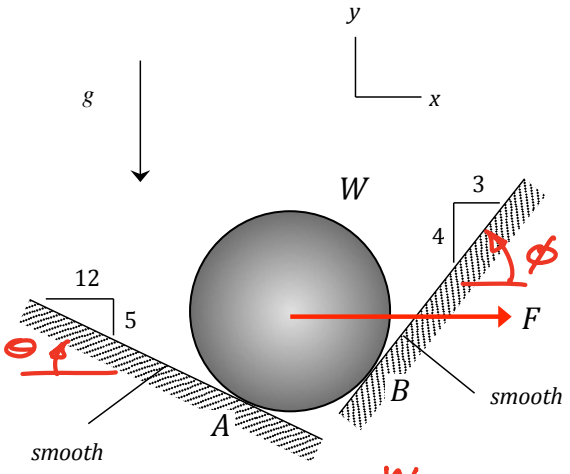
Quiz No. 2 ***Name*** SOLUTION

ME 270 – Summer 2023 – Prague

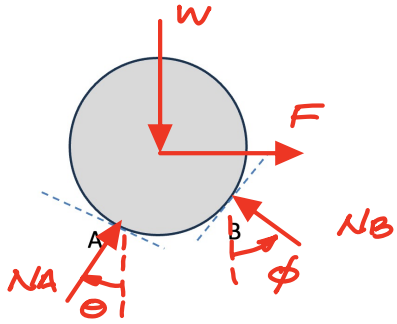
Given: A sphere, having a weight of *W*, is supported by two smooth, inclined surfaces. A horizontal force *F* acts at the center of the sphere, as shown. Let $W = 3F$.

Find: Determine the reaction forces acting on the sphere at A and B due to the inclined surfaces.



Solve:

<u>*Step 1 - FBD:*</u> Complete the free body diagram of the sphere in the figure provided to the right.



$\cos\theta = \frac{12}{13}$ $\cos\phi = \frac{3}{5}$

$\sin\theta = \frac{5}{13}$ $\sin\phi = \frac{4}{5}$

<u>*Step 2 - Equilibrium equations*</u>: Write down the two equilibrium equations from your FBD to the right.

(1) $\sum F_x = F + N_A \sin\theta - N_B \sin\phi = 0$

(2) $\sum F_y = -3F + N_A \cos\theta + N_B \cos\phi = 0$

<u>*Step 3*</u> - <u>*Solvability*</u>: Count the number of equations and the number of unknowns. Do you have a sufficient number of equations to find the unknowns in your equations?

2 eqns/2 unknowns (N_A and N_B)

<u>*Step 4 – Solve*</u>: Determine the reactions at A and B on the sphere. Express your answers in terms of *F* alone.

(1) $\Rightarrow N_B = \dfrac{F + N_A \sin\theta}{\sin\phi}$

(2) $\Rightarrow -3F + N_A \cos\theta + \left(\dfrac{F + N_A \sin\theta}{\sin\phi}\right)\cos\phi = 0$

$\hookrightarrow N_A = \dfrac{(3 - \cot\phi)F}{\cos\theta + \sin\theta\cot\phi}$

$= \left[\dfrac{3 - \frac{3}{4}}{\frac{12}{13} + \frac{5}{13}\frac{3}{4}}\right]F = \frac{13}{7}F$ ← N_A

$\therefore N_B = \dfrac{F + (\frac{13}{7}F)\frac{5}{13}}{4/5} = \frac{15}{7}F$ ← N_B