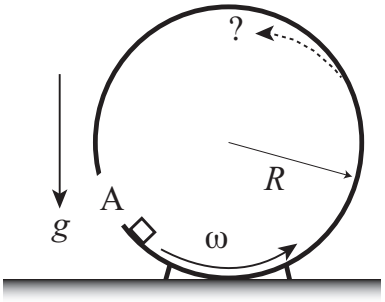
Physics 101 (F11) **Q5A**

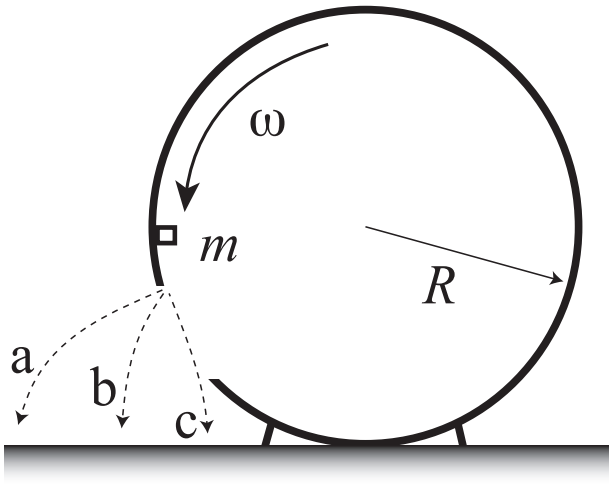
Name: _____ **Section:** _____ **Score:** _____/20

1. A vertical hoop of radius R is fixed to the ground. Along its frictionless inside surface slides a block of mass m. It has a constant angular speed ω.



(a) Suppose $R = 0.4$ m. What is the minimum (constant) angular speed ω such that the block can reach the top of the hoop without falling off? [5]

(b) There is a gap at A, so the block falls off from the hoop on its way back to the bottom. Choose the (qualitatively) correct trajectory of the block after falling off the hoop. [5]



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2. DVD players read disks at a constant rate (linear speed) and thus the disk's rotational speed varies as it reads from the inner toward the outer edge of the disk.

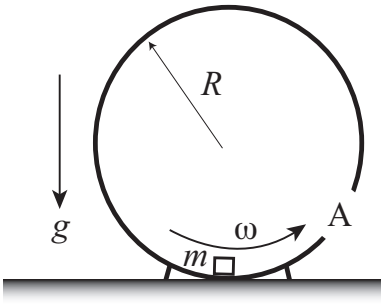
(a) To start a movie, 1500 rpm is needed to play the innermost track. What is the (minimum) angular acceleration (in rad/s) required to reach this rotational speed within 11 complete rotations? [5]

(b) The radius of the innermost track is 2.3 cm. What is the *linear* speed required to play the outermost edge (its radius is 5.8 cm)? [5]

Physics 101 (F11) **Q5B**

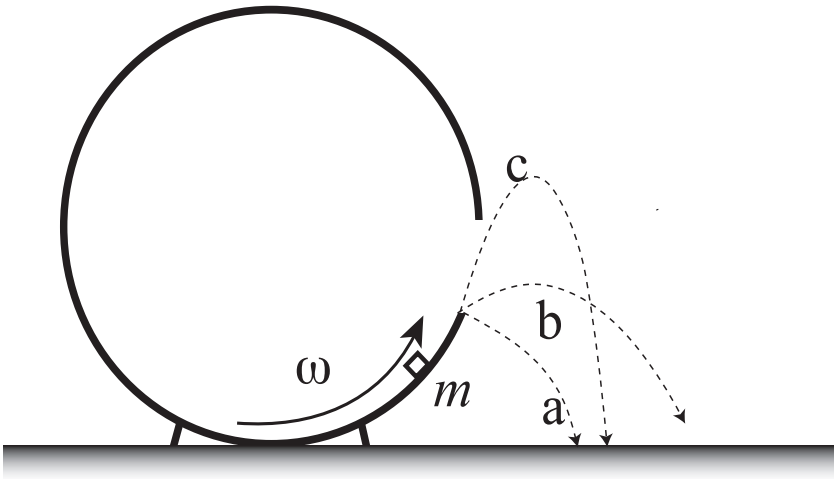
Name: _____ **Section:** _____ **Score:** _____/20

1. A vertical hoop of radius R is fixed to the ground. Along its frictionless inside surface slides a block of mass $m = 0.2$ kg. It has a constant angular speed $\omega = 2.1$ rad/s.



(a) Suppose $R = 1.2$ m. What is the force (its direction and magnitude) that the block exerts on the hoop when the block is just passing the bottom? [5]

(b) There is a gap at A, so the block falls off from the hoop on its way to the top. Choose the (qualitatively) correct trajectory of the block after falling off the hoop. [5]



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2. CD players read disks at constant rate (linear speed) and thus the disk's rotational speed varies as it reads from the inner toward the outer edge of the disk.

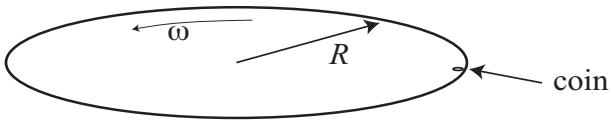
(a) To start a song, 500 rpm is needed to play the innermost track. What is the (minimum) angular acceleration (in rad/s) required to reach this rotational speed within 8 complete rotations from the stationary state? [5]

(b) The radius of the innermost track is 2.3 cm and that of the outermost track is 5.8 cm. What is the required rotational speed (in rpm) to play the outermost track? [5]

Physics 101 (F11) **Q5C**

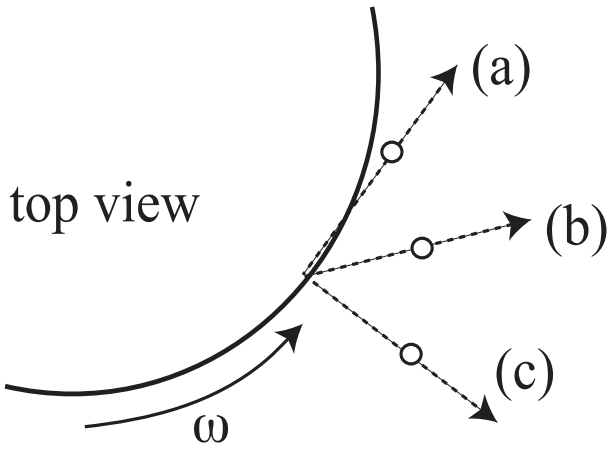
Name: _____ **Section:** _____ **Score:** _____**/20**

1. On a horizontal turntable is a coin. The coefficient of static friction between the table and the coin is $\mu_s = 0.7$. The radius of the turntable is $R = 1.2$ m.



(a) The coin is at the very edge of the table (you may ignore the size of the coin). What is the minimum angular speed of the turntable for the coin to fall off the table? [5]

(b) When the coin falls off the turntable to the frictionless floor (at the same height) due to a larger angular speed than that in (a), what is its qualitatively correct trajectory? Choose the right answer from below. [5]}



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2. A centrifuge spins a sample at a distance 0.1 m from its axle at a rotational speed of 1800 rpm.

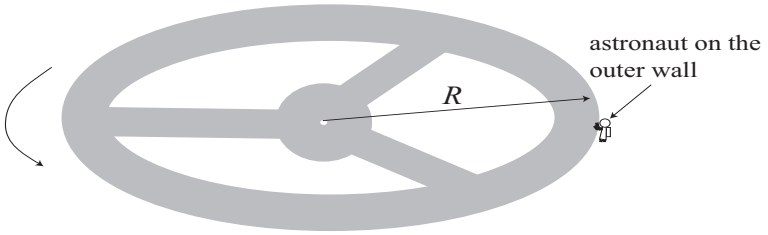
(a) We wish to apply the same centripetal acceleration to a sample held at a distance 0.07 m from the axle. What is the required rotational speed in rpm? [5]

(b) We wish to accelerate the rotational speed from 1800 rpm to 3000 rpm within 230 rotations. What is the minimum angular acceleration do we have to apply to the centrifuge? [5]

Physics 101 (F11) **Q5D**

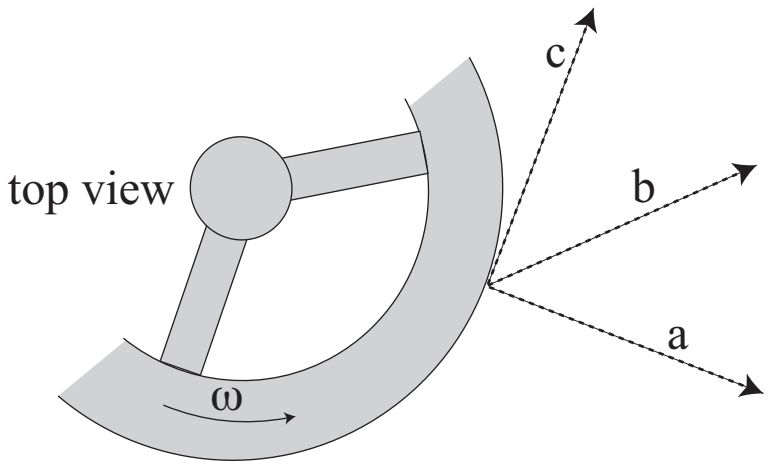
Name: _____ **Section:** _____ **Score:** _____**/20**

1. A donut shaped space station is rotating around its rotational symmetry axis as illustrated below. Its outermost radius is $R = 120$ m, and it is rotating at an angular speed of 0.35 rad/s. An astronaut is clinging to the outer surface of the space ship.



(a) The mass of the astronaut is $M = 120$ kg. What force (its direction and magnitude) must she exert on the wall to stay on the wall of the station? [5]

(b) She releases her grips and off she is gone to the depth of the universe. What is her trajectory just after she detaches from the wall? Choose the correct one from below. [5]



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2. An ancient phonogram used a vinyl disk that rotates at a constant rotational speed of 100/3 rpm.

(a) The playing speed (the linear relative speed of the needle and the disk) v_i at the beginning of the music (the outermost edge of radius = 14.5 cm) and that v_f at its ending part (the innermost grooves of radius = 5 cm) are different. What is the ratio v_i/v_f? [5]

(b) To stop the rotation within 5 rotations, what angular acceleration is required? [5]