Day 7: Forces: Due Tues/Wed (3 ec pts)

#2 Forces: Unbalanced forces cause changes in velocity.

a. A force has both direction and magnitude.

b. When an object is subject to two or more forces at once, the result is the cumulative effect of all the forces.

c. When the forces on an object are **balanced**, the motion of the object does not change.

d. Be able to identify separately the two or more forces that are acting on a single static object, including gravity, elastic forces due to tension or compression in matter, and friction.

e. When the forces on an object are **unbalanced**, the object will change its velocity (that is, it will speed up, slow down, or change direction).

f. The greater the mass of an object, the more force is needed to achieve the same rate of change in motion.

g. Know the role of gravity in forming and maintaining the shapes of planets, stars, and the solar system.

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1. Vocabulary: Use the words in the box to fill in the blanks below. Each word will be used only once.

1. A _____ is a push or pull.

2. The unit for force is the _____.

3. A force has both _____ and _____.

4. _____ is determined by combining forces.

5. _____ forces produce a change in motion and velocity.

6. _____ forces produce no change in motion.

7. _____ is a force of attraction between objects that is due to their masses.

8. The law of universal gravitation states that all objects in the universe attract each other through _____. The size of the force depends on the masses of the objects and the _____ between them.

9. _____ is the amount of matter in an object.

10. _____ is a measure of gravitational force on an object.

11. Newton's _____ law of motion states that the motion of an object will not change if no unbalanced forces act on it.

12: _____ is the tendency of matter to resist change in motion.

13. Newton's second law of motion states that the _____ of an object depends on its mass and on the force exerted on it.

14. Newton's third law of motion states that whenever one object exerts a force on a second object, the second object exerts a(n) _____ force on the first.

15. _____ is the property of a moving object that depends on its mass and velocity.

Acceleration
Balanced
Direction
Distance
Equal and opposite
First
Force
Gravity
Gravitational force
Inertia
Magnitude
Mass
Momentum
Net Force
Newton
Unbalanced
Weight

2. Newton's 3 Laws of Motion

Newton's laws of motion	Write the law in your own words Be sure to include the formula if applicable	Example of the law
The first law		
The second law		
The third law		

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3. Applying Newton's Laws: Answer the following questions in your notebook on **a separate piece of paper**

1. When Jane drives to work, she always places her pocketbook on the passenger's seat. By the time she gets to work, her pocketbook has fallen on the floor in front of the passenger seat. One day, she asks you to explain why this happens in terms of physical science. What do you say?

2. You are waiting in line to use the diving board at your local pool. While watching people dive into the pool from the board, you realize that using a diving board to spring into the air before a dive is a good example of Newton's third law of motion. Explain how a diving board illustrates Newton's third law of motion.

3. You know the mass of an object and the force applied to the object to make it move. Which of Newton's laws of motion will help you calculate the *acceleration* of the object?

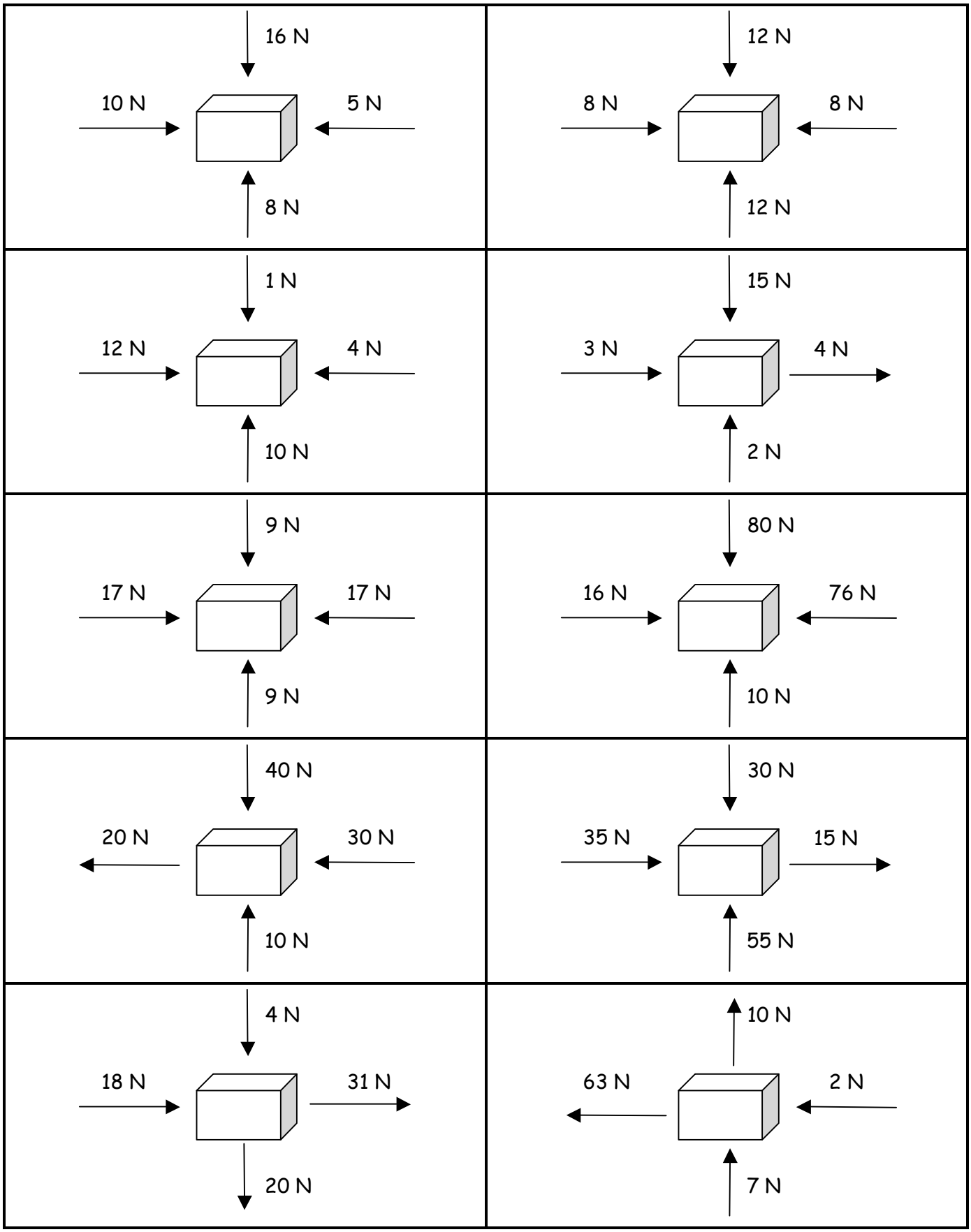
4. Your shopping cart has a mass of 65 kilograms. In order to accelerate the shopping cart down an aisle at 0.3 m/s^2, what force would you need to use or apply to the cart?

5. A small child has a wagon with a mass of 10 kilograms. The child pulls on the wagon with a force of 2 newtons. What is the acceleration of the wagon?

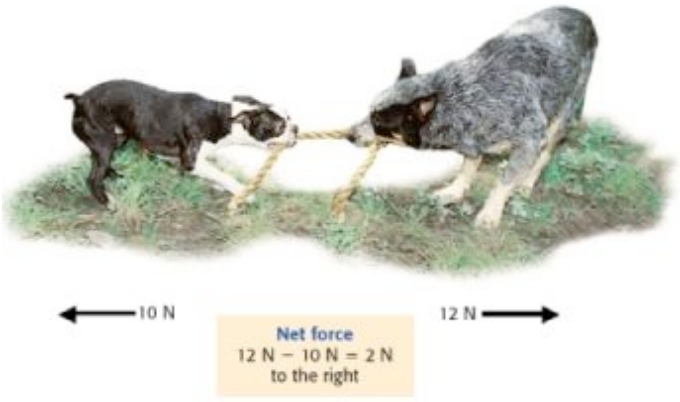
6. You dribble a basketball while walking on a basketball court. List and describe the pairs of action-reaction forces in this situation.

7. Explain how gravity was the major force responsible for formation of the solar system.

4. Force Diagrams: State whether each box is **balanced** or **unbalanced**. If unbalanced, write the sizes (magnitude) & directions of the resultant force.



Forces in Different Directions



Forces in the Same Direction

Part 2: Newton's Second Law

Isaac Newton expressed the relationship between force, mass, and acceleration in his second law. This law is so important that it became the basis for much of modern physics. In fact, Newton's contribution to science was so great that the unit for force, the newton (N), was named after him. A newton is defined as the force needed to produce an acceleration of 1 m/s² on a 1 kg object. Therefore, 1 N = 1 kg × 1 m/s². The equation for Newton's second law is given below.

EQUATION: Force = mass × acceleration

$F = m \times a$

If you know two of the values in this equation, you can calculate the third by changing the equation around, as follows:

$$\text{acceleration} = \frac{\text{Force}}{\text{mass}} \quad \textit{and} \quad \text{mass} = \frac{\text{Force}}{\text{acceleration}}$$

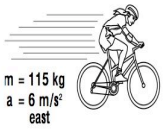
SAMPLE PROBLEM: A soccer ball accelerates at a rate of 22 m/s² forward when kicked by a player. The soccer ball has a mass of 0.5 kg. How much force was applied to the ball to produce this acceleration?

Force = mass × acceleration
Force = 0.5 kg × 22 m/s²
Force = 11 kg × m/s²
Force = **11 N**

Use the equations above to complete the following problems:

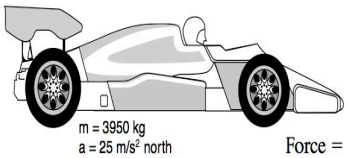
2. Calculate the force necessary to accelerate the following vehicles at the rate of acceleration shown in the illustration.

a.



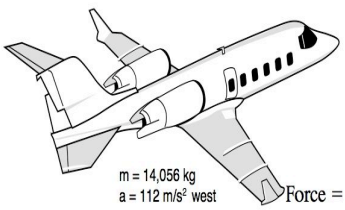
Force = _____

b.



Force = _____

c.



Force = _____

d. If the cyclist decelerates to 4 m/s² east, what is the new force? _____

- So as *acceleration decreases*, force _____.

e. If the racecar had a mass of 5000 kg, what is the new force? _____

- So as *mass increases*, force _____.

f. If the plane increases its acceleration to 200 m/s² west, what is the new force? _____

- So as *acceleration increases*, force _____.

Brainpop notes: