

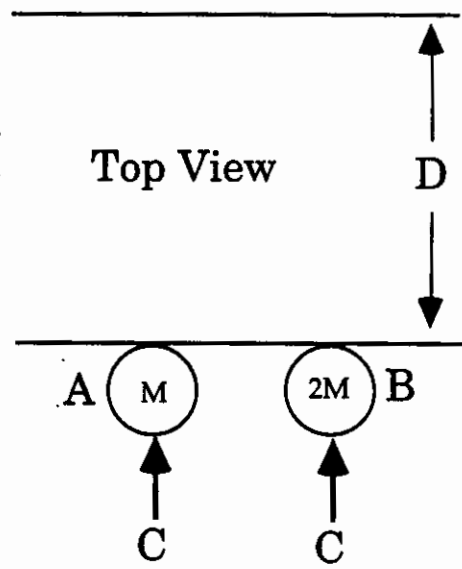
# 8.01L Fall 2005 Exam 2 Samples


**For each question, your answer will be one of the following:**

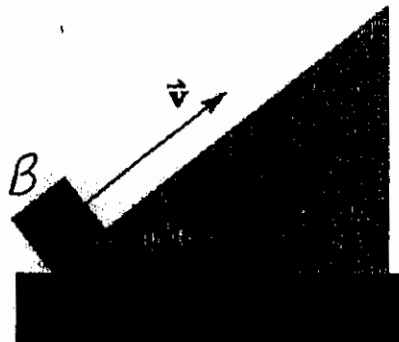
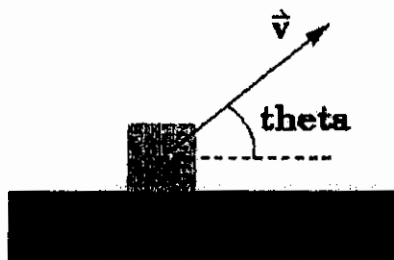
- a) Object A    b) Object B  
c) Both are the same                                      d) Can't answer  
without further information →

Chose answer (d) if you can't answer without further information (i.e. you need other parameters or you need to know the numerical values of the parameters).

Two objects (Object A with mass  $M$  and object B with mass  $2M$ ) are each acted on by a force of magnitude  $C$ . Both objects start at rest and they both move a distance  $D$  along a horizontal, frictionless surface.



- i) Which object moves the distance  $D$  in the smallest time?
- ii) When they reach the distance  $D$ , which object has the larger kinetic energy?
- iii) Suppose we now add kinetic friction with coefficient  $\mu$  to the surface. Now, which object has the larger kinetic energy at the distance  $D$ ?
- 



Now consider the situation shown in the figure. Object A is launched as a projectile with initial speed  $v$  at an angle  $\theta$  above the horizontal. Object B has exactly the same initial speed at exactly the same angle as object A but object B is sliding up a frictionless incline. As before, object A has mass  $M$  and object B has mass  $2M$ .

- iv) During the subsequent motion, each object will reach a maximum height above the starting location. At its maximum height, which object has the larger kinetic energy?
- v) During the subsequent motion, each object will reach a maximum height above the starting location. Which object has the larger maximum height?

Massachusetts Institute of Technology  
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Physics 8.01L

SAMPLE EXAM 2

SOLUTIONS

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**Problem 1**

- i) a) Object  $A$  Same force, smaller mass, so  $A$  has a bigger acceleration and moves the same distance in a shorter time.  
 ii) c) Both are the same. Same force, same distance, so the same change in kinetic energy.  
 iii) a) Object  $A$ . Smaller mass so smaller normal force, therefore smaller friction. Net force is larger on  $A$ , so it gains more kinetic energy.  
 iv) a) Object  $A$ .  $B$  moves up and stops completely. At its maximum height,  $A$  still has horizontal motion.  
 v) b) Objects  $B$  They start with the same kinetic energy (KE).  $B$  converts all of its KE to gravitation potential energy (PE), while  $A$  always has some non-zero KE.

**Problem 2**

~~A) iv) Same force by Newton's 3rd law.~~

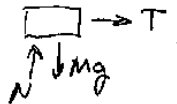
~~B) iv) None of the above.  $N_A - M_A g - F = -M_A a$ ,  $\Rightarrow N_A = M_A g + F - M_A a$~~

~~C) iii) Less than  $m_A g$  but not zero.  $T - M_A g = -M_A a$ ,  $T = M_A(g - a)$~~

~~D) iv) Normal force does work and creates PE.  $N$  points up, motion is up  $\Rightarrow$  + Work KE is constant, but PE rises.~~

**Problem 3**

a)



~~$a = \frac{v^2}{R}$ ,  $v = \frac{2\pi R}{\tau}$~~

~~b)  $a = \frac{v^2}{R} = \frac{4\pi^2 R}{\tau^2}$  Spring is stretched a distance  $R$  so:~~

~~$T = kR = ma = m \left( \frac{4\pi^2}{\tau^2} \right) R$ ,  $R$  drops out.~~

~~$\tau = 2\pi \sqrt{\frac{m}{k}}$~~

**Problem 4**

a)

