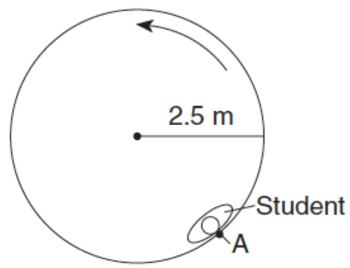
Name: ______________________________ Period: __________

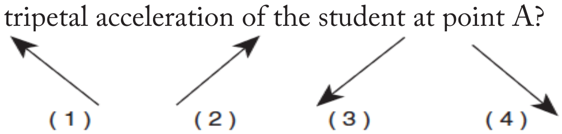
UCM-Circular Motion

Base your answers to questions 1 and 2 on the information and diagram below.

The diagram shows the top view of a 65-kilogram student at point A on an amusement park ride. The ride spins the student in a horizontal circle of radius 2.5 meters, at a constant speed of 8.6 meters per second. The floor is lowered and the student remains against the wall without falling to the floor.



1. Which vector best represents the direction of the centripetal acceleration of the student at point A?

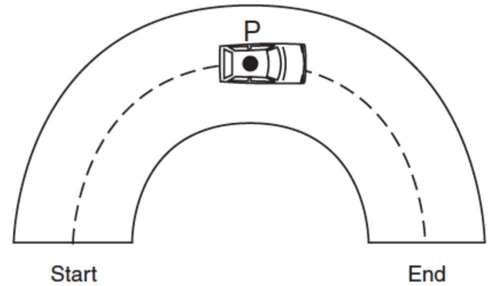


2. The magnitude of the centripetal force acting on the student at point A is approximately
   1. 1.2×10^4 N
   2. 1.9×10^3 N
   3. 2.2×10^2 N
   4. 3.0×10^1 N

3. The magnitude of the centripetal force acting on an object traveling in a horizontal, circular path will *decrease* if the
   1. radius of the path is increased
   2. mass of the object is increased
   3. direction of motion of the object is reversed
   4. speed of the object is increased

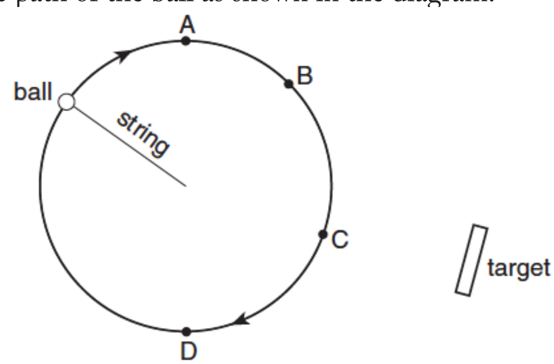
4. Centripetal force F_C acts on a car going around a curve. If the speed of the car were twice as great, the magnitude of the centripetal force necessary to keep the car moving in the same path would be
   1. F_C
   2. $2F_C$
   3. $F_C/2$
   4. $4F_C$

5. A car travels at constant speed around a section of horizontal, circular track. On the diagram below, draw an arrow at point P to represent the direction of the centripetal acceleration of the car when it is at point P.



6. A child is riding on a merry-go-round. As the speed of the merry-go-round is doubled, the magnitude of the centripetal force acting on the child
   1. remains the same
   2. is doubled
   3. is halved
   4. is quadrupled

7. A ball attached to a string is moved at constant speed in a horizontal circular path. A target is located near the path of the ball as shown in the diagram.



   At which point along the ball's path should the string be released, if the ball is to hit the target?
   1. A
   2. B
   3. C
   4. D

8. Which unit is equivalent to meters per second?
   1. Hz·s
   2. Hz·m
   3. s/Hz
   4. m/Hz

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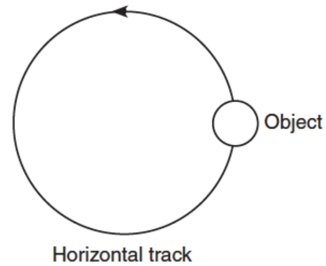
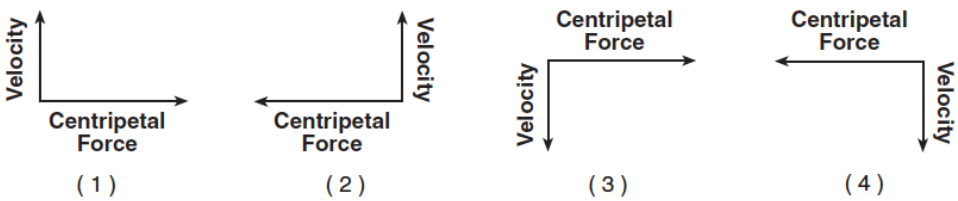
UCM-Circular Motion

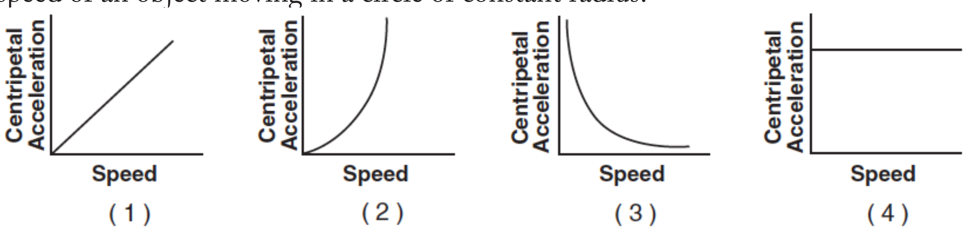
9. The diagram at right shows an object moving counterclockwise around a horizontal, circular track.

   Which diagram represents the direction of both the object's velocity and the centripetal force acting on the object when it is in the position shown?





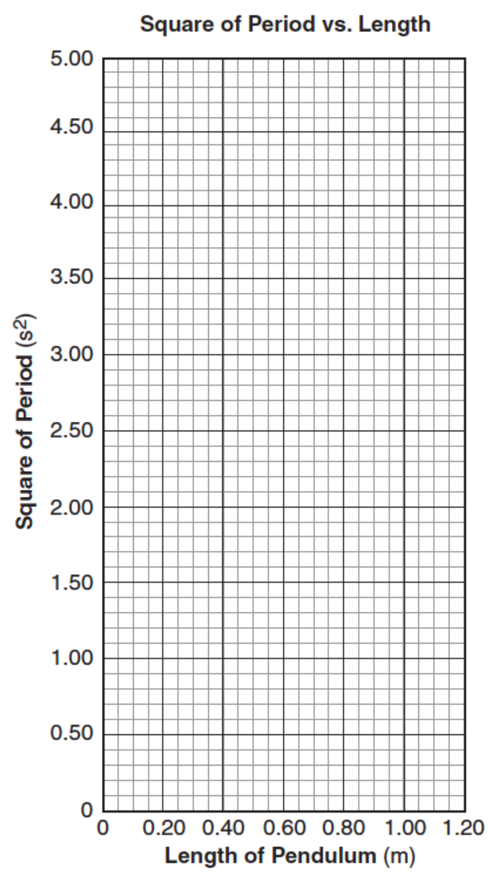
10. Which graph best represents the relationship between the magnitude of the centripetal acceleration and the speed of an object moving in a circle of constant radius?



Base your answers to questions 11 through 13 on the information and data table below.

In an experiment, a student measured the length and period of a simple pendulum. The data table lists the length (l) of the pendulum in meters and the square of the period (T^2) of the pendulum in seconds^2.

Length (ℓ) (meters)	Square of Period (T^2) (seconds^2)
0.100	0.410
0.300	1.18
0.500	1.91
0.700	2.87
0.900	3.60



11. Using the information in the data table, construct a graph on the grid provided by plotting the data points for the square of period versus length, and then drawing the best-fit straight line.

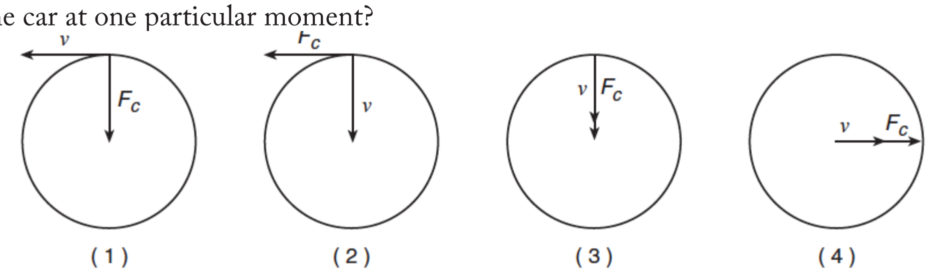
12. Using your graph, determine the time in seconds it would take this pendulum to make one complete swing if it were 0.200 meter long.

13. The period of a pendulum is related to its length by the formula: $T^2 = \left(\frac{4\pi^2}{g}\right) \bullet l$ If g represents the acceleration due to gravity, explain how the graph you have drawn could be used to calculate the value of g.

Name: ______________________ Period: __________

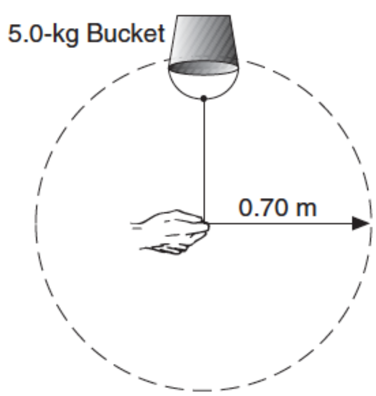
UCM-Circular Motion

14. A 1.0×10^3-kilogram car travels at a constant speed of 20 meters per second around a horizontal circular track. Which diagram correctly represents the direction of the car's velocity (v) and the direction of the centripetal force (F_C) acting on the car at one particular moment?



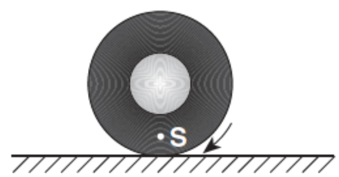
15. A baby and a stroller have a total mass of 20 kilograms. A force of 36 newtons keeps the stroller moving in a circular path with a radius of 5.0 meters. Calculate the speed at which the stroller moves around the curve. [Show all work, including the equation and substitution with units.]

16. The diagram below shows a 5.0-kilogram bucket of water being swung in a horizontal circle of 0.70-meter radius at a constant speed of 2.0 meters per second.

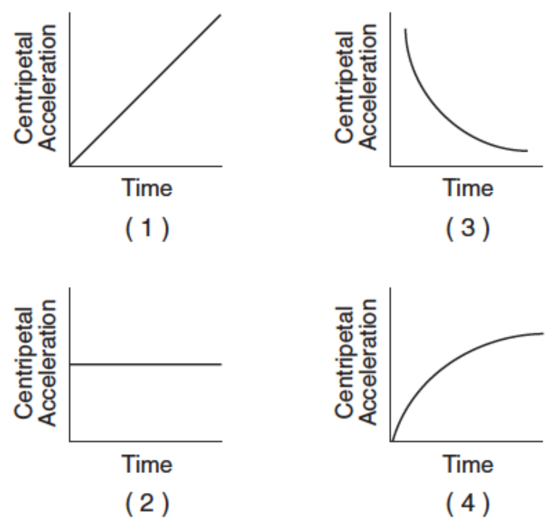


The magnitude of the centripetal force on the bucket of water is approximately
1. 5.7 N
2. 14 N
3. 29 N
4. 200 N

17. In the diagram below, S is a point on a car tire rotating at a constant rate.



Which graph best represents the magnitude of the centripetal acceleration of point S as a function of time?



18. A 0.50-kilogram object moves in a horizontal circular path with a radius of 0.25 meter at a constant speed of 4.0 meters per second. What is the magnitude of the object's acceleration?
1. 8.0 m/s^2
2. 16 m/s^2
3. 32 m/s^2
4. 64 m/s^2

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UCM-Circular Motion

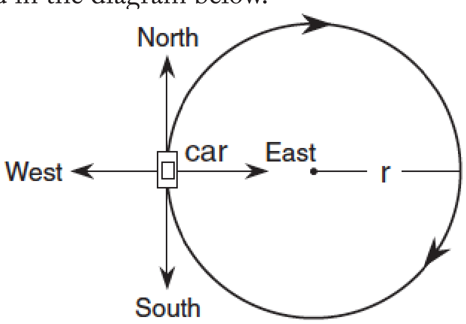
Base your answers to questions 19 and 20 on the information below.

A go-cart travels around a flat, horizontal, circular track with a radius of 25 meters. The mass of the go-cart with the rider is 200 kilograms. The magnitude of the maximum centripetal force exerted by the track on the go-cart is 1200 newtons.

19. What is the maximum speed the 200-kilogram go-cart can travel without sliding off the track?
    1. 8.0 m/s
    2. 12 m/s
    3. 150 m/s
    4. 170 m/s

20. Which change would increase the maximum speed at which the go-cart could travel without sliding off this track?
    1. Decrease the coefficient of friction between the go-cart and the track.
    2. Decrease the radius of the track.
    3. Increase the radius of the track.
    4. Increase the mass of the go-cart.

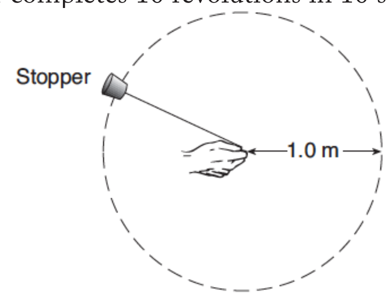
21. A car moves with a constant speed in a clockwise direction around a circular path of radius r, as represented in the diagram below.



When the car is in the position shown, its acceleration is directed toward the
1. north
2. west
3. south
4. east

Base your answers to questions 22 and 23 on the information below.

In an experiment, a 0.028-kilogram rubber stopper is attached to one end of a string. A student whirls the stopper overhead in a horizontal circle with a radius of 1.0 meter. The stopper completes 10 revolutions in 10 seconds.

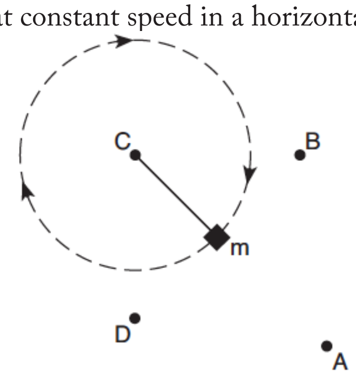


(Not drawn to scale)

22. Determine the speed of the whirling stopper.

23. Calculate the magnitude of the centripetal force on the whirling stopper. [Show all work, including the equation and substitution with units.]

24. The diagram below represents a mass, m, being swung clockwise at constant speed in a horizontal circle.



At the instant shown, the centripetal force acting on mass m is directed toward point
1. A
2. B
3. C
4. D

Name: ______________________________ Period: __________

UCM-Circular Motion

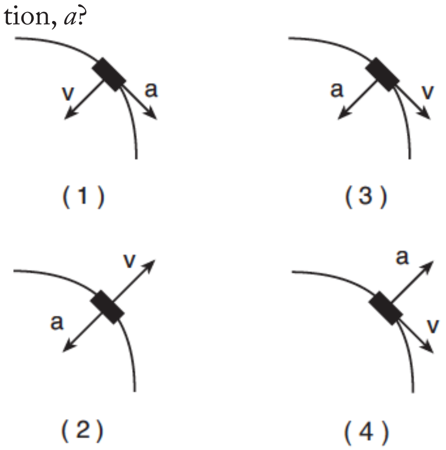
Base your answers to questions 25 and 26 on the information below.

A 2.0×10^3-kilogram car travels at a constant speed of 12 meters per second around a circular curve of radius 30 meters.

25. What is the magnitude of the centripetal acceleration of the car as it goes around the curve?
    1. $0.40\ m/s^2$
    2. $4.8\ m/s^2$
    3. $800\ m/s^2$
    4. $9{,}600\ m/s^2$

26. As the car goes around the curve, the centripetal force is directed
    1. toward the center of the circular curve
    2. away from the center of the circular curve
    3. tangent to the curve in the direction of motion
    4. tangent to the curve opposite the direction of motion

27. A car round a horizontal curve of constant radius at a constant speed. Which diagram best represents the directions of both the car's velocity, *v*, and acceleration, *a*?



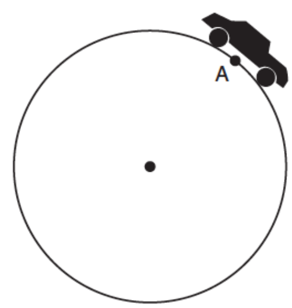
28. A 1750-kilogram car travels at a constant speed of 15 meters per second around a horizontal circular track with a radius of 45 meters. The magnitude of the centripetal force acting on the car is
    1. 5 N
    2. 583 N
    3. 8750 N
    4. 3.94×10^5 N

Base your answers to questions 29 through 31 on the information below.

The combined mass of a race car and its driver is 600 kilograms. Traveling at constant speed, the car completes one lap around a circular track of radius 160 meters in 36 seconds.

29. Calculate the speed of the car. [Show all work, including the equation and substitution with units.]

30. On the diagram below, draw an arrow to represent the direction of the net force acting on the car when it is in position A.



31. Calculate the magnitude of the centripetal acceleration of the car. [Show all work, including the equation and substitution with units.]

32. A ball of mass M at the end of a string is swung in a horizontal circular path of radius R at constant speed V. Which combination of changes would require the greatest increase in the centripetal force acting on the ball?
    1. doubling V and doubling R
    2. doubling V and halving R
    3. halving V and doubling R
    4. halving V and halving R

Name: ______________________ Period: ____________

UCM-Circular Motion

Base your answers to questions 33 through 36 on the information and table below.

Length (meters)	Period (seconds)
0.05	0.30
0.20	0.90
0.40	1.30
0.60	1.60
0.80	1.80
1.00	2.00

In a laboratory exercise, a student kept the mass and amplitude of swing of a simple pendulum constant. The length of the pendulum was increased and the period of the pendulum was measured. The student recorded the data in the table. You are to construct a graph on the grid provided following the directions below.

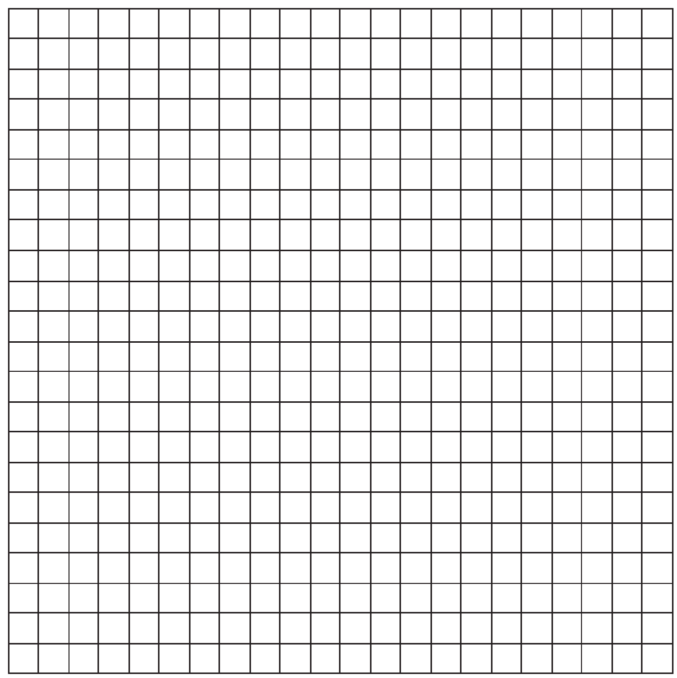
33. Label each axis with the appropriate physical quantity and unit, and mark an appropriate scale on each axis.

34. Plot the data points for period versus pendulum length.

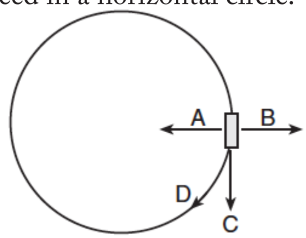
35. Draw the best-fit line or curve for the data graphed.

36. Using your graph, determine the period of a pendulum whose length is 0.25 meter.

Period vs. Length of Pendulum

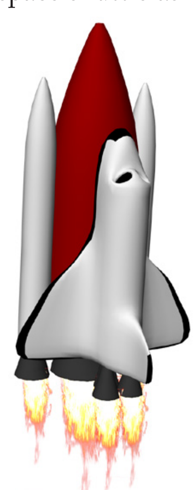


37. In the diagram below, a cart travels clockwise at constant speed in a horizontal circle.



At the position shown in the diagram, which arrow indicates the direction of the centripetal acceleration of the cart?
1. A
2. B
3. C
4. D

38. The centripetal force acting on the space shuttle as it orbits Earth is equal to the shuttle's
1. inertia
2. momentum
3. velocity
4. weight

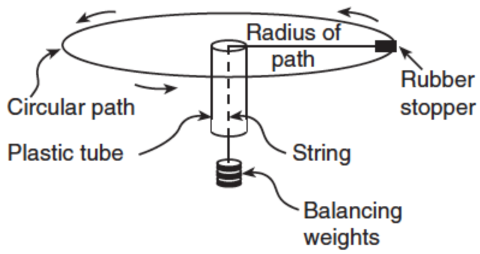


Name: ______________________ Period: __________

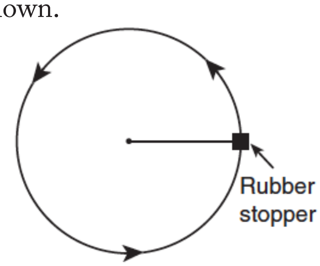
UCM-Circular Motion

Base your answers to questions 39 through 42 on the information and diagram below.

In an experiment, a rubber stopper is attached to one end of a string that is passed through a plastic tube before weights are attached to the other end. The stopper is whirled in a horizontal circular path at constant speed.



39. On the diagram of the top view (below), draw the path of the rubber stopper if the string breaks at the position shown.



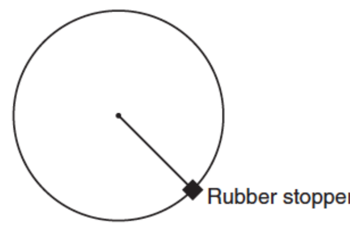
Top view

40. Describe what would happen to the radius of the circle if the student whirls the stopper at a greater speed without changing the balancing weights.

41. List three measurements that must be taken to show that the magnitude of the centripetal force is equal to the balancing weights.

42. The rubber stopper is now whirled in a vertical circle at the same speed. On the diagram, draw and label vectors to indicate the direction of the weight (F_g) and the direction of the centripetal force (F_C) at the position shown.

Vertical Circle (side view)



43. An unbalanced force of 40 newtons keeps a 5.0-kilogram object traveling in a circle of radius 2.0 meters. What is the speed of the object?
    1. 8.0 m/s
    2. 2.0 m/s
    3. 16 m/s
    4. 4.0 m/s

44. A student on an amusement park ride moves in a circular path with a radius of 3.5 meters once every 8.9 seconds. The student moves at an average speed of
    1. 0.39 m/s
    2. 1.2 m/s
    3. 2.5 m/s
    4. 4.3 m/s

45. A stone on the end of a string is whirled clockwise at constant speed in a horizontal circle as shown in the diagram. Which pair of arrows best represents the directions of the stone's velocity, v, and acceleration, a, at the position shown?