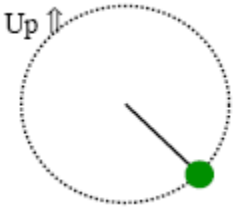
Practical Discussion Problems (6)

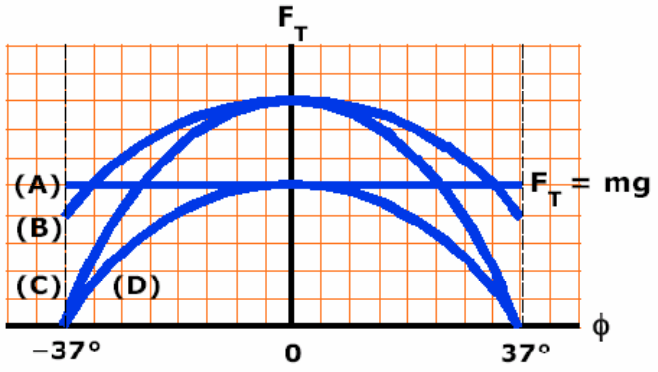
Circular Dynamics (Newton's Laws of Motion)

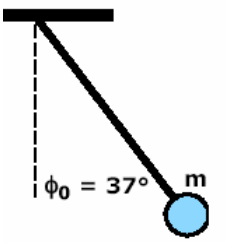
Q1: An object is swinging on a string. At the instant that it stops at the highest point of its swing, which of the following is true?



1) The object stops so its acceleration is zero.
2) The acceleration in the direction the ball was moving is zero.
3) The string tension must balance gravity so the vertical acceleration is zero.
4) The acceleration in the direction of the string is zero.
5) The acceleration in the horizontal direction is zero.
6) Both 2 & 3 are true. 7) Both 2 & 5 are true.
8) Both 4 & 3 are true. 9) Both 4 & 5 are true.

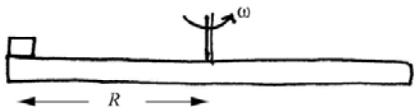
Q2: A ball of mass m is attached to a piece of light string and released from rest at an angle ø0 = 37° from the vertical as shown. Which of the graphs below best represents the tension in the string as a function of the angle ø (also relative to the vertical)?





(A) graph A (B) graph B **(C)** graph C **(D)** graph D
(E) none of the above

Q3: A coin of mass *m* (which you may treat as a point object) lies on a turntable, exactly at the rim, a distance *R* from the center. The turntable turns at constant angular speed ω and the coin rides without slipping. Suppose the coefficient of static friction between the turntable and the coin is given by μ . Let *g* be the gravitational constant.



(a) What is the maximum angular speed ω max such that the coin does not slip? Explain your plan for solving this problem. Include all graphs or diagrams that you intend to use.

(A) $\omega_{\max} = \sqrt{\frac{\mu g}{R}}$ (B) $\omega_{\max} = \sqrt{\frac{g}{\mu R}}$ (C) $\omega_{\max} = \sqrt{\frac{g}{R}}$ (D) $\omega_{\max} = \sqrt{\frac{mg}{R}}$

(E) $\omega_{\max} = \sqrt{\frac{2\mu g}{R}}$

(b) Suppose an identical second coin is now stacked on top of the first coin and the turntable turns at constant angular speed ω such that the coins ride without slipping. The coefficient of static friction between the two coins is also μ. What is the magnitude of the radial force exerted by the turntable on the bottom coin? Does this force point inward or outward?

(A) $F = mR\omega^2$ inward (B) $F = 2mR\omega^2$ outward (C) $F = 2mR\omega^2$ inward
(D) $F = mR\omega^2$ outward (E) (A) $F = 4mR\omega^2$ inward