

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
Department of Physics

Physics 8.01X

Fall Term 2002

## QUIZ 1

**Name:** \_\_\_\_\_

**Recitation Section:** \_\_\_\_\_

<b>Recitations:</b>	R01 TR 10-11	26-168	D. Litster
	R02 TR 11-12	26-168	D. Litster
	R03 TR 1-2	24-402	G. Roland
	R04 TR 2-3	24-402	G. Roland
	R05 TR 3-4	24-402	F. Zhou
	R06 TR 10-11	26-210	M. Borthwick
	R07 TR 11-12	26-210	M. Borthwick

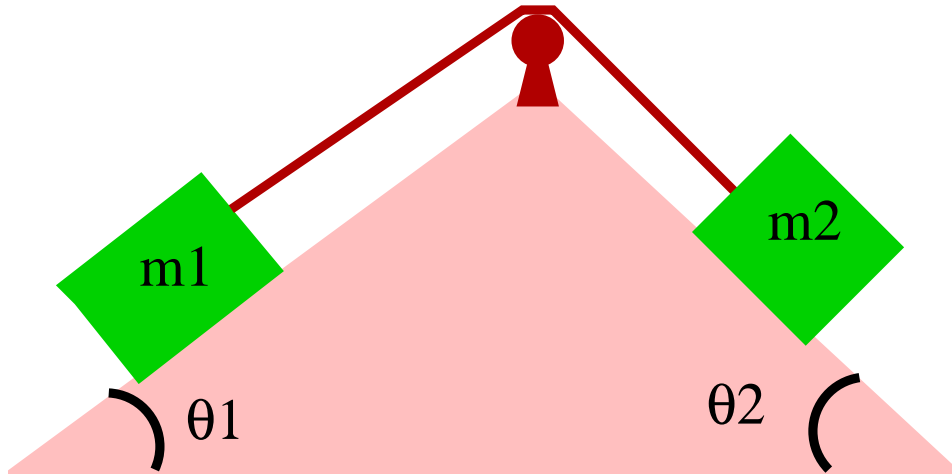
**Problem 1:** (40 points) \_\_\_\_\_

**Problem 2:** (30 points) \_\_\_\_\_

**Problem 3:** (30 points) \_\_\_\_\_

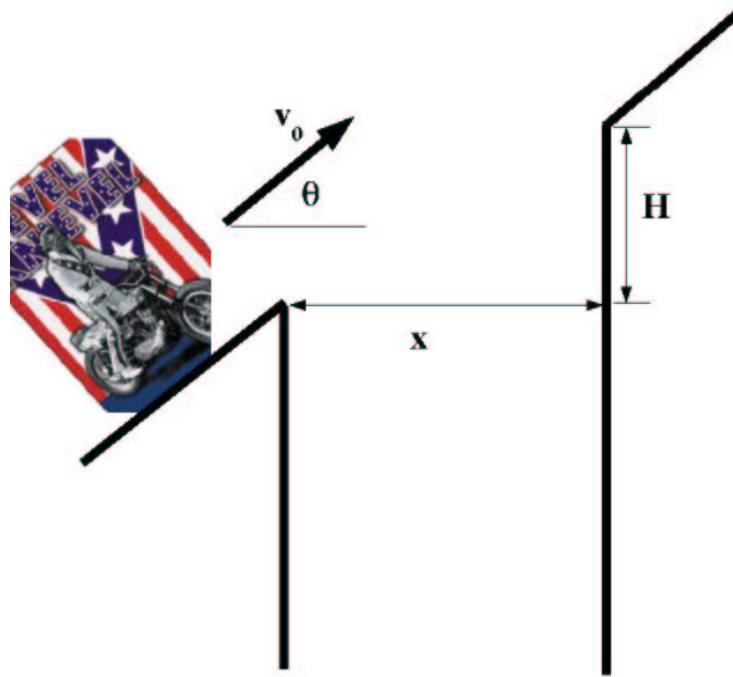
**Total:** (100 points) \_\_\_\_\_

The following exam consists of three problems on 8 pages including this one. Answers without work will not be given any credit.



**Problem 1:**

- (8 points) Two masses slide on frictionless inclines. Draw a force diagram for each mass.
- (8 points) If  $m_1 = 8$  kg, and  $m_2 = 10$  kg,  $\theta_1 = 40^\circ$  and  $\theta_2 = 50^\circ$ , find the acceleration of the masses.
- (8 points) What is the tension in the rope?
- (8 points) Suppose the blocks are held at rest and then released at time  $t = 0$ . How far have they traveled after 1 second?
- (8 points) The two masses are replaced by  $m_1$  and  $m_2$  such that there is no acceleration. Find whatever information you can about the two replacement masses.



**Problem 2:**

Evil Knievel takes off from a ramp on his motorcycle at angle  $\theta$  to clear a canyon of width  $x$  and land on the other side, which is elevated at a height  $H$  with respect to the side Evil jumps from.

- (6 points) Write an expression for time the motorcycle is in the air in terms of  $x$ ,  $v_0$  and  $\theta$ .
- (8 points) Write an expression for the vertical distance  $y$  reached by the motorcycle when it has traversed a distance  $x$ , in terms of  $x$ ,  $g$ ,  $v_0$  and  $\theta$ .
- (8 points) For a given angle  $\theta$  and distance  $x$ , what is the upper limit on  $H$  such that the motorcycle has any chance of making the jump?
- (8 points) For  $H$  less than this upper limit, what is the minimum takeoff speed  $v_0$  for a successful jump? Neglect the size of the motorcycle and assume that covering the horizontal distance  $x$  and a vertical distance  $H$  is sufficient to clear the canyon. Answer in terms of  $x$ ,  $g$ ,  $H$  and  $\theta$ .

**Problem 3:**

- a. (15 points) In experiment ES, the voltage across the capacitor is given by

$$V_{cap}(t) = V_{cell} \left(1 - e^{-\frac{t}{RC}}\right). \quad (1)$$

Using the values  $V_{cell} = 2.2 \text{ V}$ ,  $R = 20 \text{ M}\Omega$  and  $C = 10^{-6} \text{ F}$ , approximately how long does it take for the voltage across the capacitor to reach 160 mV? Briefly explain any approximations you have made.

b. (15 points) In experiment FO, suppose the wire nut falls 6.5 cm and the average voltage measurement across the capacitor is 64 mV. In a second trial the wire nut falls 18 cm. What average voltage reading do you expect across the capacitor?