Newton’s Laws Worksheet (p. 1)
Show “K-U-E-S” where necessary, otherwise answer completely.

1. Consider hitting a baseball with a bat. If the force of the bat pushing on the ball is the action force, what is the reaction force?

2. Do action and reaction pairs of forces cancel/balance one another?

3. As you sit in a chair, does the chair exert an upward force against your derriere (*French for behind*). How much force does the chair exert? In what direction?

4. Consider the forces acting on you as you sit in your seat, the downward pull of gravity and the upward support of your seat. Are these forces equal and opposite? How do you know? Do they form an action - reaction pair? Explain.

5. For each of the following forces, what is the equal and opposite force required by Newton's third law? (a) The force of a hammer on a nail. (b) the force of gravity pulling down on a book? (c) the force of a helicopter blade pushing down on the air. (d) the force of air resistance acting on a falling baseball.

6. Which is more fundamental, mass or weight? Does an object with mass have weight? Does an object with weight have mass?

7. Could an object have mass without having weight? Could an object have weight without having mass?

8. Why does a 2 kg brick have twice the inertia of a 1 kg brick?

9. In the orbiting space station you are handed two identical boxes, one filled with sand the other filled with feathers. How can you tell which is which without opening the boxes?

10. Why is a massive cleaver more effective for chopping vegetables than an equally sharp and less massive knife?

11. When tearing a paper towel or plastic bag from a roll, why is a sharp jerk more effective than a slow pull?

12. Since the earth rotates once every 24 hours, the western wall in the classroom moves in a direction towards you at a linear speed that is about 1000 km/h. When you stand facing the wall you are carried along at the same speed, so you don't notice it. But when you jump upward, with your feet no longer in contact with the floor, why doesn't the wall slam into you at about 1000km/h?

13. Can an object round a curve without any force acting upon it? Explain

14. You have to exert a steady force of 20 pounds to pull a wagon west across the lawn with a constant velocity. What force is balancing your pulling force? How much force is there?

16. You find an object that is not moving and you know it is being acted on by a force, how do you explain this to your confused friend?

Newton's Laws Worksheet (p. 2)
Show "K-U-E-S" where necessary, otherwise answer completely. **All work needs to be done on your own paper.**

18. A cart is pulled to the left with a force of 100.0 N, and to the right with a force of 30.0 N. What is the net force on the cart? *70 N left*

19. Four people pulling on an object with the following forces: 45.0 lb east, 70.0 lb north, 20.0 lb west, 155.0 lb south. What is the net force on the object? *88.6 lb southeast*

20. If the net force on a sliding block is tripled, by how much does the acceleration increase?

21. If the mass of a sliding box is tripled while a constant force is applied, by how much does the acceleration decrease?

22. If the mass of a moving object is tripled just as the net force on it is tripled, how is the acceleration affected?

23. Find the acceleration of a 2,000.0 kg, single engine airplane just before takeoff when the force of the engine is 500.0 N forward. *0.2500 m/s^2*

24. What is the acceleration of a 39,690 kg jumbo jet just before takeoff if each of its four engines produces 281,570 N of force. *28.38 m/s^2*

25. Calculate the acceleration if you push with a 30 N horizontal force on a 2 kg block of wood on a friction-free air table. *20 m/s^2*

26. What is the mass of a kiwi fruit thrown with an acceleration of 1.42 m/s^2? The thrower applied a force of 0.35 N to the kiwi fruit. *0.25 kg*

27. Calculate the horizontal force that must be applied to produce an acceleration of 9.8 m/s^2 for a 1.0 kg puck experiencing no friction. *9.8 N*

29. You hold an apple over your head. (a) Identify all the forces acting on the apple and their reaction forces. (b) When you drop the apple, identify all the forces acting on it as it falls and the corresponding reaction forces. (c) Identify the forces on the apple when it hits the ground. What force causes the apple to stop?

30. If a Mack truck and a Honda Civic have a head-on collision, upon which vehicle is the impact force greater? Which vehicle experiences the greater acceleration? Explain each answer.

31. Which team wins in a tug-of-war; the team that pulls harder on the rope , or the team that pushes harder on the ground? Explain.

32. A horse pulls a heavy wagon with a certain force. The wagon, in turn, pulls back with an opposite but equal force on the horse. Doesn't this mean the forces cancel one another, making acceleration impossible? Why or why not?

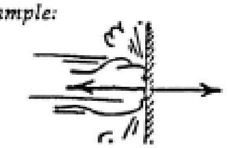
Name Period Date

Concept-Development Practice Page **6-1**

Newton's Third Law

33. In the example below, the action-reaction pair is shown by the arrows (vectors), and the action-reaction described in words. In *(a)* through *(g)* draw the other arrow (vector) and state the reaction to the given action. Then make up your own example in *(h)*.

Example:

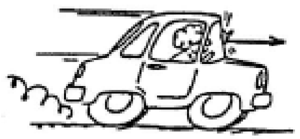


Fist hits wall.

Wall hits fist.

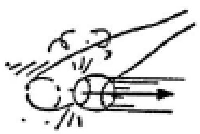
Head bumps ball.

(a) ____________



Windshield hits bug.

(b) ____________

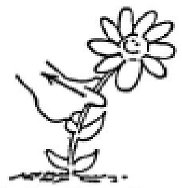


Bat hits ball.

(c) ____________

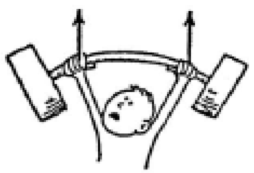
Hand touches nose.

(d) ____________



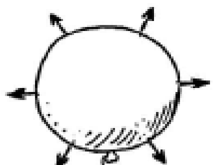
Hand pulls on flower.

(e) ____________



Athlete pushes bar upward.

(f) ____________

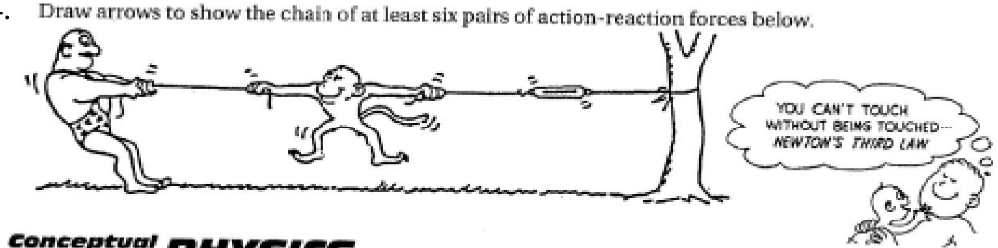


Compressed air pushes balloon surface outward.

(g) ____________

(h) ____________

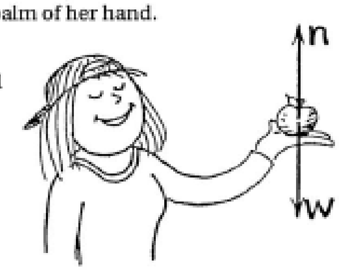
34. Draw arrows to show the chain of at least six pairs of action-reaction forces below.



Conceptual PHYSICS

Newton's Third Law

35. Nellie Newton holds an apple weighing 1 newton at rest on the palm of her hand. The force vectors shown are the forces that act on the apple.



a. To say the weight of the apple is 1 N is to say that a downward gravitational force of 1 N is exerted on the apple by
(the earth) (her hand).

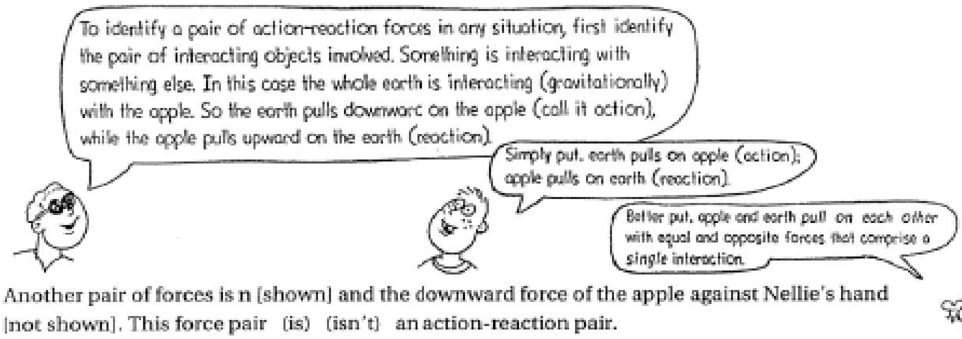
b. Nellie's hand supports the apple with normal force **n**, which acts in a direction opposite to **W**. We can say **n**
(equals W) (has the same magnitude as W)

c. Since the apple is at rest, the net force on the apple is (zero) (nonzero).

d. Since **n** is equal and opposite to **W**, we (can) (cannot) say that **n** and **W** comprise an action-reaction pair. The reason is because action and reaction always
(act on the same object) (act on different objects),
and here we see **n** and **W**
(both acting on the apple) (acting on different objects).

e. In accord with the rule, "If ACTION is A acting on B, then REACTION is B acting on A," if we say *action* is the earth pulling down on the apple, *reaction* is
(the apple pulling up on the earth) (**n**, Nellie's hand pushing up on the apple).

f. To repeat for emphasis, we see that **n** and **W** are equal and opposite to each other
(and comprise an action-reaction pair) (but do *not* comprise an action-reaction pair).



g. Another pair of forces is **n** [shown] and the downward force of the apple against Nellie's hand [not shown]. This force pair (is) (isn't) an action-reaction pair.

h. Suppose Nellie now pushes upward on the apple with a force of 2 N. The apple
(is still in equilibrium) (accelerates upward), and compared to **W**, the magnitude of **n** is
(the same) (twice) (not the same, and not twice).

i. Once the apple leaves Nellie's hand, **n** is (zero) (still twice the magnitude of W),
and the net force on the apple is (zero) (only W) (still W - **n**, which is a negative force).

Conceptual PHYSICS

Name Period Date

Concept-Development Practice Page 4-1

36. (*Circle the correct answer.*) An astronaut in outer space away from gravitational or frictional forces throws a rock. The rock will

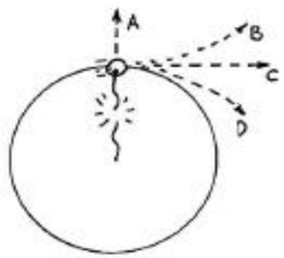
(gradually slow to a stop)

(continue moving in a straight line at constant speed)

The rock's tendency to do this is called

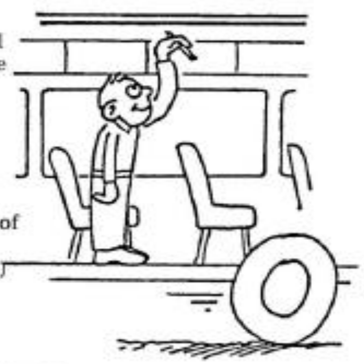
(inertia) (weight) (acceleration)

37. The sketch shows a top view of a rock being whirled at the end of a string (clockwise). If the string breaks, the path of the rock is



(A) (B) (C) (D)

38. Suppose you are standing in the aisle of a bus that travels along a straight road at 100 km/h, and you hold a pencil still above your head. Then relative to the bus, the velocity of the pencil is 0 km/h, and relative to the road, the pencil has a horizontal velocity of



(less than 100 km/h) 100 km/h) (more than 100 km/h)

Suppose you release the pencil. While it is dropping, and relative to the road, the pencil still has a horizontal velocity of

(less than 100 km/h) (100 km/h) (more than 100 km/h)

This means that the pencil will strike the floor at a place directly

(behind you) (at your feet below your hand) (in front of you)

Relative to you, the way the pencil drops

(is the same as if the bus were at rest)

(depends on the velocity of the bus)

How does this example illustrate the law of inertia?

____

____

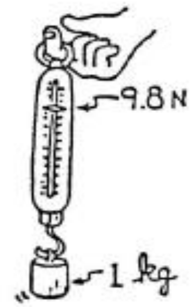
____

Conceptual PHYSICS

39. Use the words *mass, weight,* and *volume,* to complete the table.

The force due to gravity on an object	
The quantity of matter in an object	
The amount of space an object occupies	

40. Different masses are hung on a spring scale calibrated in newtons.



The force exerted by gravity on 1 kg = 9.8 N.

The force exerted by gravity on 5 kg = ______ N.

The force exerted by gravity on ______ kg = 98 N.

Make up your own mass and show the corresponding weight:

The force exerted by gravity on ______ kg = ______ N.

41. By whatever means (spring scales, measuring balance, etc.), find the mass of your physics book. Then complete Table I.

Table I

OBJECT	MASS	WEIGHT
MELON	1 kg	
APPLE		1 N
PHYSICS BOOK		
UNCLE HARRY	90 kg	

42. Why isn't the girl hurt when the nail is driven into the block of wood?

____

____

Would this be more dangerous or less dangerous if the block were less massive ________? Explain.

____

____

____

CAUTION: Safety dictates you not try this experiment yourself.

Conceptual PHYSICS

