PHYSICS IN MOTION
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# Unit 4A
# Momentum and Impulse
## *Practice Problems TEACHER*

**Work each of the following problems. SHOW ALL WORK.**

1. **A 1,200 kg car travels at 20 m/s. What is its momentum?**

$$p = mv$$
$$p = (1200\ kg)(20\ {}^{m}/_{s})$$
$$p = 24000\ kg\,{}^{m}/_{s}$$

2. **If the car in the previous question slows to a stop, what is its final momentum?**

*If the final velocity is zero, the final momentum is zero.*

3. **What is the change in momentum of the car in the previous questions?**

$$\triangle p = p_f - p_i$$
$$\triangle p = 0 - 24000\ kg\,{}^{m}/_{s}$$
$$\triangle p = -24000\ kg\,{}^{m}/_{s}$$

4. **If the car slows down in 5 seconds, what force does the car experience in braking?**

$$\triangle p = F\triangle t$$
$$-24000\ kg\,{}^{m}/_{s} = F(5\ s)$$
$$F = -4800\ N$$

5. **While catching an egg, the receiver "gives" with her hands and arms, making the stopping time of the egg about seven times longer than if it were caught stiff-armed. By what factor does the force encountered by the egg change?**

*If the change in momentum is the same, but the stopping time*

*is seven times longer, the force exerted will be seven times less.*

**questions continued on next page**

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**Work each of the following problems. SHOW ALL WORK.**

**6. What is the momentum in kg m/s of a 62 g golf ball traveling at 73 m/s?**

$$m = 62\,g = 0.062\,kg$$
$$v = 73\,{}^{m}/_{s}$$

$$p = mv$$
$$p = (0.062\,kg)(73\,{}^{m}/_{s})$$
$$p = 4.53\,kg\,{}^{m}/_{s}$$

**7. If the impact of the golf club on the ball in the previous question occurs over a time of 2 x $10^{-3}$ seconds, what force does the ball experience to accelerate from rest to 73 m/s?**

$$p_i = mv_i = (0.062\,kg)(0\,{}^{m}/_{s}) = 0$$
$$p_f = mv_f = (0.062\,kg)(73\,{}^{m}/_{s}) = 4.53\,kg\,{}^{m}/_{s}$$

$$\Delta p = p_f - p_i$$
$$\Delta p = 4.53\,kg\,{}^{m}/_{s} - 0$$
$$\Delta p = 4.53\,kg\,{}^{m}/_{s}$$

$$\Delta p = Ft$$
$$4.53\,kg\,{}^{m}/_{s} = F(0.002\,s)$$
$$F = 2263\,N$$

**8. How long must a tow truck apply a force of 550 N to increase the speed of a 1,200 kg car at rest to 2 m/s?**

$$p_i = mv_i = (1200\,kg)(0\,{}^{m}/_{s}) = 0$$
$$p_f = mv_f = (1200\,kg)(2\,{}^{m}/_{s}) = 2400\,kg\,{}^{m}/_{s}$$

$$\Delta p = p_f - p_i$$
$$\Delta p = 2400\,kg\,{}^{m}/_{s} - 0$$
$$\Delta p = 2400\,kg\,{}^{m}/_{s}$$

$$\Delta p = Ft$$
$$2400\,kg\,{}^{m}/_{s} = (550\,N)t$$
$$t = 4.36\,s$$