



Physics Olympiad and Problem Solving Programs
N210 - Introductory Physics Olympiad
Problem Set 9.2 - Mock Exam: Newton's Law and Frictions Solutions
Name: _____ Date: _____

Instruction: This is a self-proctored, *closed-book* mock exam. You have 20 minutes to answer the following questions.

1. **D**. The force must overcome the static friction. $F = \mu_s mg = (0.5)(100)(10) = \boxed{500 \text{ N}}$.
2. **C**. Since the object is accelerating, we have $F > \mu_k mg$. When the object is stopped, it is not moving when pushed. Thus, $F \leq \mu_s mg$.
3. **E**. To maintain the constant speed, the force must be the same as the friction. $F = \mu_k mg = (0.5)(10)(10) = \boxed{50 \text{ N}}$.
4. **E**. Let the mass of body 1 be m , the mass of body 2, $2m$. Let the force on body 2 be F , the force on body 1 is $4F$. With $F = ma$, we have $a = \frac{F}{m}$. Thus, $\frac{a_1}{a_2} = \frac{F_1/m_1}{F_2/m_2} = \frac{4/1}{1/2} = \frac{8}{1}$. So, the ratio is 8 : 1.
5. **B**. There are two forces on the body so $F - f = ma$ or $a = \frac{F - \mu mg}{m} = \frac{5 - (0.3)(1)(10)}{1} = \boxed{2 \text{ m/s}^2}$.
6. **C**. Since the objects are in balance, the tension in the string must equal to the weight of the body. So, $T = 100 \text{ N}$. Note that the tension in the string that holds the pulley will be $2T = 200 \text{ N}$.
7. **C**. $N - W = ma$ so $a = \frac{N - W}{m} = \frac{520 - 500}{50} = \boxed{0.4 \text{ m/s}^2}$.
8. **C**.