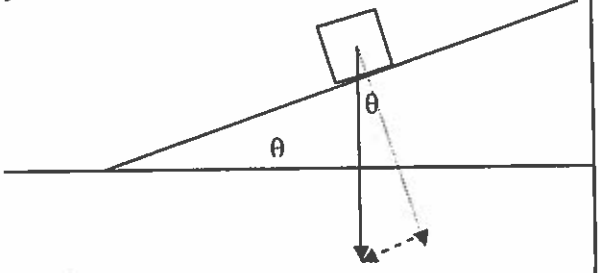
PHYSICS 12

FORCES ON AN INCLINED PLANE

- $\overrightarrow{F_N}$, $\overrightarrow{F_f}$ and $\overrightarrow{F_g}$ are acting on an object unless stated otherwise
- $\overrightarrow{F_N}$ is always perpendicular to the surface of contact ($\perp$)
- $\overrightarrow{F_f}$ is always parallel to the surface of contact (//) and it always opposes the motion

$\overrightarrow{F_g}$ is always directed to the center of the Earth = strictly vertically down

Consider an object on an inclined plane:



$\overrightarrow{F_g}$ must be resolved into its two components:

1. How does the angle of the inclined plane affect the magnitude of the $\overrightarrow{F_{g//}}$?

2. How does the angle of the inclined plane affect the magnitude of the $\overrightarrow{F_{g\perp}}$?

3. What angle of an inclined plane is desirable and reasonable in real-life situations? Give examples.

4. Consider three different inclined planes. Sketch $\overrightarrow{F_{g//}}$ *and* $\overrightarrow{F_{g\perp}}$ for three different inclined planes. How do the magnitude of $\overrightarrow{F_{g\perp}}$ and $\overrightarrow{F_{g//}}$ compare for the three different scenarios? At what angle is the magnitude the same? Make calculations for a 25.0-kg object.

	Scenario 1	Scenario 2	Scenario 3
Degree of inclination	15°	45°	65°
Magnitude of $\overrightarrow{F_{g\perp}}$			
Magnitude of $\overrightarrow{F_{g//}}$			
Practical use			

Free-Body Diagrams for objects on inclined planes:

- Object is not drawn on an angle
- The parallel and perpendicular components of the force of gravity are not drawn
- **The fact that the normal force and force or gravity vectors are NOT collinear is the indicator that the object lies on an inclined plane**
- It is a good habit to draw two diagrams; an FBD and a diagram that includes the inclined plane as well as the parallel and perpendicular components of the force of gravity

Which vector component of $\overrightarrow{F_g}$ decides the magnitude of $\overrightarrow{F_N}$?

? Which vector component of $\overrightarrow{F_g}$ decides the magnitude of $\overrightarrow{F_f}$?

? Which vector component of $\overrightarrow{F_g}$ decides the magnitude of the object's acceleration down the inclined plane?

? What other factors affect the object's acceleration? Explain.

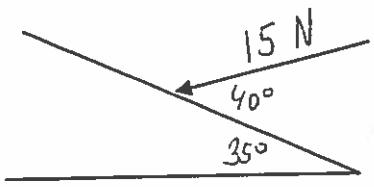
5. What do the magnitudes of $\overrightarrow{F_{net}}$, $\overrightarrow{F_{g//}}$, $\overrightarrow{F_f}$ and $\overrightarrow{F_N}$ relative to each other have to be in order for a stationary object to: **Draw FBDs that show the relative magnitude of all forces.**

a) Remain at rest?

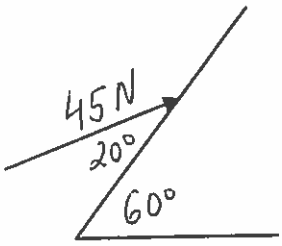
b) Start sliding down the plane?

Find components of the following forces acting on an inclined plane at an angle. One component has to be parallel (//) with the inclined plane and the other component has to be perpendicular to the surface of the inclined plane (⊥). (Hint: Construct a right triangle that has the given vector as a hypotenuse and place the right angle at the inclined plane)

a)



b)



c) Note that $\theta = \alpha$ whenever the force acting on the inclined plane is strictly vertical