Worksheet 5: Work-Energy Theorem

1. What is the amount of work required to increase a 1100 kg car's speed from 20.0 m/s to 30.0 m/s?

2. As a 6 x 10^2 kg object is pushed horizontally with a force of 1 x 10^2 N, it gains 5 x 10^3 J of kinetic energy. Through what distance did the force act?

3. A rifle can shoot a 4.2 g bullet at a speed of 965 m/s. If the work on the bullet is done over a distance of 0.75 m, what is the average force on the bullet?

4. Pam, wearing a rocket pack, stands on frictionless ice. She has a mass of 40.0 kg. The rocket supplies a constant force for 22 m and Pam acquires a speed of 62 m/s. What is the magnitude of the force?

5. A 1500 kg car is traveling at 25 m/s. The brakes are suddenly applied and the car slides to a stop. The average breaking force between the tires and the road is 7100 N. How far will the car slide once the brakes are applied?

6. In the 1950's, an experimental train that had a mass of 2.50 x 10^4 kg, was powered across a level track by a jet engine that produces a thrust of 5.00 x 10^5 N for a distance of 5.00 x 10^2 m. What is the final speed of the train if there was no friction?

7. A hockey puck is accelerated, using a hockey stick, over a smooth, level ice surface. The puck has a mass of 0.400 kg and is moved by the stick for a distance of 0.800 m. What was the average force applied to the puck if the final speed is 25.0 m/s?

8. A 24 kg go-cart moves at a speed of 10.0 m/s. The engine exerts 50.0 N force to accelerate the cart over a distance of 30.0 m.
   (a) What amount of work did the engine do on the cart?
   (b) What is the cart's final kinetic energy?
   (c) What will be the cart's final speed?

9. As you throw a 2.00 x 10^2 g baseball, your hand moves a distance of 90.0 cm before you release the ball. If you exert an average force of 50.0 N on the ball while it is in your hand, determine:
   (a) the kinetic energy of the ball as it leaves your hand.
   (b) the speed with which the ball leaves your hand.

10. An applied force of 10.0 N is applied to a 2.0 kg mass over a distance of 4.0 m. The surface is horizontal and friction is negligible. Assume that the object is initially at rest.
    (a) Calculate the work done on the object.
    (b) Calculate the final speed of the object.
11. A 70.0 kg sled is on a frictionless, horizontal ice surface. An applied force of 200.0 N acts on the sled over a distance of 5.0 m.
(a) Calculate the work done on the object.
(b) According to the Work Energy Theorem, what should be the change in the kinetic object of the object.
(c) Recall that the object is initially at rest. You know its mass and $KE$. Calculate the final speed of the object.

12. (a) When a hockey player makes a wrist shot, he applies a reasonably constant force to a puck for a distance of between 0.8 to 1.4 m. Explain why the work energy theorem may be used to analyse the resulting motion of the puck.
(b) It would be reasonable to assume that a hockey player, using the stick, is able to exert a force of 60.0 N on a puck for a distance of 1.00 m. The mass of a puck is approximately 0.200 kg. Determine:
(i) The amount of work done on the puck.
(ii) The amount of kinetic energy in the puck immediately after release.
(iii) The final speed of the puck. Check to ensure that the answer is reasonable!

13. (a) A force of 4.40 N is applied to a dart over a distance of 54 cm. The dart has a mass of 28 g. Assuming no energy is lost due to friction, what will be the kinetic energy of the dart after it is thrown?
(b) Use your result in part (a) to calculate the speed of the dart.

14. An 8 kg cart was traveling at 5 m/s. Calculate the final speed of the cart if 300 J of work is done on it?

15. While driving a 1200 kg car at 20.0 m/s, you decide to pass the truck in front of you. To do this, the engine must provide an additional 35000 J of work.
(a) What is the car's initial kinetic energy?
(b) What is the final speed of your car?

16. A 625 kg car accelerates from 10.0 m/s to 25.0 m/s over a distance of 15.0 m. What was the force that the engine had to exert on the car to achieve this acceleration?

17. How much work must be done on a 750 kg car to slow it down from $1.0 \times 10^3$ km/h to 50.0 km/h?

18. A bullet of mass 4.2 g traveling at a speed of 965 m/s comes to rest by pushing 1.5 cm into metal. What is the average force that the bullet exerts?