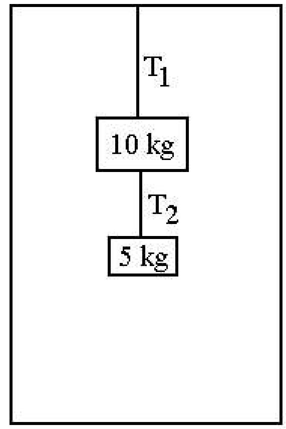
Sample Exam II

MULTIPLE CHOICE (4 pts each)

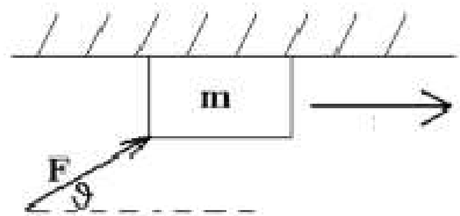


1) Consider the two masses (m_1 = 10 kg, m_2 = 5 kg) hanging as shown in an elevator. What is the tension in each rope as the elevator accelerates downward at 3 m/s^2? Let g = 10 N/kg.

   A) T_1 = 105 N; T_2 = 35 N
   B) T_1 = 195 N; T_2 = 65 N
   C) T_1 = 100 N; T_2 = 50 N
   D) T_1 = 150 N; T_2 = 50 N
   E) None of the answers above is correct.

2) Choose the answer which bests completes the sentence:
   If an object is at rest, then

   A) no forces act on the object.
   B) any forces which form Third Law pairs cancel each other out.
   C) the mass of the object must be very large.
   D) the sum of all forces acting on the object must be zero.
   E) the weight and the normal force must be equal in magnitude and opposite in direction.



3) Consider a block of mass m which is just about to slide along the ceiling, as shown. The coëfficient of static friction between block and ceiling is μ_S. Which of the following sets of equations follow from Newton's second law?

A) $F \sin\theta + mg - F_N = 0$	$F \cos\theta + F_f = 0$	$F_f = \mu_S F_N$
B) $F \cos\theta - mg - F_N = 0$	$F \sin\theta + F_f = 0$	$F_f = \mu_S F_N$
C) $F \cos\theta - mg + F_N = 0$	$F \sin\theta - F_f = 0$	$F_f = \mu_S F_N$
D) $F \sin\theta - mg - F_N = 0$	$F \cos\theta - F_f = 0$	$F_f = \mu_S F_N$
E) $F \sin\theta - mg + F_N = 0$	$- F \cos\theta - F_f = 0$	$F_f = \mu_S F_N$

4) Suppose you would like to launch a satellite so that it orbits the earth in a circle just above the surface (ignore inconvenient considerations such as air resistance and irregular topography). What would the speed of the satellite need to be? The radius of the earth is $6.4\times10^{+6}$ m.

   A) $6.4\times10^{+7}$ m/s
   B) 8000 m/s
   C) 2500 m/s
   D) 800 m/s

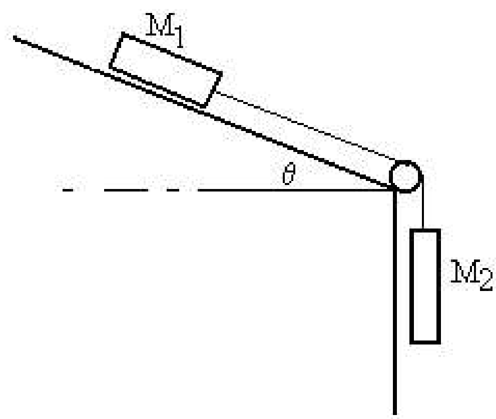
E) 10 m/s

N.B.: If you're rusty on scientific notation, remember that $6.4 \times 10^{+6} = 6{,}400{,}000$.

5) The most expensive production automobile ever is the *Veyron* by Volkswagen (cost = \$6 million each). The Veyron can slow from 110 m/s to a stop in 10 seconds on a flat road, *i.e.*, it can decelerate at 11.1 m/s^2. Assuming that this is due entirely to the brakes (it's not), what minimum coëfficient of static friction between road and tires will allow this? Pick the closest value.

   A) 0
   B) 0.25
   C) 0.9
   D) 1.1
   E) 2.6

PROBLEM I (20 pts)



Consider the two masses ($M_1 = 2$ kg, $M_2 = 5$ kg) as shown, one of which is on a smooth surface inclined at an angle of $\theta = 30°$ from the horizontal.

A) What is the acceleration of the masses? (15 pts)

B) Find the tension in the string. (5 pts)

PROBLEM II (20 pts)

Billy decides to boat 2000 m downstream and back. His mom tells him he must be back within an hour (= 3600 seconds). The river flows at 1 m/s relative to the ground and Billy's boat moves at 3.0 m/s relative to the water.

A) How much time will it take Billy to travel the 2000 m downstream?

B) How much of his 60 minutes remain for the return trip upstream?

C) With what velocity relative to the water would Billy's boat need to move to return on time? Can he make it back in time?

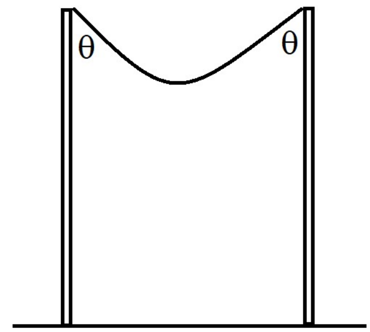
PROBLEM III (20 pts)

Commander Buzz Kutter is floating in space 50 meters from the open airlock of his spaceship, the

Lazy Star. The only thing in his possession not immediately needed for survival is a hammer. Outline a procedure that might allow Kutter to return to his ship. Explain fully.

PROBLEM IIII (20 pts)

A uniform string of mass M hangs between the tops of two poles of equal height. At each end, the string makes an angle θ with the pole, as shown. Find the tension in the string at its center.



HINT: Here's a problem where the tension in a string is NOT the same along its length. It is not massless.