

Name: _____

PHYS 1110-02 Quiz 2

You may use an 8.5"×11" note sheet written on both sides, a calculator of any type, and an autumn leaf. Please write your answers in the boxes provided. Show your work outside the boxes. If you wish to change an answer written in a box, thoroughly erase the unwanted answer and write the desired answer in its place. If a numerical answer is a physical quantity rather than a pure number, include the units with your answer.

“Multiple choice” questions, in which only one answer is correct, have circular bubbles (○): select exactly one choice. “Select all” questions, in which any number of the choices may be correct, have square bubbles (□): select all correct answers. Select your choice by filling the circle or square: please do not “X”, check, circle, or otherwise mark your choice. Do not mark bubbles for rejected options.

If the point value of a question is not indicated, it is worth one point.

Constants and equivalents

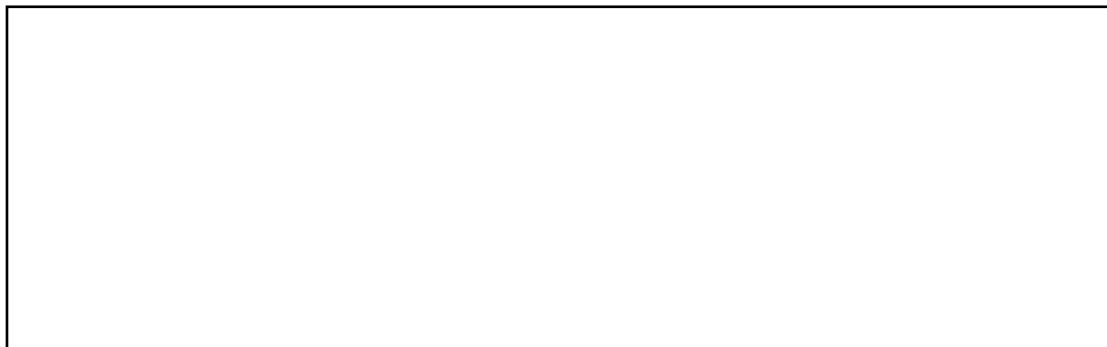
$g = 9.8 \text{ m/s}^2$	1 h = 60 min	1 min = 60 s	1 day = 24 h
1 in = 2.54 cm	1 ft = 12 in	1 m = 3.218 ft	1 mi = 5280 ft = 1609.3 m

Some metric prefixes

nano	n	$\times 10^{-9}$	deka	D	$\times 10^1$
micro	μ	$\times 10^{-6}$	hecta	h	$\times 10^2$
milli	m	$\times 10^{-3}$	kilo	k	$\times 10^3$
centi	c	$\times 10^{-2}$	mega	M	$\times 10^6$
deci	d	$\times 10^{-1}$	giga	G	$\times 10^9$

Questions

1. A trebuchet launches a boulder with an initial speed of 28.5 m/s at a launch angle of 55° above horizontal from a height of 6.00 meters above the ground. It fires at a castle wall 45.0 meters distant.
 - A. Draw a diagram of the situation. Include a set of (x, y) axes in which the y axis points upward and the x axis points in the direction toward the castle from the trebuchet.



B. What is the y component of the boulder's initial velocity?

C. What is the x component of the boulder's initial velocity?

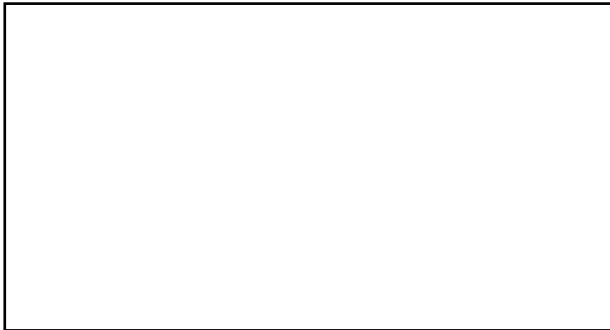
D. What is the x component of the boulder's acceleration while it is in the air?

E. What is the y component of the boulder's acceleration while it is in the air?

F. (5 points) How high above the ground is the boulder when it reaches the castle wall?

2. A 50-kilogram worker slides a 26-kilogram crate across a level floor. The worker pushes with a force in the direction that the box slides, at 20° below horizontal and with a magnitude of 80 newtons. Kinetic friction between the crate and the floor has a magnitude of 65 newtons.

A. (5 points) Draw a free body diagram for the crate, labeling all the forces applied to it. Next to the diagram, indicate the direction that the crate slides.



B. (5 points) What is the magnitude of the net force on the crate?

C. (3 points) What is the magnitude of the acceleration of the crate?

D. (2 points) What is the direction of the acceleration of the crate? Select all answers that apply by filling their bubbles.

- ☐ a. The same direction that the crate slides
- ☐ b. Opposite the direction that the crate slides
- ☐ c. Vertically upward
- ☐ d. Vertically downward
- ☐ e. Sideways, to the worker's right or left

E. (3 points) What is the magnitude of the crate's weight?

F. (2 points) What is the magnitude of the normal force exerted on the crate by the floor?

G. What is the direction of the force of friction acting on the crate? Select all answers that apply by filling their bubbles.

- ☐ a. The same direction that the crate slides
- ☐ b. Opposite the direction that the crate slides
- ☐ c. Vertically upward
- ☐ d. Vertically downward
- ☐ e. Sideways, to the worker's right or left

H. What is the coefficient of friction between the crate and the floor?

I. Is the friction acting between the crate and the floor static friction or kinetic friction?

- ☐ a. Static friction.
- ☐ b. Kinetic friction.

J. What object exerts the normal force acting on the crate?

K. What object exerts the force of the crate's weight?

L. One of the interactions involving the crate includes the crate exerting a vertically upward force on some other object.

i. (2 points) What is this other object?

ii. What is the magnitude of this vertically upward force?

3. Suppose that the crate of the previous problem is resting motionless on the floor, and the worker tries to move it by pushing with a force of 40 newtons, directed at 20° below horizontal. This time, the box does not budge (it remains motionless).

A. Is the friction acting between the crate and the floor static friction or kinetic friction?

☐ a. Static friction. ☐ b. Kinetic friction.

B. What is the magnitude of this force of friction?

4. (5 points) If the net force acting on a body is zero, what does that mean for the body's velocity? Select the most correct answer by filling its bubble.

- ☐ a. The body's velocity must be zero.
- ☐ b. If the body's velocity is not zero, its speed is decreasing.
- ☐ c. The body's velocity must be constant.
- ☐ d. The net force gives no information about the body's velocity.