

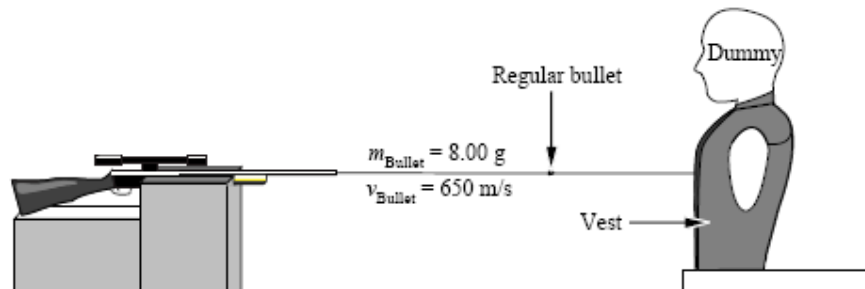


P30 Unit A Assignment: Momentum and Impulse

Name: _____

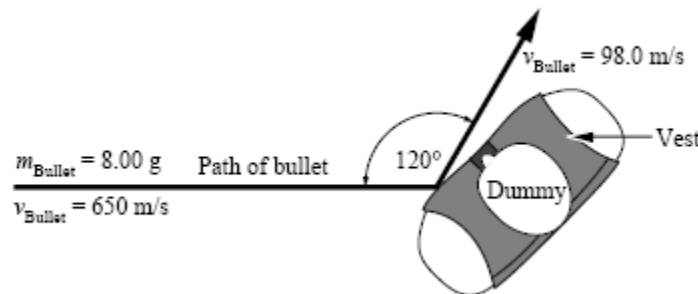
Date: _____

1. A cart shoved along a flat table comes to a rest in two seconds. What happened to its momentum?
2. A curling stone has a momentum of 32 kgm/s [W]. What would be the momentum if the mass of the stone is decreased to 7/8 of its original mass and its speed is increased to 4/3 of its original speed? (2 marks) (37 kgm/s [W])
3. Several Canadian companies are redesigning and testing bulletproof vests. One company does a test that involves firing a target rifle at a crash test dummy wearing a vest.



The regular bullet is in the rifle barrel for 1.42×10^{-3} s. What is the average force exerted on the regular bullet by the expanding gases? (2 marks) (3.66×10^3 N)

4. A second test performed by the company has the regular bullet strike the vest at a glancing angle. The mass of the vest and the dummy is 56.0 kg. The bullet-vest collision is inelastic.



Determine the resultant **speed** of the vest and the dummy following the glancing collision shown above. (4 marks) (8.67×10^{-2} m/s)

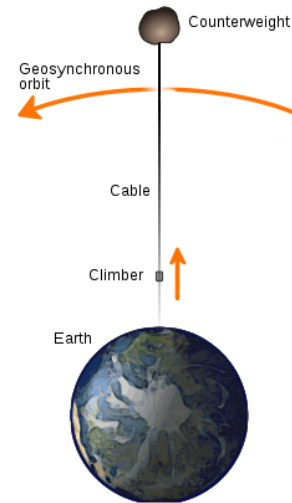
5. If a 22 g bullet, shot straight up into the air, reaches an altitude of 4.59 km, what is the recoil velocity of the 3.00 kg rifle? (3 marks) (-2.2 m/s)

5/6/2016

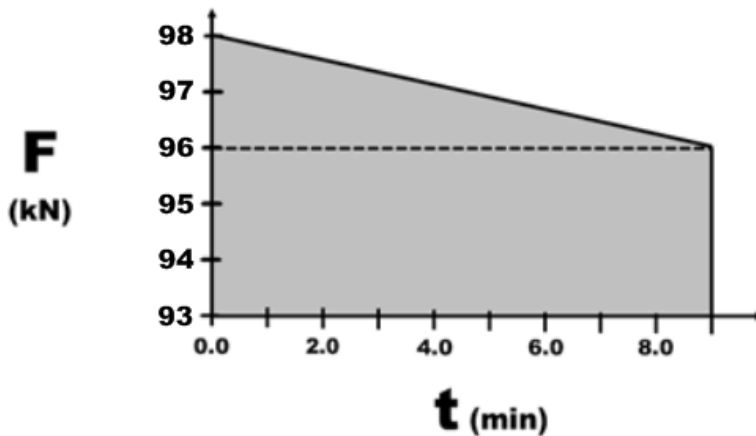
6. A Space Elevator is a hypothetical device used for transportation of people and materials between the Earth and a geosynchronous orbit in outer space.

The cable is constructed from carbon nanotubes and the climber uses rollers to climb the cable via friction.

In order to escape the Earth's gravitational pull, the climber must apply a force directed up the cable. This force is greatest near the surface of the Earth and can be lessened as the climber begins distance itself. A possible force vs. time graph for the climber is shown below:



Force vs. Time of a Space Elevator



What is the impulse of the space elevator during its total 9.0 minute trip? (5.2×10^7 kgm/s)(2 marks)

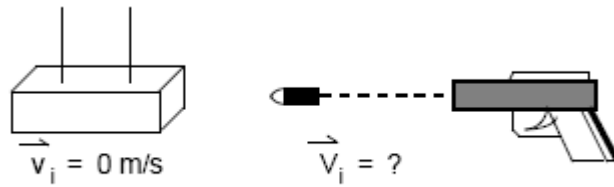
7. A student in a physics class, having learned about elastic collisions and conservation laws, decides that he can make a self-propelled car. He proposes to fix a pendulum on a cart using a “super-ball” as a pendulum bob. He fixes a block to the cart so that when the ball reaches the bottom of the arc, it strikes the block and rebounds elastically. It is supposed to give the cart a series of bumps that propel it along.

- Will his scheme work? (Assume the “super-ball” is perfectly elastic.) Give reasons for your answers.
- What would happen if the cart had an initial velocity in the forwards direction?
- What would happen if the cart had an initial velocity in the backwards direction?

5/6/2016

8. A clerk working at a local food store is asked to retrieve the empty shopping carts left outside by shoppers. Each cart has a mass of 20 kg. The clerk places 8 carts, which are locked together, close to the entrance on a slight incline. The clerk gathers another 12 carts and pushes them toward the store entrance. Meanwhile, the first 8 carts roll toward the 12 carts with a speed of 2.3 m/s. When the carts collide, they all come to a complete stop. At what speed were the 12 carts moving just before impact? **(2 marks) (1.5 m/s)**

9. The speed of a bullet can be determined using different methods. A simplification of one method of determining the speed of a bullet requires shooting the bullet into the end of a stationary wooden block suspended by two long strings. This method is illustrated below.



In this case, a bullet ($m = 13.0 \text{ g}$) is shot from a handgun and becomes embedded in a 3.10 kg block of wood. The block of wood swings upward a vertical distance of 70.0 cm . Using the information provided, the Law of Conservation of Energy, and the Law of Conservation of Momentum, calculate the speed of the bullet just before its impact with the block. In your solution, identify where you applied the Law of Conservation of Energy and the Law of Conservation of Momentum. **(4 marks) (887 m/s)**

Bonus Questions: Answer only **ONE!!!**

Fair Bonus Question: What is the date of your diploma?

Unfair Bonus Question: If LD was to have a vanity license plate, what would it say? (six characters, numbers or letters)

