformly and comes to a stop after 2 s. The car's average velocity during this motion was 43 km/h. What was the car's acceleration while slowing down?

    a. -43 km/h/s
    b. -21.5 km/h/s
    c. -46.7 km/h/s
    d. -40 km/h/s

    Solution
    Since the car's acceleration was uniform and the final velocity was zero, the initial velocity is double the average velocity.

$$v_{avg} = \frac{v_i + v_f}{2} = \frac{v_i}{2}$$
$$v_i = 2v_{avg} = 86\,\mathrm{km/h}$$

    The acceleration is the change in speed divided by the time.

$$a = \frac{v_f - v_i}{t} = \frac{0 - 86\,\mathrm{km/h}}{2\,\mathrm{s}} = -43\,\mathrm{km/h/s}$$