Name: _____

Class: _____

Due Date: _____

Physics Topic 18A – Linear Momentum and Impulse

Answer the following questions. The solutions to this worksheet can be found on the YouTube channel Go Physics Go.

1. C: Use *Newton's third law of motion* to complete the next sentence: Man throws rock forward.

2. C: What is the meaning and equation for *impulse* $\vec{J}$? Do not confuse impulse $\vec{J}$ with current I!

3. C: What is the meaning, symbol, equation, and fundamental units for *momentum* $\vec{p}$? Momentum is also called "*inertia in motion*." Why? Do not confuse momentum $\vec{p}$ with pressure P or power P or density ρ!

4. C: Why are the front of cars built so weak? Why are cars so easy to damage during an accident?

5. C: Why do athletes have their elbows bent when catching a ball? Why do athletes have their knees bent when coming down after jumping?

6. C: What common mistake do people make when firing/shooting a gun? https://www.youtube.com/watch?v=bYWzMDVgweg

7. C: What does the law of *conservation of momentum* tell us? What is the equation for the law of conservation of momentum?

8. C: What is an *elastic collision*? Is momentum conserved? Is kinetic energy conserved? Is total energy conserved?

9. C: What is an *inelastic collision*? Is momentum conserved? Is kinetic energy conserved? Is total energy conserved?

10.C: What is a *perfectly inelastic collision*? Is momentum conserved? Is kinetic energy conserved? Is total energy conserved?

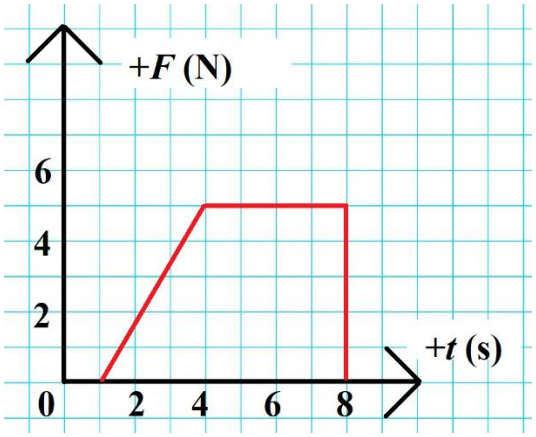
11.C: What does the area under a *force vs. time graph* tell us?

12.C: What does the slope of a line on a *force vs. time graph* tell us?

13.E: A 2.00 kg block is moving east with a speed of 5.00 m/s. It hits a wall and rebounds to the west at a speed of 4.00 m/s. What is the magnitude and direction of the change in momentum of the block?

14.E: A 2.00 kg block is moving east on a frictionless surface with a speed of 5.00 m/s. It then moves on a rough surface for three seconds. Finally it continues to move east on a frictionless surface with a new speed of 1.00 m/s. What is the force of friction of the rough surface?

15.E: A *force vs. time* graph is shown below for a mass being pushed in a horizontal line.



a. Calculate the magnitude of the impulse given to the mass.

b. Calculate the average force given to the mass.

16.E: Abroad the aircraft carrier Carl Vinson, a steam catapult exerts a force of 800,000 N on a 24,000 kg F-14 Tomcat. Find the time for the kitty to accelerate from rest to 65 m/s.

17.E: Each minute, a snow cannon shoots 150 snowballs, each having a mass of 0.08 kg. IN the barrel, the snowballs are accelerated from rest to 475 m/s. Find the force exerted on the snowballs.

18.E: A pump accelerates oil, whose density is $850\ \frac{\text{kg}}{\text{m}^3}$, from rest to 5 m/s. The volumetric flow rate through the pump is $0.4\ \frac{\text{m}^3}{\text{sec}}$. Find the force exerted on the fluid.

19.E: A baseball, which has a mass of 0.685 kg, is moving with a velocity of 38.0 m/s to the right when it contacts the baseball bat during which time the velocity of the ball becomes 57.0 m/s in the opposite direction.

a. How much impulse has been delivered to the ball by the bat?

b. While in contact with the bat the ball undergoes a maximum compression of approximately 1.00 cm. Approximately how long did it take for the ball to be stopped by the bat?

c. What will be the average force applied to the ball by the bat while stopping the ball?

20. E: A rocket has a mass of 49,000 kg and is sitting "at rest" in space. It contains 186,000 kg of fuel. When this fuel is burned it is exhausted from the rocket with a velocity of 38,500 m/s to the left. For simplicity assume that all the fuel is emitted at once. What will be the final velocity of the rocket?

21. E: A 3.00 kg block is moving west at 4.00 m/s on a frictionless horizontal surface. A 5.00 kg block is moving east at 6.00 m/s on the same surface. Both of them collide and stick together.

    a. What is the final speed and direction of the block?

    b. Is momentum conserved?

    c. What is the initial total kinetic energy?

    d. What is the final total kinetic energy?

e. Is kinetic energy conserved?

f. Is this an elastic or inelastic collision?

g. Is total energy conserved?

22.E: A 7.00 kg block is moving north at 8 m/s on a frictionless horizontal surface. A 9.00 kg block is moving south at 10.0 m/s on the same surface. They collide. The 7.00 kg block is now moving south at 4.00 m/s.

a. What is the final speed and direction of the 9 kg block?

b. Is momentum conserved?

c. What is the initial total kinetic energy?

d. What is the final total kinetic energy?

e. Is kinetic energy conserved?

f. Is this an elastic or inelastic collision?

g. Is total energy conserved?

23.E: A 12.0 kg block is initially at rest on a frictionless horizontal surface. It then explodes into three pieces. A 3.00 kg block moves west at 4.00 m/s. A 5.00 kg block moves east at 6.00 m/s.

a. What is the final speed and direction of the 4.00 kg block?

b. Is momentum conserved?

c. What is the initial total kinetic energy?

d. What is the final total kinetic energy?

e. Is kinetic energy conserved?

f. Is total energy conserved?

24.E: A 12.0 kg block is moving east at 13.0 m/s on a frictionless horizontal surface. It then explodes into three pieces. A 4.00 kg block moves west at 5.00 m/s. A 6.00 kg block moves east at 7.00 m/s.

a. What is the final speed and direction of the 2.00 kg block?

b. Is momentum conserved?

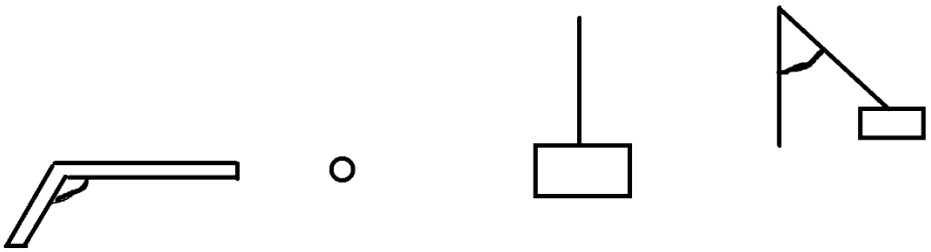
c. What is the initial total kinetic energy?

d. What is the final total kinetic energy?

e. Is kinetic energy conserved?

f. Is total energy conserved?

25.E: A rifle, which has a mass of 5.50 kg, is used to fire a bullet, which has a mass of 65.0 grams, at a "ballistics pendulum." The ballistics pendulum consists of a block of wood, which has a mass of 5.00 kg, attached to a string which is 125 cm long. When the block is struck by the bullet the block swings backward until the angle between the ballistics pendulum and the vertical reaches a maximum angle of 38.0°.



a. What will be the maximum gravitational energy contained in the ballistics pendulum when it reaches the maximum angle?

b. What was the velocity of the block of wood immediately after being struck by the bullet?

c. What was the velocity of the bullet immediately before it strikes the block of wood?

d. How much work was done by the bullet as it lodged in the block of wood?

e. What will be the recoil velocity of the rifle?

f. How much energy was released when the bullet was fired?