

Student #: _____

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Physics 11 Homework Unit 4: Mechanical Energy

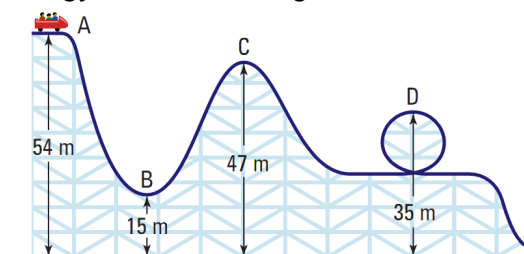
1. A weight lifter used a circular platform attached to a harness to lift a class of 30 children and their teacher. While the children and teacher sat on the platform, he lifted them. The total weight of the platform plus people was $1.1 \times 10^4 \text{ N}$. When he lifted them a distance of 52 cm, at a constant velocity, how much work did he do? How high would you have to lift one child, weighing 135 N, in order to do the same amount of work that the weight lifter did?

2. An energetic group of university students attempts to remove an old tree stump for use for use as firewood during a party. The students apply an average upward force of 650 N. The 865 kg tree stump does not move after 15 minutes of continuous effort, and the group gives up.
 - (a) How much work did the students do on the tree stump?
 - (b) Explain the results obtained in part (a).

3. A farmer pushes a wheelbarrow with an applied force of 124 N. If the farmer does 7314 J of work on the wheelbarrow while pushing it a horizontal distance of 77.0 m, find the angle between the direction of the force and the horizontal.

4. You throw a ball directly upward, giving it an initial velocity of 10.0 m/s.
 - (a) Neglecting friction, what would be the maximum height of the ball?
 - (b) Do you need to know the mass of the ball? Why or why not?

5. A 4.0×10^4 kg roller coaster starts from rest at point A. Neglecting friction; calculate its potential energy relative to the ground, its kinetic energy, and its speed at points B, C and D.



6. A football player pushes a tackling dummy forward at a constant 0.85 m/s for 11 m using 7150 J of energy. The tackling dummy has a mass of 120 kg.
- Find the force the football player exerts.
 - What is the frictional force the dummy exerts?
 - What work is done by friction as the dummy is slid along the field for 11 m?
 - Is the mass of the dummy necessary for this question?

7. A hockey player pushes on a 170 g hockey puck from rest with his stick at an angle so the vertical force is 22 N [down] and the horizontal force is 45 N [forward]. Assume the ice is friction-less.
- What is the actual force (both magnitude and direction) the player transmits to the puck?
 - How much work does the player do if he pushes the puck for 0.03 s?
 - What is the significance of the fact that both the horizontal force and motion are both forward?

8. A 50 kg person is taking a ride on an elevator travelling up at a steady speed of 2.5 m/s. Find the time of the elevator trip if the elevator does 4905 J of work on the person.

9. A pair of sleds weighs 25 kg and experience a frictional force of 25 N. If a dog team applies a 175 N force pulling it 12 m, find:

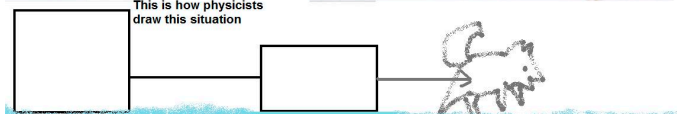
- the work done by friction.
- the work done by the dog team.
- the net work done (using the net force). How does then net work compare to the answers from the previous two parts of the question?



This is an artistic representation



This is how physicists draw this situation

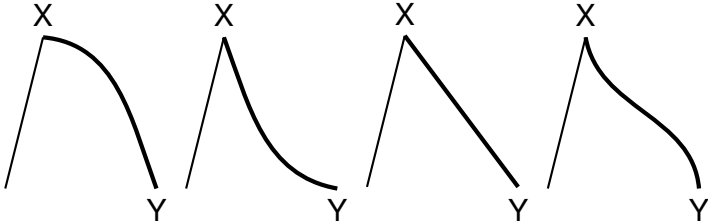


- What form of energy does the frictional force represent? What form of energy does the net force produce?

- _____ 10. A boy pushes down on a car rolling horizontally along a road. If the boy pushes down with 10 N of force as the car rolls 3.0 m horizontally, the amount of work done by the boy is:
- (a) 0 J
 - (b) 30 N m
 - (c) -30 N m
 - (d) 3.3 J
 - (e) none of the above
- _____ 11. What is the speed of a 0.25 kg ball if its kinetic energy is 15 J?
- (a) 1.4 m/s
 - (b) 1.9 m/s
 - (c) 2.7 m/s
 - (d) 5.5 m/s
 - (e) 11 m/s
- _____ 12. A ball is dropped off a high cliff. Which of the following quantities increases as the ball gets closer to the ground?
- (a) acceleration
 - (b) force of gravity
 - (c) gravitational potential energy
 - (d) kinetic energy
 - (e) all of the above
- _____ 13. A 10.0 kg crate slides across a level floor 13 m against a force of friction of 7.5 N. If all the work done by friction is converted to heat, the thermal energy produced is:
- (a) 17 J
 - (b) 49 J
 - (c) 75 J
 - (d) 98 J
 - (e) 980 J
- _____ 14. In the process of being thrown, a 0.145 kg baseball goes from rest to a speed of 156 km/h over a distance of 2.05 m. What is the force that was exerted on the baseball?
- (a) 1.9 N
 - (b) 3.3 N
 - (c) 6.6×10^4 N
 - (d) 66 N
 - (e) 861 N

- _____ 15. A 10.0 kg crate initially at rest on a floor with a static and kinetic friction coefficient of 0.20 is pushed with a force of 15 N for 4.0 s. The net work done (total work done by all forces) on the crate is:
- (a) 0
 - (b) 10 J
 - (c) 15 J
 - (d) 60 J
 - (e) 600 J
- _____ 16. When exiting a highway, a car slowed down from 108 km/h to 90 km/h over the course of 4.0 s. The force of the brakes was 1000 N. What is the work done by the brakes on the car?
- (a) 4000 J
 - (b) -4000 J
 - (c) 110.000 J
 - (d) -110.000 J
 - (e) none of the above
- _____ 17. In moving an object of mass 10 kg through a distance of 8.0 m, 40 J of work is done. The average force exerted is:
- (a) 4.0 N
 - (b) 80 N
 - (c) 320 N
 - (d) 400 N
 - (e) 5.0 N
- _____ 18. What is the kinetic energy of a 20 kg object moving at a speed of 10 m/s?
- (a) 100 J
 - (b) 200 J
 - (c) 1000 J
 - (d) 2000 J
 - (e) 500 J
- _____ 19. The gravitational potential energy of a sparrow of mass 40 g resting on a tree branch of height 15 m is approximately: (use $E_g = 0$ on the ground)
- (a) 0.60 J
 - (b) 5.9 J
 - (c) 390 J
 - (d) 600 J
 - (e) 5.9 kJ

- _____ 20. Two objects (m_1 and m_2) have the same mass. m_1 is travelling twice as fast as m_2 . The work that must be done to stop m_1 compared to m_2 is:
- (a) two times greater
 - (b) the same
 - (c) four times greater
 - (d) half as great
 - (e) one quarter as great
- _____ 21. When a rock is thrown straight up in the air, after it leaves the hand, the rock begins to slow down. This occurs because:
- (a) the rock is gaining potential energy as it rises, and thus it must lose kinetic energy.
 - (b) the force of gravity acting on the rock increases as the rock rises.
 - (c) the forces acting on the rock are balanced.
 - (d) the potential energy of the rock decreases as the rock rises.
- _____ 22. A 2.5 kg mass at rest on a horizontal surface is acted upon by an applied horizontal force of 150 N. A frictional force also acts on the mass. How much work is done on the mass?
- (a) 0
 - (b) 30 J
 - (c) 50 J
 - (d) 60 J
 - (e) 125 J
- _____ 23. A mass of 10 kg, initially at rest on a horizontal friction-less surface, is acted upon by a horizontal force of 25 N. The speed of the mass after it has moved 5.0 m is:
- (a) 5.0 m/s
 - (b) 10 m/s
 - (c) 15 m/s
 - (d) 125 m/s
 - (e) 250 m/s
- _____ 24. Galileo drops a 100 kg cannonball from the top of the Tower of Pisa, at a height of 57 m. The kinetic energy just before striking the ground is approximately:
- (a) 1.8 J
 - (b) 17 J
 - (c) 5.7×10^3 J
 - (d) 5.6×10^4 J
 - (e) 981 J

- _____ 25. A 300 N force is applied horizontally to a 50 kg crate pushing it 2.0 m. The force of friction between the crate and the floor is 200 N. The work done by the *applied force* is:
- (a) 200 J
 - (b) 400 J
 - (c) 600 J
 - (d) 980 J
 - (e) none of the above
- _____ 26. A 300 N force is applied horizontally to a 50 kg crate pushing it 2.0 m. The force of friction between the crate and the floor is 200 N. The work done by the *frictional force* is:
- (a) 200 J
 - (b) -400 J
 - (c) -600 J
 - (d) 980 J
 - (e) none of the above
- _____ 27. Electrons with a speed of 1.0×10^7 m/s strike the screen of a television set. With what kinetic energy does a single electron hit the screen? (mass of electron is 9.11×10^{-31} kg)
- (a) 9.0×10^{-38} J
 - (b) 4.6×10^{-17} J
 - (c) 4.5×10^{-24} J
 - (d) 9.0×10^{-17} J
 - (e) 9.0×10^{-24} J
- _____ 28. A Tesla Model S has a mass of 2000 kg. When it is travelling at 90 km/h, it has a kinetic energy of:
- (a) 2.50×10^4 J
 - (b) 9.00×10^4 J
 - (c) 6.25×10^5 J
 - (d) 8.10×10^6 J
 - (e) 1.25×10^6 J
- _____ 29. A girl wants to slide down a “friction-less” playground slide. If she starts at rest from “X” and slides down to “Y”, which of the following slide shapes will give the girl the greatest possible speed upon reaching “Y”? All the slides have the same vertical height.
- (a) A
 - (b) B
 - (c) C
 - (d) D
 - (e) She gets to the bottom of all the slides with the same speed.
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- _____ 30. Using the same friction-less slides, which slide (A, B, C, or D) will take the least time to descend? (If you think that they arrive at the bottom with the same speed then choose E.)
- (a) A
 - (b) B
 - (c) C
 - (d) D
 - (e) She gets to the bottom of all the slides at the same time.
- _____ 31. A toy rocket engine generates a force ("thrust") of 300 N horizontally to the right against a 50 kg rocket. The force of air resistance ("drag") is 200 N. If the rocket travels horizontally 2.0 m, the kinetic energy gained by the rocket is approximately:
- (a) 200 J
 - (b) 400 J
 - (c) 600 J
 - (d) 980 J
 - (e) none of the above