**FORCES, VECTORS, AND MOTION POGIL**

NAME

HOUR

STANDARD 4 LEARNING MODULE 8

**Vectors and Forces Background:** It is important to understand that more than one force usually acts upon an object at one time. Forces often act in pairs and opposite of each other. However, there is often more than one pair of forces acting on an object. If an object is not moving or moving at a constant speed, the forces are said to be balanced and the net force will equal zero. If an object speeds up or slows down (accelerates or decelerates) or changes direction, the forces acting on the object are unbalanced. The net force will not be zero and will cause the object to respond by speeding up or slowing down (accelerating or decelerating) in the direction of the larger force. We can draw arrows called vectors that tell us two things about force: the direction and the size of the force. These drawings are called vector diagrams.

**30 Newtons**

**20 Newtons**

**Vector Diagram 1**



Person 2 pulls with **30 Newtons** of force.

Person 1 pulls with **20 Newtons** of force.

Net Force = 10 N

**Net Force Explanation:** The net force is calculated by **subtracting** the two forces. This is because they are pulling in **opposite** directions. We would add if they were in the same directions. So, **30N-20N=10N**. The bigger force is to the right so the net force will be to the right. Also, because the forces are not equal and they are opposite, they are unbalanced forces. The box will accelerate to the right.

**QUESTIONS**:

1.) How was the net force calculated in model one? Explain/show

2.) Are the forces exerted by the two people balanced or unbalanced? Explain how you know.

3.) Explain the motion of the treasure chest.

**Vector Diagram 2:** This box full of Halloween candy weighs 20 Newtons. The friction between the bottom of the box and the ramp is 10 Newtons.

**Net Force Explanation:** This time the two forces are opposite and equal. Because they are **opposite** we **subtract**. When we subtract 20N-20N we get 0 Newtons. These forces are **balanced** and there is **no net force** and therefore no vector (arrow). The box of candy will either be motionless and not moving or, will be moving at a constant rate.

**20 Newtons**

Net Force = 0 N

Frictional Force=20 N

**Questions**

4.) Are these two forces balanced or unbalanced? Explain

5.) How do you calculate the net force? Explain/show.

6.) What will the motion of the box of candy be? Explain

**Vector Diagram 3:** A biker is in a race and he is fighting against air resistance but is overcoming it by 5 Newtons. He is going faster. He is accelerating. However, a gust of wind comes along. Below is the vector diagram for the instant the gust of wind is acting on the rider.

Air Resistance=**10 N**

Inertia of rider=**15 N**

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**Net Force Explanation:** Both air resistance and the gust of wind is in the **same direction**. So these are **added** together. This is 10N+6N=16 Newtons to the left, against the rider. This 16N and the 15N acting on the rider are **opposite directions** and will be **subtracted**. So, 16N-15N=1N. These forces are unbalanced and results in a net force of 1N to the left and will result in the biker decelerating during the gust of wind.

Force of gust of wind=6 **N**

Net Force=1 **N**

**Questions**

7.) Are all of these forces balanced or unbalanced? Explain

8.) How did you calculate the net force? Explain.

9.) How will the motion of the cyclist change?

**PRACTICE PROBLEMS**



**Vector Diagram 4**

10.) What is the net force acting on the treasure chest?

Force=8 **N**

Force=11 **N**

Explain OR show calculation.

11.) Are these forces balanced or unbalanced?

12.) What will the resultant motion of the chest be? Explain.

Force of falling skydiver=34 N

**Vector Diagram 5**

13.) What is the net force acting on the skydiver?

Explain or show work

14.) Are these forces balanced or unbalanced?

Air Resistance=34 N

15.) What will the resultant motion of the skydiver be?

Pulling force=25 **N**

Pulling force=20 **N**

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**Vector Diagram 6**

16.) What is the net force of the tug of war people?

Explain or show work.

Sliding Friction Force

at feet=11 **N**

Sliding Friction Force

at feet=5 **N**

17.) Are these forces balanced or unbalanced?

18.) What will be the resultant motion of the tug of war people?

**Vector Diagram 7: Logs have been put under a**

Rolling Friction=30N

Moi=250N

Cart=100N

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**Moi to help roll it slightly downhill into position.**

Entire Tribe Pulling=300N

19.) What is the net force of the Moi?

Explain OR show calculation.

Gravity Pulling=80N

20.) Are all these forces balanced or unbalanced?

21.) What will be the resultant motion of the Moi and cart?

Pedaling force Force= 26N

Air Resistance=7 N

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**Vector Diagram 8: A cyclist is sprinting to the finish line**

**and is going uphill. At this moment a gust of wind**

**blows up hill.**

Rolling Friction of Wheels=10N

22.) Draw in arrows with

approximate lengths for each of

the forces.

Force of Gravity=13N

23.) What is the net force acting on the cyclist?

Explain or show work.

Gust of wind uphill=11N

24.) Are these forces balanced or unbalanced? Explain.

25.) What will be the resultant motion of the cyclist? Explain.

