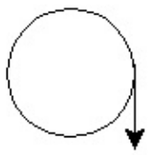
# Physics 3204

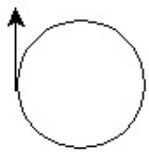
**Worksheet #3: Vertical UCM**

1. Which shows the direction of the centripetal force acting on a mass spun in a vertical circle?

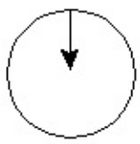
(A)



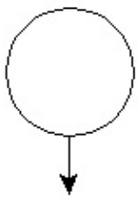
(B)



(C)



(D)



2. Which is constant for an object that is rotating vertically on the end of a string with uniform circular motion?

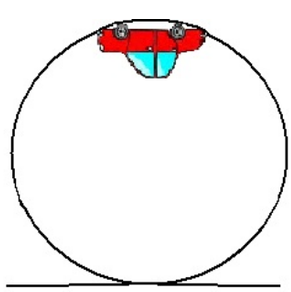
(A) momentum
(B) net force
(C) tension
(D) velocity

3. A 1.20 kg ball on a string is swung at a speed of 3.57 m/s in a vertical circle of radius 1.10 m. What is the tension in the string at the top of the circle?

(A) 2.1 N
(B) 11.8 N
(C) 13.9 N
(D) 25.7 N

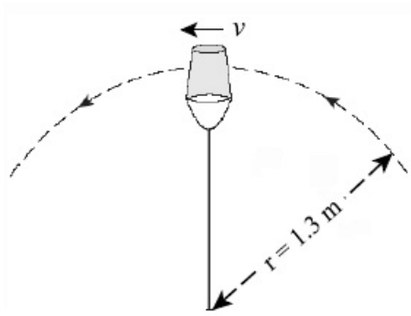
4. A roller coaster car of mass, $m$, is on a track that forms a circular loop of radius $r$ in a vertical plane. If the car is to just maintain contact with the track, what expression represents the minimum speed at the top of the loop?

(A) $rg$
(B) $\sqrt{rg}$
(C) $rmg$
(D) $\sqrt{rmg}$



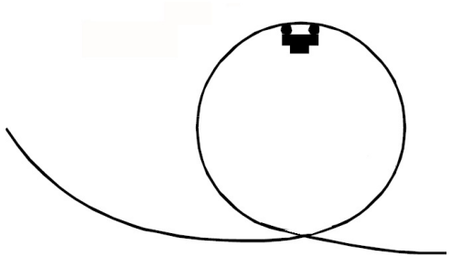
5. The diagram below shows a pail of water being swung in a vertical circle of radius 1.3 m. What is the minimum speed, v, at the top of the circle that will keep the water from spilling?

(A) 3.6 m/s
(B) 7.5 m/s
(C) 9.8 m/s
(D) 13 m/s



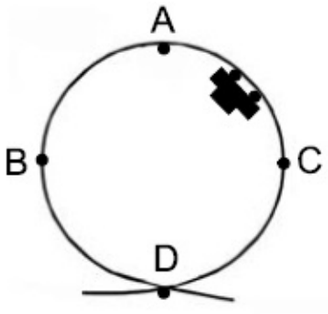

6. The roller coaster cart shown below, passes the point at the very top of a loop, which has a diameter of 14.0 m. If the normal force is equal to one half the weight of the cart, what is the speed of the roller coaster at this point?

(A) 4.14 m/s
(B) 8.28 m/s
(C) 10.1 m/s
(D) 14.3 m/s



7. If the vehicle below completes the loop, at which point is the normal force lowest?

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

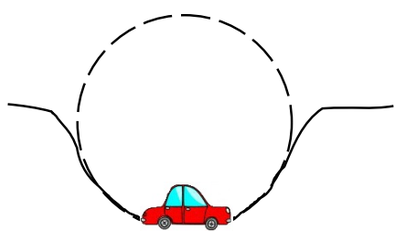



8. A pilot moving at a speed of $2.50 \times 10^2$ m/s, experiences a normal force of seven times his weight at the bottom of a vertical dive. What is the radius of curvature of the dive if it follows a semi-circular path as shown?

(A) 425 m
(B) 797 m
(C) 911 m
(D) 1060 m

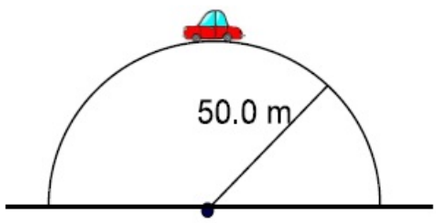
9. The diagram below represents a $1.9 \times 10^3$ kg car driving into the bottom of a small valley. If the car is travelling at 9.0 m/s and the radius of the valley is 12.0 m, what is the normal force acting on the car?

(A) $5.8 \times 10^3$ N
(B) $1.3 \times 10^4$ N
(C) $1.9 \times 10^4$ N
(D) $3.1 \times 10^4$ N



10. A 2.00 kg object is attached to the end of a 3.00 m long rope and is spun in a vertical circle. Calculate the speed of the object, at the bottom of the circle, if the tension in the rope is 49.0 N. **AUGUST 2009** [3]

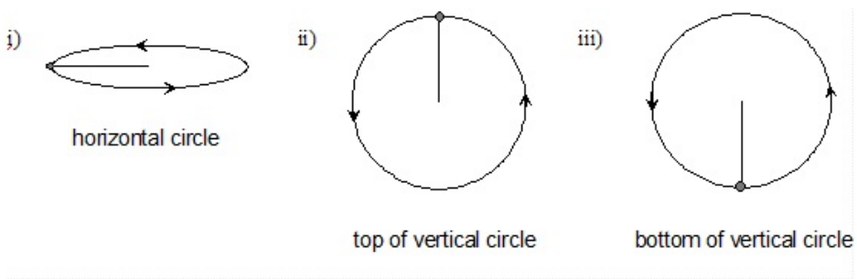
11. A car of mass $1.50 \times 10^3$ kg travelling at 18 m/s, tops a hill having a radius of curvature of 50.0 m. **AUGUST 2008**




i) Calculate the normal force on the car at the top of the hill. [3]

ii) Calculate the maximum speed that will allow the car to stay on the road at the top of the hill. [3]

12. A 0.40 kg stone is tied to a string and whirled around in a circle of radius 0.75 m with a constant speed of 5.0 m/s. In which situation is the string most likely to break? Explain. **JUNE 2009** **[2]**

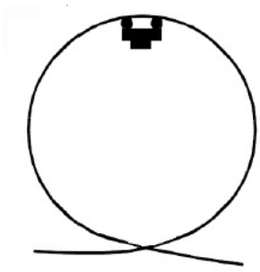


13. In an automatic clothes dryer a hollow drum moves the clothes in a vertical circle of diameter 0.75 m. The dryer is designed so that the clothes tumble and do not simply stick to the drum as it rotates. Calculate the speed at which the drum must rotate so that a 0.425 kg sweater at the top of the drum will just begin to tumble.

**JUNE 2008**

14. A roller coaster cart is at the top of a vertical circular loop and is travelling at 9.30 m/s. The total mass of the cart and passengers is 435 kg.

(i) If the radius of the loop is 4.50 m, calculate the normal force acting on the cart at the top of the loop. **AUGUST 2007**



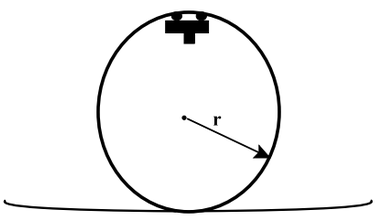
ii) Calculate the minimum speed required at the top of the loop to keep the cart on the track

15. A pail of water on the end of a string revolves at a uniform rate in a vertical circle of radius 85.0 cm. Its speed is 4.15 m/s and the mass of the pail and water together is 1.00 kg. **JUNE 2006**

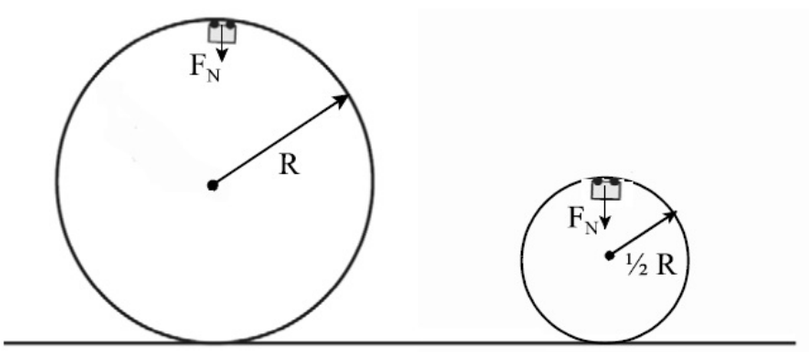
(i) Calculate the magnitude of the tension in the string when the pail is at the top of its path.

(ii) At what minimum speed must the pail be travelling when upside down at the top of the circle so that the water does not fall out?

16. The diagram below represents the loop of a roller coaster. If the radius of the loop is 12.0 m, what is the minimum speed, at the top of the loop, required to prevent passengers from falling out?




17. During a roller coaster ride the riders move through two loops, the second being one half the radius of the first. The riders travel at the same speed at the top of each of these two loops. **JUNE 2006**




Using principles of physics, explain why riders would experience a greater normal force at the top of the second, smaller loop than at the top of the first, larger loop.