Physics 2A
Fall 2024

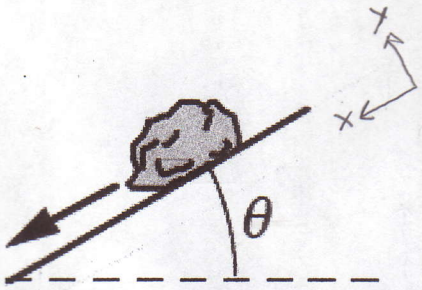
ave. = 5.3
σ = 2.8

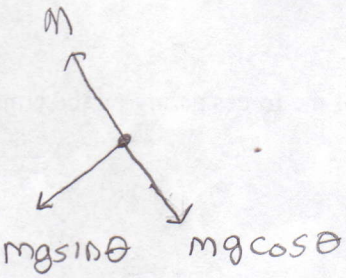
Name Answer Key

Lab: early late (please circle one)

Quiz #5: Applying Newton's Laws

Problem 1 (2 points)
A 2.0-N rock slides on a frictionless inclined plane. Which one of the following statements is true concerning the normal force that the plane exerts on the rock?





$\sum F_y = ma_y = 0$

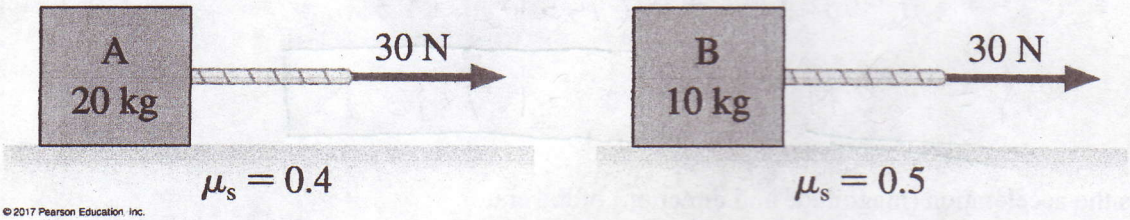
$n = mg\cos\theta$

E

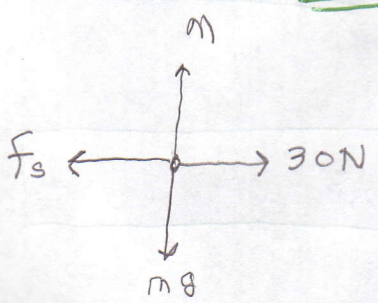
a) The normal force is zero newtons.
b) The normal force is 2.0 N.
c) The normal force is greater than 2.0 N.
d) The normal force *increases* as the angle of inclination, θ, is *increased*.
(e) The normal force is less than 2.0 N, but greater than zero newtons.

Problem 2 (3 points)
Boxes A and B in the figure below both remain at rest as a 30 N force is applied to each. Is the force of friction on box A greater than, less than, or equal to the force of friction on box B? *Explain your answer.*

$a_x = 0$



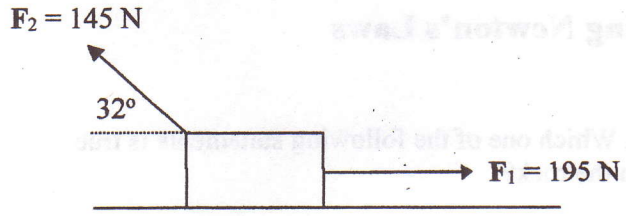
Force of friction on box A is equal to force of friction on box B. Since $a_x = 0 m/s^2$, $\sum F_x = 0$. Force of friction of each box is 30N.



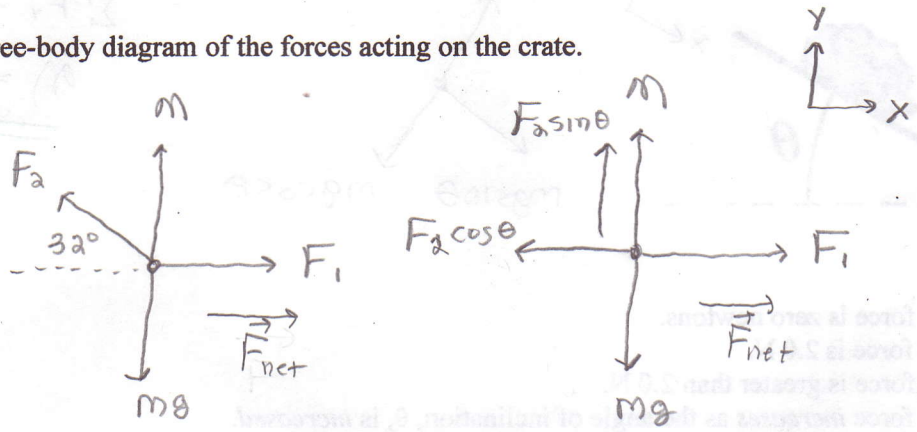
Note: $f_{s,max} > 30N$ for each box so boxes remain at rest.

Problem 3 (5 points)

A 25 kg crate on a frictionless surface is acted upon by two forces, F_1 and F_2, as shown in the figure below.



a) Draw a free-body diagram of the forces acting on the crate.



b) What is the normal force acting on the crate?

$$\sum F_y = ma_y = 0$$

$$n + F_2 \sin\theta - mg = 0 \rightarrow n = mg - F_2 \sin\theta$$

$$n = (25\,kg)(9.80\,m/s^2) - (145\,N)\sin 32^\circ$$

$$n = 168\,N \rightarrow \boxed{n = 1.7 \times 10^2\,N}$$

c) What is the acceleration (magnitude and direction) of the crate?

$$\sum F_x = ma_x$$

$$F_1 - F_2\cos\theta = ma_x \rightarrow a_x = \frac{F_1 - F_2\cos\theta}{m}$$

$$a_x = \frac{195\,N - (145\,N)\cos\theta}{25\,kg}$$

$$a_x = 2.88\,m/s^2 \rightarrow \boxed{a_x = 2.9\,m/s^2 \text{ to the right}}$$