Forces in Place

Read each situation, then model the forces on one object.

P.2.c "Create free and fixed body diagrams to model all the forces acting on a single object."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each contact between objects in the passage. Circle each place where the passage tells you to ignore a possible force.

A Force Check at the Test Station

1. Engineers use two sketches to track pushes and pulls on one object. In a free-body diagram, replace the object with a dot and draw one arrow for each external force. Label each arrow and point it in the force's direction. In a fixed-body diagram, keep the object's outline and put contact-force arrows where other objects touch it. Draw gravity at the object's center of mass in either sketch. For example, a lantern hanging from one vertical cord has an upward cord force and downward gravity. Do not add a force just because the lantern could move in that direction.

2. At a test station, a worker pushes a crate to the right across a level floor. The crate touches the worker's hand on its left side. The floor is smooth enough that friction can be ignored. Nearby, a puck slides down a smooth ramp that slopes downward to the right. The puck touches only the ramp, which exerts a force perpendicular to its surface. Neither object has a rope attached. Ignore air resistance in both cases. These notes identify each object's contacts, not every arrow students will need to draw. Gravity acts on the crate and the puck, too.

3. Across the room, a bucket hangs freely from two taut ropes. One rope runs from the bucket's left handle upward to the left; the other runs from its right handle upward to the right. No floor or wall touches the bucket. Outside, a sled slides to the right over rough, level snow while a person pulls it with a rope angled upward to the right. The rope is tied to the front of the sled. The snow touches the sled underneath and resists its sliding motion. Ignore air resistance for the bucket and sled. Neither object has any other contact.

2 ANSWER WITH EVIDENCE

Use the passage

1. For the crate, list and label every arrow in a free-body diagram. Give each arrow's direction.

2. For the puck, describe every arrow in a fixed-body diagram. Give its direction and where it starts.

3. For the bucket, describe every arrow in a fixed-body diagram. Give its direction and where it starts.

4. For the sled, list every force and its direction. Where would each arrow start in a fixed-body diagram?

3 YOUR TURN

Your own words

Invent a new situation with one object, exactly two contacts, and no air resistance. Draw its labeled free-body diagram and fixed-body diagram in separate panels, then write one sentence naming both contacts.

Forces in Place

PART 1 · READ AND MARK

Underline each contact between objects in the passage. Circle each place where the passage tells you to ignore a possible force. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	For the crate, list and label every arrow in a free-body diagram. Give each arrow's direction.	**Hand force right, floor's normal force up, and gravity down.**
2	For the puck, describe every arrow in a fixed-body diagram. Give its direction and where it starts.	**Draw the ramp's normal force at the puck's contact with the ramp, pointing up and right, perpendicular to the ramp. Draw gravity at the puck's center of mass, pointing down.**
3	For the bucket, describe every arrow in a fixed-body diagram. Give its direction and where it starts.	**Draw a rope force up and left at the left handle and another up and right at the right handle. Draw gravity down at the bucket's center of mass.**
4	For the sled, list every force and its direction. Where would each arrow start in a fixed-body diagram?	**Rope force up and right at the front tie point; snow's normal force up and friction left at the underside; gravity down at the center of mass.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Situation: A hand presses straight down on a book resting on a level, frictionless table. Free-body panel: A dot has three labeled arrows, hand force down, table normal force up, and gravity down. Fixed-body panel: A book outline has hand force down at the top, table normal force up at the bottom, and gravity down at its center of mass. The book touches the hand and the table.

Accept equivalent force names, such as weight for gravity. For fixed-body diagrams, check that contact forces start where contact occurs and gravity starts at the center of mass.