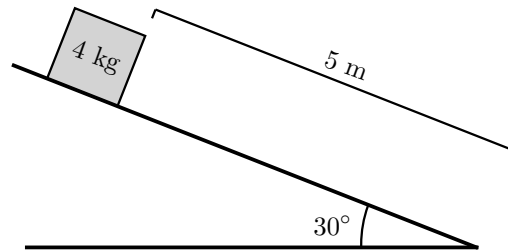


Instructions: (60 points) The Exam is divided into two parts: a 35-question multiple-choice section and a four-question free-response section; the two sections are weighed equally.

Use the blank spaces provided on the exam to fully answer the following questions. **SHOW ALL OF YOUR WORK.**

Note: You may continue to use $g = 10 \text{ m/s}^2$ and $k = 9(10^9) \text{ N} \cdot \text{m}^2/\text{C}^2$ if you prefer.

- (15^{pts}) 1. A 4 kg block slides down a 10 m long ramp inclined to an angle to 30° .



15 pts

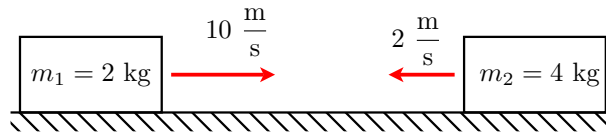
- (a) (2 pts) How much energy is initially stored in the system?
- (b) (5 pts) Assuming a frictionless surface, how fast would the box be moving when it reaches the bottom of the ramp?
- (c) (4 pts) Due to friction, the box reaches the bottom of the ramp with a speed of only $5 \frac{\text{m}}{\text{s}}$. How much work was done by friction?
- (d) (4 pts) What was the average frictional force exerted on the box as it slid down the ramp?

15 pts

- (15^{pts}) **2.** A 2 kg block slides to the right across a frictionless surface with an initial speed of $10 \frac{\text{m}}{\text{s}}$ and collides with a 4 kg block initially traveling to the left with an initial speed of $2 \frac{\text{m}}{\text{s}}$. The 2 kg and 4 kg blocks stick together after the collision.

15 pts

Before The Collision:

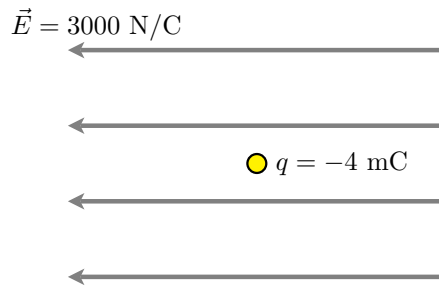


- (a) (3 pts) How fast are the two blocks moving after the collision?
- (b) (1 pt) In what direction are the two blocks moving after the collision?
- (c) (2 pts) What was the impulse exerted on the 4 kg block?
- (d) (1 pt) What was the impulse exerted on the 2 kg block? (You do not need to show any work to answer this problem.)
- (e) (3 pts) Suppose the two boxes are in contact for only 0.02 s during the collision. What is the magnitude of the average force exerted by the 2 kg block on the 4 kg block?
- (f) (1 pt) What type of collision is this?
- (g) (4 pts) How much energy is lost during the collision?

15 pts

(15^{pts}) 3.

A 3 kg object with a charge of -4 mC is placed in a 3000 N/C electric field as shown in the figure below.

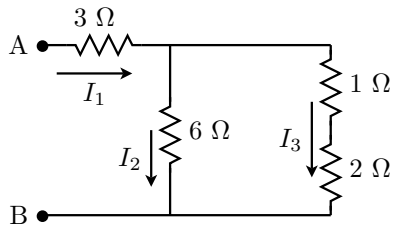


15 pts

- (a) (1 pt) In what direction will the electrostatic force point?
- (b) (2 pts) What is the magnitude of the electrostatic force?
- (c) (4 pts) If the object starts from rest, how fast will it be moving after it travels 2 m?
- (d) (8 pts) Through what change in voltage did the object move in part (c)?

15 pts

(15^{pts}) 4. Consider the circuit shown below.



15 pts

(a) (5 pts) What is the equivalent resistance between points A and B?

(b) (10 pts) Suppose a 10 V battery is connected between points A and B. Calculate I_1 , I_2 , and I_3 when a 10 V battery is connected.

15 pts