AP Physics Study Guide Chapters 5, 8, 9 **Name_____**

Circle the vector quantities below and underline the scalar quantities below
Centripetal Force Centripetal Acceleration Speed Torque

Write the equation or definition that defines each quantity, include units
Frequency Period Frequency-Period relationship UCM speed

Centripetal acceleration Centripetal Force Torque

Define Uniform Circular Motion

Explain how an object moving at constant speed can be accelerating

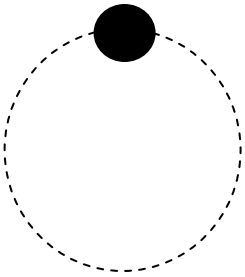
List the force(s) responsible for providing the net force causing centripetal acceleration of the object in UCM
Ball at end of string in horizontal circle:

Ball at end of string in vertical circle:

Motorcycle on inside of vertical loop-the-loop track

Car rounding a horizontal circular turn

Draw the centripetal force, centripetal acceleration and velocity vectors for the ball moving clockwise in the circle below



Show the expression that results from applying Newton's 2nd law to a ball at the end of a string in UCM when it is at

the top of a vertical circle

the bottom of a vertical circle

Define the critical velocity of an object in UCM at the top of a vertical circle:

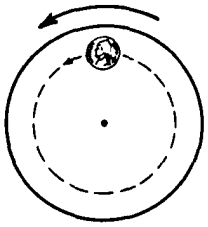
Explain what the lever arm distance is for an object that is experiencing a force causing it to rotate about an axis

List and explain the two criteria for static equilibrium when an object is experiencing both vertical forces and rotational torques.

1)

2)

No process is required for these multiple choice questions. Put answers on lines at right.



View from Above

1. The horizontal turntable shown above rotates at a constant rate. As viewed from above, a coin on the turntable moves counterclockwise in a circle as shown. Which of the following vectors best represents the direction of the frictional force exerted on the coin by the turntable when the coin is in the position shown?

(A) ← B) → C) ↙ D) ↓ E) ↑ 1)_____

2. An object weighing 4 newtons swings on the end of a string as a simple pendulum. At the bottom of the swing, the tension in the string is 6 newtons. What is the magnitude of the centripetal acceleration of the object at the bottom of the swing?

(A) 0 (B) 0.5 g (C) g (D) 1.5 g (E) 2.5 g 2)_____

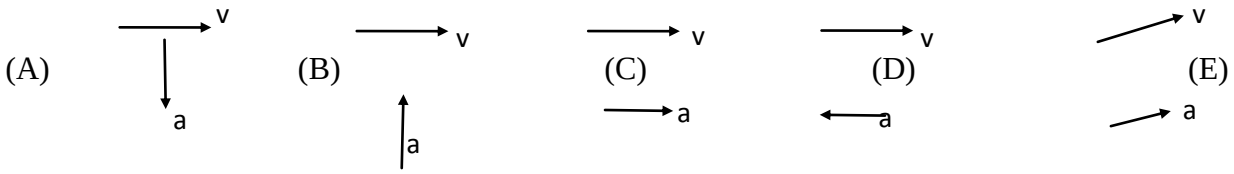
3. In which of the following situations would an object be accelerated? 3)_____

I. It moves in a straight line at constant speed.
II. It moves with uniform circular motion.
III. It travels as a projectile in a gravitational field with negligible air resistance.

(A) I only (B) III only (C) I and II only (D) II and III only (E) I, II, and III.

4)_____

4. An automobile moves at constant speed down one hill and up another hill along the smoothly curved surface shown above. Which of the following diagrams best represents the directions of the velocity and the acceleration of the automobile at the instant that it is at the lowest position. as shown?



5. Three forces act on an object. If the object is in translational equilibrium, which of the following must be true?

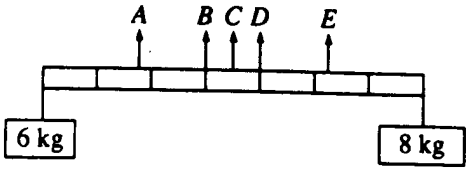
I. The vector sum of the three forces must equal zero.
II. The magnitudes of the three forces must be equal. 5)_____
III. All three forces must be parallel.

a. I only b. II only c. I and III only d. II and III only e. I, II, and III

6) A car initially travels north and then turns to the left along a circular curve. This causes a package on the seat of the car to slide toward the right side of the car. Which of the following is true of the net force on the package while it is sliding?

(A) The force is directed away from the center of the circle.
(B) The force is directed north.
(C) There is not enough force directed north to keep the package from sliding.
(D) There is not enough force tangential to the car's path to keep the package from sliding.
(E) There is not enough force directed toward the center of the circle to keep the package from sliding.

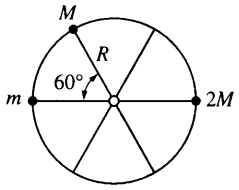
6)_____



7)Two objects, of masses 6 and 8 kilograms, are hung from the ends of a stick that is 70 centimeters long and has marks every 10 centimeters, as shown above. If the mass of the stick is negligible, at which of the points indicated should a cord be attached if the stick is to remain horizontal when suspended from the cord?

(A) A (B) B (C) C (D) D (E) E

7)_____



8) A wheel of radius *R* and negligible mass is mounted on a horizontal frictionless axle so that the wheel is in a vertical plane. Three small objects having masses *m*, *M*, and *2M*, respectively, are mounted on the rim of the wheel, as shown above. If the system is in static equilibrium, what is the value of *m* in terms of *M* ?

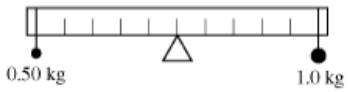
a. *M*/2 b. M c. 3*M*/2 d. 2*M* e. 5*M*/2

8)_____

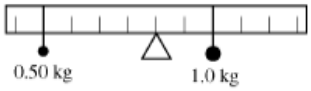
9) 9)_____

. A uniform meterstick is balanced at the center, as shown above. Which of the following shows how a 0.50 kg mass and a 1.0 kg mass could be hung on the meterstick so that the stick stays balanced?

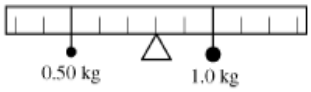
(A)



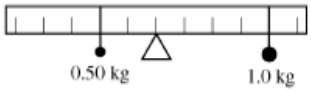
(B)



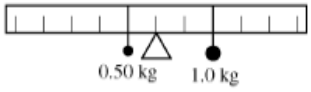
(C)



(D)



(E)



10) 10)_____

Side View

A rock attached to a string swings in a vertical circle, as shown above, with negligible air resistance. Which of the following diagrams could correctly show all the forces on the rock when the string is in the position above?

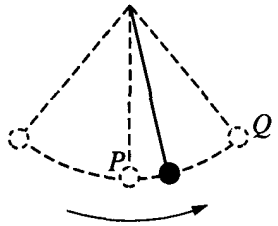
(A)

(B)

(C)

(D)

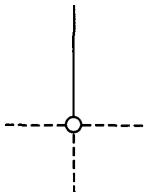
(E)



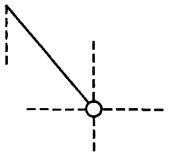
1) A heavy ball swings at the end of a string as shown above, with negligible air resistance. Point P is the lowest point reached by the ball in its motion, and point Q is one of the two highest points.

a. On the following diagrams draw and label vectors that could represent the velocity and acceleration of the ball at points P and Q. If a vector is zero, explicitly state this fact. The dashed lines indicate horizontal and vertical directions.

   i. Point P

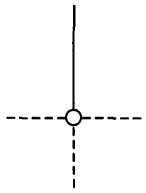


   ii. Point Q

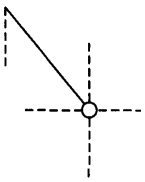


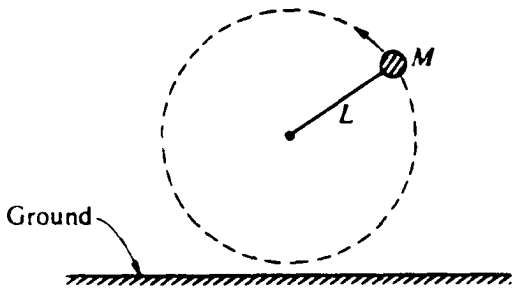
b. After several swings, the string breaks. The mass of the string and air resistance are negligible. On the following diagrams, sketch the path of the ball if the break occurs when the ball is at point P or point Q. In each case, briefly describe the motion of the ball after the break.

i. Point P



ii. Point Q





2) A ball of mass M attached to a string of length L moves in a circle in a vertical plane as shown above. At the top of the circular path, the tension in the string is twice the weight of the ball. At the bottom, the ball just clears the ground. Air resistance is negligible. Express all answers in terms of M, L, and g

a. Determine the magnitude and direction of the net force on the ball when it is at the top.

a)_____

b. Determine the speed v_o of the ball at the top.

b)_____

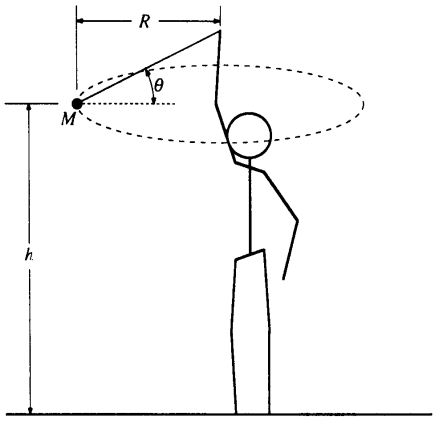
The string is then cut when the ball is at the top.

c. Determine the time it takes the ball to reach the ground.

c)_____

d. Determine the horizontal distance the ball travels before hitting the ground.

d)_____



3) An object of mass M on a string is whirled with increasing speed in a horizontal circle, as shown above. When the string breaks, the object has speed v_o and the circular path has radius R and is a height h above the ground. Neglect air friction.

a. Determine the following, expressing all answers in terms of h, v_o, and g.

i. The time required for the object to hit the ground after the string breaks

i)_____

ii. The horizontal distance the object travels from the time the string breaks until it hits the ground

ii)_____

iii. The speed of the object just before it hits the ground iii)_____

b. On the figure below, draw and label all the forces acting on the object when it is in the position shown in the diagram above.

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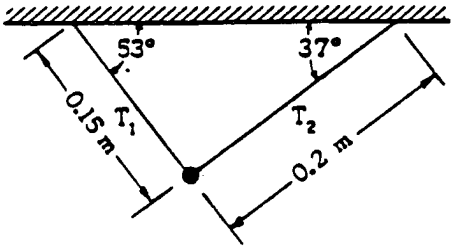
c. Determine the tension in the string just before the string breaks. Express your answer in terms of M, R, v_o, and g.



4) A ball of weight 5 Newtons is suspended by two strings as shown above.

a. In the space below, draw and clearly label all the forces that act on the ball.

b. Determine the magnitude of each of the forces indicated in part (a).

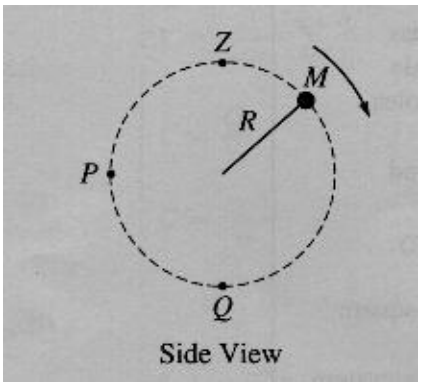
_____

_____

Suppose that the ball swings as a pendulum perpendicular to the plane of the page, achieving a maximum speed of 0.6 meter per second during its motion.

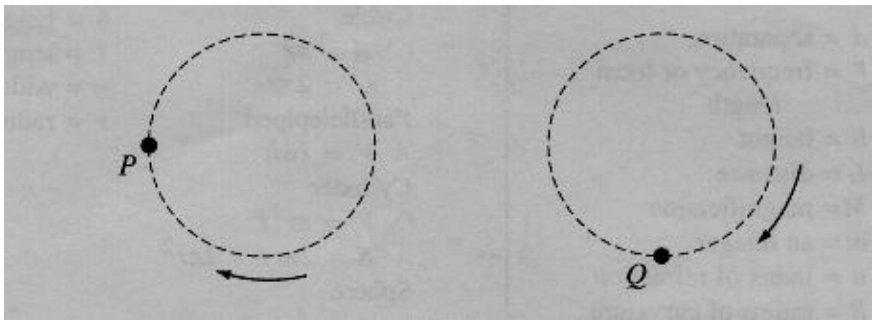
c. Determine the magnitude and direction of the net force on the ball as it swings through the lowest point in its path.

c)_____



5) A ball of mass *M* is attached to a string of length *R* and negligible mass. The ball moves clockwise in a vertical circle, as shown above. When the ball is at point *P*. the string is horizontal. Point *Q* is at the bottom of the circle and point *Z* is at the top of the circle. Air resistance is negligible. Express all algebraic answers in terms of the given quantities and fundamental constants.

(a) On the figures below, draw and label all the forces exerted on the ball when it is at points *P* and *Q*, respectively.



(b) Derive an expression for v_{min}, the minimum speed the ball can have at point Z without leaving the circular path.

b)_____

(c) The maximum tension the string can have without breaking is T_{max}. Derive an expression for v_{max}, the maximum speed the ball can have at point Q without breaking the string.

c)___

(d) Suppose that the string breaks at the instant the ball is at point P. Describe the motion of the ball for a short period of time immediately after the string breaks.