2013 F=ma Exam: Problem 10

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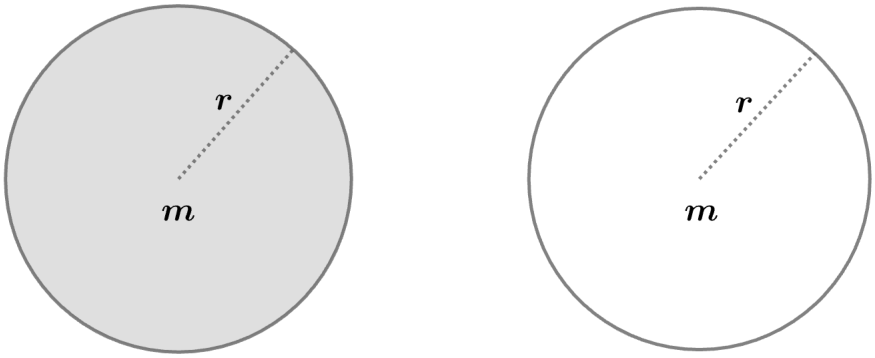
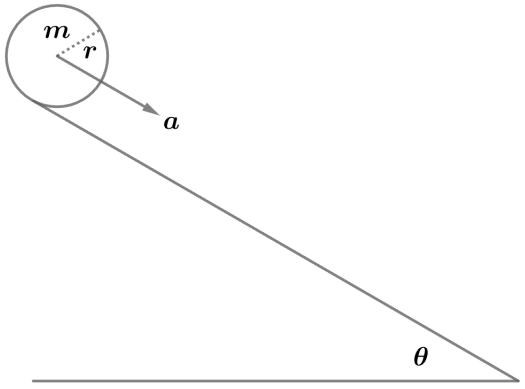


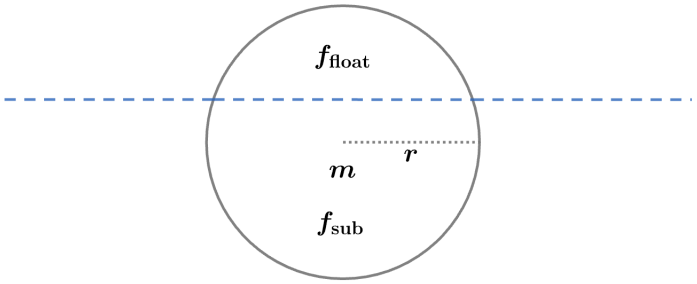
- A) Not correct since by the shell theorem, the gravitational field outside a solid sphere or spherical shell is identical to that of a point located at the center with the same mass. Thus, orbits around both objects are identical.
- B) Correct since the acceleration of an object rolling down an inclined plane is given by

$$a = \frac{g \sin\theta}{1+\beta}$$



where the object has moment of inertia $I = \beta m r^2$. For a solid sphere, $\beta = 2/5$ while for a spherical shell, $\beta = 2/3$. Since the solid sphere has a smaller β, it has a larger acceleration and takes less time to roll down the inclined plane.

- C) Not correct since by the shell theorem, the gravitational field outside a solid sphere or spherical shell is identical to that of a point located at the center with the same mass. Thus, tidal forces exerted by both objects are identical.
- D) Not correct since the fraction of an object that floats is $f_{\text{float}} = 1 - f_{\text{sub}} = 1 - \frac{\rho_{\text{obj}}}{\rho_{\text{wat}}}$. Both objects have the same shape and mass so they have the same average density and therefore f_{float}.



- E) Not correct since in a uniform gravitational field g, the force applied to an object of mass m is

$$F = mg$$

Since both objects have the same mass, they experience the same force.

Thus, the answer is $\boxed{\text{B}}$.