A cart with competing forces

Forces and motion | constructed motion data

Name _____ Date _____

A 4 kg cart has a 20 N force east and an 8 N force west. Neglect other horizontal forces and treat mass as constant.

1. Represent the forces and find net force and acceleration.

2. Explain why a westward force does not by itself establish westward motion.

3. Describe a measurement that could test the predicted acceleration.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A landing pad that spreads a stop

Momentum and design | constructed force-time models

Name _____ Date _____

A falling test object lands on two pads. Pad A produces an idealized triangular force-time pulse with base 0.04 s and peak 800 N. Pad B produces a triangular pulse with base 0.08 s and peak 400 N. Treat the curves as net stopping force for this model.

1. Compare impulses using the areas.

2. Choose a pad if reducing peak force is the design criterion, and justify the role of time.

3. State a condition needed before applying the comparison to another object.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Energy before the gate

Energy accounting | constructed energy budget

Name _____ Date _____

A cart starts with 120 J of mechanical energy. During travel, 30 J transfers to thermal energy through friction. At a lower gate its gravitational potential energy is 20 J. Account for the cart-track system and surroundings as specified.

1. Find kinetic energy at the gate.

2. Explain where the 30 J belongs in the energy account.

3. Describe how the prediction changes if frictional transfer doubles with the same initial state.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Two lamps on a supply

Electrical energy | constructed circuit

Name _____ Date _____

Two ideal resistors, 6 ohms and 3 ohms, are connected in parallel to a 12 V ideal supply. Ignore wire resistance.

1. Calculate each branch current and total current.

2. Calculate the total power and energy delivered in 10 seconds.

3. Explain what happens to the first branch current if the second branch is removed under the ideal-source assumption.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A wave crosses a boundary

Waves | constructed wave data

Name _____ Date _____

A repeating source makes waves at 5 Hz. In medium A their speed is 20 m/s. In medium B their speed is 10 m/s. The source frequency stays fixed at the boundary.

1. Find wavelength in each medium.

2. Explain which property is held constant and how the model links the other two.

3. Identify a measurement that would test the prediction.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Two nuclear representations

Nuclear processes | constructed particle model

Name _____ Date _____

Model A shows one heavy nucleus splitting into two lighter nuclei and free neutrons. Model B shows two light nuclei combining into a heavier nucleus. In each case, the total rest mass of final products is slightly lower, and the mass-energy difference is released.

1. Distinguish the processes.

2. Explain the energy release with a conservation account.

3. Identify a quantity that must balance when writing a particular nuclear equation.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.