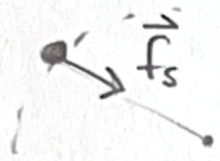
MCQ Set 6

1. D

Newton's Laws

$$\Sigma F_r = ma_r$$

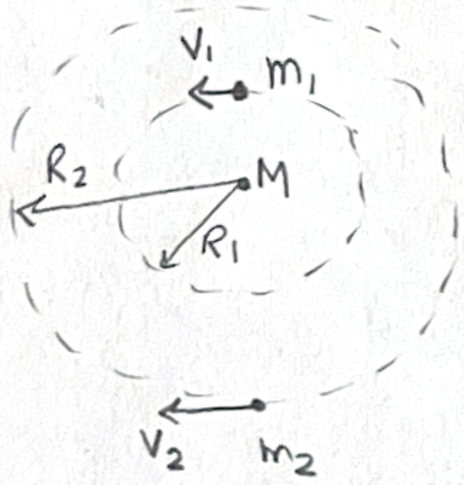


$$f_{s\max} = M_1\left(\frac{v2}{R}\right)$$

$$\mu_s(Mg) = M\left(\frac{V^2}{R}\right)$$

$$\mu_s = \frac{V^2}{Rg}$$

2. A



$m_2 > m_1$

① Newton's Laws

$$\Sigma F_r = ma_r$$

For m_1

$$\Sigma F_r = ma_r$$

$$\frac{GMm_1}{R_1^2} = m_1\left(\frac{V_1^2}{R_1}\right)$$

$$\sqrt{\frac{GM}{R_1}} = V_1$$

$\Longrightarrow$ For m_2

by analogy,

$$V_2 = \sqrt{\frac{GM}{R_2}}$$

② Now I need the ratio of their speeds, V_1/V_2:

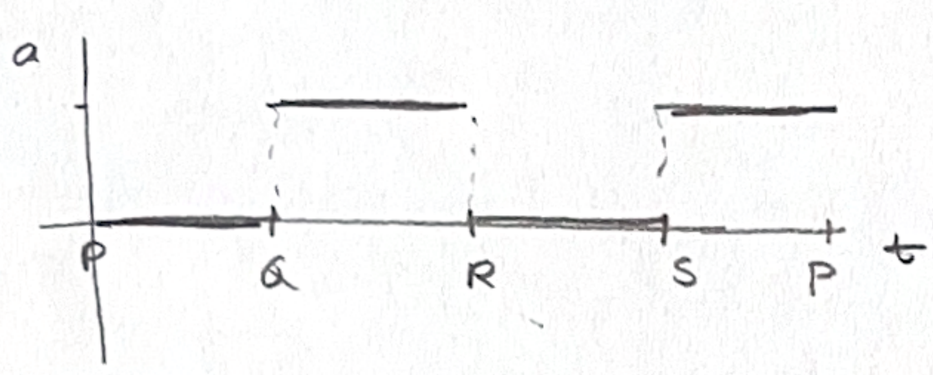
$$\frac{V_1}{V_2} = \sqrt{\frac{GM}{R_1}} \div \sqrt{\frac{GM}{R_2}}$$

$$= \sqrt{\frac{GM}{R_1}} \cdot \sqrt{\frac{R_2}{GM}}$$

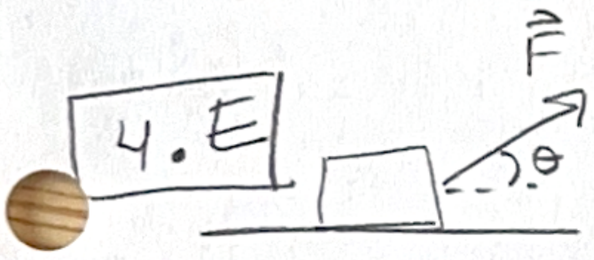
$$= \boxed{\sqrt{\frac{R_2}{R_1}}}$$

3.B

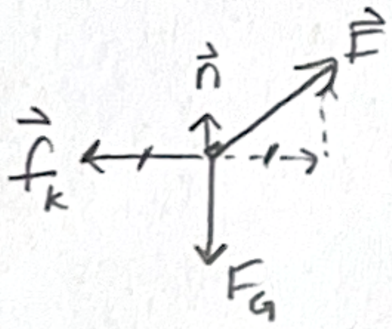
- on the straight-line segments, $\vec{a}=0$ because the velocity has constant magnitude and direction
- on the curved segments, there is an $\vec{a}$ toward the center of the circular arc. Its magnitude is $a_r = \frac{v^2}{r}$, and since v (speed) and r are constant, a_r has constant magnitude during the curved segments.



4.E



Newton's Laws



$\Sigma F_x = ma_x$

$F\cos\theta - f_k = m(0)$

$F\cos\theta = f_k$

$F\cos\theta = \mu_k n$

$F\cos\theta = \mu_k(mg - F\sin\theta)$

$\Sigma F_y = ma_y$

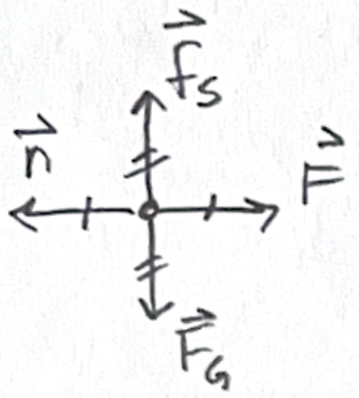
$F\sin\theta + n - mg = m(0)$

$n = mg - F\sin\theta$

$$\frac{F\cos\theta}{mg - F\sin\theta} = \mu_k$$

5. C

Newton's Laws / Static Equilibrium



$\Sigma F_x = ma_x$

$F - n = m(0)$

$F = n$

$F = \frac{mg}{\mu_s}$

$\Sigma F_y = ma_y$

$f_s - F_G = m(0)$

$f_s = mg$

$\mu_s n = mg$

$n = \frac{mg}{\mu_s}$

6. D

I is incorrect because it has the wrong directions for the forces. For example the force from the person on the wall would be →, not ←.

III is incorrect because weight cannot point up, and the floor is not in contact with the person.