Unit 5 – Physics 2D Motion Study Guide

Name: Key
Period: ____ Date: ____

Useful Equations:

Kinematics:

$v_f = v_0 + at$

$d = v_0 t + \frac{1}{2}at^2$

$v_f^2 = v_0^2 + 2ad$

Others:

$v = \frac{2\pi r}{T}$

$a_c = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$

$F_c = m\frac{4\pi^2 r}{T^2}$

$F_g = \frac{Gm_1m_2}{r^2}$

$G = 6.67 * 10^{-11} Nm^2/kg^2$

$L = \omega I$

Concepts:

Kinematic equations
Torque
Rotational Velocity
Centripetal Acceleration
Centripetal Force
X/Y components of projectile motion
Newton's Law of Gravitation
Rotational Inertia
Angular Momentum

Multiple Choice:

1) A car traveling at constant velocity v suddenly brakes in an effort to keep from hitting a rabbit which is 8 ft away If the braking action causes a constant deceleration a, how long does it take for the car to come to a complete stop?
A) $t = va$ B) $t = 8a/v$ C) $t = 8a$ (D) $t = v/a$

2) In the previous question, how far did the car travel as it was braking?
A) $\frac{v^2}{2a}$ (B) $\frac{2v^2}{a}$ C) $8av$ D) $1/2\ a^2$

3) If an object has an acceleration of 0 m/s^2, then one can be sure that the object is not ____.
A) Moving B) Changing Position (C) Changing Velocity

4) If an object is moving eastward and slowing down, then the direction of its acceleration vector is ____.
A) Eastward (B) Westward C) Neither D) Not enough to tell

5) If an object is moving eastward and slowing down, then the direction of its velocity vector is ____.
A) Eastward B) Westward C) Neither D) Not enough to tell

6) A car starts from rest and after 7 seconds it is moving at 42 m/s. What is the car's average acceleration?
A) 0.17 m/s^2 B) 1.67 m/s^2 (C) 6 m/s^2 D) 7 m/s^2

7) A ball is thrown straight upward at 10 m/s. Ideally (no air resistance), the ball will return to the thrower's hand with a speed of
A) 0 m/s. B) 5 m/s. (C) 10 m/s. D) 20 m/s.

8) A rock is thrown from the edge of the top of a 100-ft tall building at some unknown angle above the horizontal. The rock strikes the ground a horizontal distance of 160 ft from the base of the building 5.0 s after being thrown. Assume that the ground is level and that the side of the building is vertical. Determine the speed with which the rock was thrown.
A) 72 ft/s B) 55 ft/s C) 68 ft/s D) 87 ft/s
a horizontal angle
A) 85 ft/s (B) 32 ft/s C) 75 ft/s D) 92 ft/s

9. What is the direction of force that acts on clothes in the spin cycle of a washing machine?

A) Outward (B) Inward C) Up D) Down

10. Suppose you try loosening a nut with a wrench, and the nut won't move. You increase your chances by…
A) extend the lever arm B) Exert force perpendicular to the lever arm C) exert more force D) all of the above

11. Which has more rotational inertia, a bicycle wheel or a solid disk if the same mass and diameter?
A) The wheel B) The disk C) The both have the same rotational inertia

12. Suppose that the gravitational force between two massive spheres is 10N. If the distance between the spheres is doubled, what is the force between the masses?
A) 40N B) 20N C) 5N D) 2.5N

Short Answer:

1. Bumblebee jumps straight upwards with a velocity of 30.0 m/s. What is his displacement after 5 s? [2 pts]

$v = 30\ m/s \quad a = -9.8\ m/s \quad t = 5\ s$

$d = 30.0\ m/s \cdot 5s + \frac{1}{2} -9.8\ m/s \cdot 5^2$

$d = 27.5\ m$

2. A bike first accelerates from 0 m/s to 10 m/s in 6 s, then continues at this constant speed for another 6s. What is the total distance traveled by the bike?

$d = \frac{1}{2}\ 1.667 \cdot 6^2 = 30.01\ m \qquad \frac{10}{6} = 1.667\ m/s^2 \qquad 10\ m/s \cdot 6s = 60m$

$60 + 30 = 90.0\ m$

3. A car slows from 50 m/s to 5.0 m/s at a constant rate of 4.2 m/s^2. How many seconds are required before the car is traveling 5.0 m/s?

$t = \frac{v_f - v_0}{a} = \frac{5 - 50}{-4.2} = 10.7\ s$

4. A vertical pole standing against a wall topples to the ground. The center of the pole has a speed of 20 m/s as it hits. With what speed does the far end of the pole hit the ground?

$v = \frac{2\pi r}{T} \qquad 20\ m/s = \frac{2\pi r}{T} \rightarrow 2 \cdot r = 40\ m/s$

5. A 20 kg girl sits on a seesaw 5 m from the fulcrum. What distance from the fulcrum must a 60kg boy sit in order to balance the seesaw?

$\frac{20kg \cdot 5}{60} = \frac{d \cdot 60}{60} \qquad d = 1.67m$

6. Imagine you are standing on top of a ladder that puts you 4 times as far from the earth's center. What would be your weight at the top, relative to your weight at the surface? Explain.

$F_g = \frac{G \cdot m_1 m_2}{r^2} \qquad 4^2 = 16 \rightarrow \frac{1}{16^{th}}$ that of earth

7. What does it mean to say that the moon is falling around the earth? How is linear velocity related to this? Why doesn't the moon collide with the earth?

The earth pulls the moon inward while its inertia wants it to fly outward.

8. Jupiter has a mass about 300 times that of earth, and its radius is about 11 times that if the earth. What would be the approximate weight of a 5-kg rock on the surface of Jupiter?

$5kg \cdot 9.8\ m/s = 49N \cdot \frac{300}{11^2} = 121.5N$