Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question. Record your answers using upper case letters. Draw a triangle in the bottom right-hand corner of the last page for extra credit.

1. A boy pushes on a parked car with a force of 200 N. The car does not move. How much work does the boy do on the car?
   a. 200 N  
   b. 200 J  
   c. zero  
   d. can't be determined

2. What are the units of work?
   a. J  
   b. N•m  
   c. kg•m²/s²  
   d. all of the above

3. Which of the following processes requires the most work?
   a. A 10 kg weight rests on a table.  
   b. A person holds a 1 kg weight still with outstretched arms.  
   c. A person lifts a 1 kg weight 1 m off the floor.  
   d. A 10 kg ball is rolled across the floor at a constant speed for a distance of 10 m.

4. A man pushes a crate along a factory floor by exerting a force of 55 N. If the crate moves a distance of 4.0 m, how much work does the man perform?
   a. 165 N  
   b. 220 N  
   c. zero  
   d. 145 J

5. What are the units of power?
   a. watts  
   b. horsepower  
   c. joules per second  
   d. all of the above

6. A weight lifter presses a 400 N weight 0.5 m over his head in 2 seconds. What is the power of the weight lifter?
   a. 100 N  
   b. 25 watts  
   c. 400 watts  
   d. 100 watts

7. What is the mechanical advantage of a ramp that is 10 meters long and 2 meters high?
   a. 20  
   b. 5  
   c. 8  
   d. 15

8. A machine is a device that
   a. requires less work to do a given task.  
   b. decreases the amount of work done by a given force.  
   c. increases energy.  
   d. can multiply and change the direction of an input force.

9. A first-class lever has the
   a. fulcrum at one end and the output force between the fulcrum and the input force.  
   b. fulcrum at one end and the input force between the fulcrum and the output force.  
   c. fulcrum in the middle.  
   d. input force in the middle.
10. A wheelbarrow is an example of a
   a. first-class lever.  
   b. second-class lever.  
   c. third-class lever.  
   d. fourth-class lever.

11. Which of the following is not a simple machine?
   a. a lever  
   b. a pair of scissors  
   c. a screw  
   d. a wheel and axle

12. What is the mechanical advantage of a single fixed pulley?
   a. 1  
   b. 1.5  
   c. 2  
   d. 3

13. What is the mechanical advantage of a single movable pulley?
   a. 1  
   b. 1.5  
   c. 2  
   d. 3

14. An inclined plane
   a. changes the direction of the force only. 
   b. changes the magnitude of the force only. 
   c. changes both the magnitude and the direction of the force. 
   d. decreases the amount of work done.

15. Which of the following is a compound machine?
   a. a wheel and axle  
   b. a pulley  
   c. a pair of pliers  
   d. a ramp

16. Which of the following statements about work and energy is not true?
   a. When work is done, energy is transferred or transformed. 
   b. Energy may be defined as the ability to do work. 
   c. Work and energy are always equal. 
   d. Work and energy have the same units.

17. What is the gravitational potential energy of a 55 kg box that is 8.0 m above the ground?
   a. 5500 J  
   b. 3400 J  
   c. 4300 J  
   d. 550 J

18. Gravitational potential energy depends on the _____
   a. the mass of the object.  
   b. the height of the object.  
   c. the acceleration due to gravity.  
   d. All of the above

19. A medicine ball has a mass of 5 kg and is thrown with a speed of 2 m/s. What is its kinetic energy?
   a. 100 J  
   b. 10 J  
   c. 2000 J  
   d. 500 J

20. The efficiency of a ramp is 75%. If the amount of work input is 240 J, what is the amount of useful work output?
   a. 320 J  
   b. 310 J  
   c. 240 J  
   d. 180 J

21. An object weighing 75 N is dropped from the top of a building and falls a distance of 28 m to the ground. How much work does gravity do on the object from the time it is dropped to the time it hits the ground?
   a. zero  
   b. 75 J  
   c. 2100 J  
   d. 4625 J

22. An object has a kinetic energy of 810 J after falling a certain distance. If the mass of the object is 20 kg, what is the speed of the object at this time?
   a. cannot be determined  
   b. 9 m/s  
   c. 8 m/s  
   d. 7 m/s
23. The law of conservation of energy states that
   a. the energy of a system can disappear.
   b. it is impossible to make a perpetual motion machine.
   c. energy cannot change form.
   d. energy can neither be created nor destroyed.

Matching

Match the following:
   a. $N \cdot m$
   b. $J$
   c. $W$
   d. Mechanical Advantage
   e. Pulley
   f. stored energy
   g. energy of motion
   h. efficiency

24. Energy
25. Same as joules
26. Force in vs Force out
27. Potential energy
28. simple machine
29. Kinetic energy
30. Power
31. Work in vs work out
Problems
Write down the formula, plug in the numbers WITH UNITS, cancel units when possible, use sig figs and box your final answer (with appropriate units). All the formulas you will need are shown below (you may have to manipulate them). Good luck!

\[ W = Fd \]

For Levers, \[ MA = \frac{\text{Length}_{\text{effortarm}}}{\text{Length}_{\text{resistancearm}}} \]

\[ P = \frac{W}{t} \]

\[ KE = \frac{1}{2}mv^2 \]

For Inclined Planes, \[ MA = \frac{\text{Length}_{\text{ramp}}}{\text{Height}_{\text{ramp}}} \]

\[ PE = mgh \]

**For levers**, \( \left( \frac{\text{Length}_{\text{effortarm}}}{\text{Force}_{\text{effort}}} \right) \left( \frac{\text{Force}_{\text{resistance}}}{\text{Length}_{\text{resistancearm}}} \right) = \left( \frac{\text{Length}_{\text{resistancearm}}}{\text{Force}_{\text{resistance}}} \right) \left( \frac{\text{Force}_{\text{effort}}}{\text{Length}_{\text{effortarm}}} \right) \)

**For Inclined Planes**, \( \left( \frac{\text{Length}_{\text{ramp}}}{\text{Force}_{\text{upramp}}} \right) \left( \frac{\text{Force}_{\text{lift}}}{\text{Height}_{\text{ramp}}} \right) = \left( \frac{\text{Height}_{\text{ramp}}}{\text{Force}_{\text{lift}}} \right) \left( \frac{\text{Force}_{\text{upramp}}}{\text{Length}_{\text{ramp}}} \right) \)

32. A weightlifter lifts a barbell weighing 500N to a height of 2m. How much work was done?

33. An ant pushing a seed does .056J of work on the seed which weighs .0035N. How far did the ant push the object?

34. While rowing in a race, John uses his arms to exert a force of 165 N per stroke while pulling the oar .800 m. How much work does John do in 30.0 strokes?

35. A carpenter carries a board with a force of 75N for a distance of 20m in 2.65s. What is the power at which the carpenter carries the board?
36. A girl does 37J of work with power of 27W. How long did the girl work?

37. A pig with a mass of 5,430g carries a rock 565cm in 14.5s. What is the power produced by the pig?

38. A ramp can simplify a task by spreading out the work done.
   Part A: A smart man uses a ramp to push a box up a ramp that is 3.0 m long. He exerts a force of 75.0 N. How much work was done?

   Part B: A not so smart man says ramps are for sissies. He moans and groans as he lifts the box straight up 1.0 m, exerting a force of 225 N. How much work did this man do?
39. What is the mechanical advantage of a lever with a effort arm length of 5.7m and a resistant arm length of 2.0m?

If you input 27N of force on the effort arm, how much force would be applied to the resistant arm?

40. A worker wants to construct a ramp with a mechanical advantage of 15.0. If the ramp must reach a height of 20 m, how long must the ramp be?

41. A skydiver falling through the air at 42m/s has a mass of 155kg. What is the skydiver's kinetic energy?

42. A rock on the edge of the Grand Canyon has a mass of 4,500kg and is 1,800m above the bottom of the canyon. What is the rock's gravitational potential energy? (Show your answer using scientific notation.)
43. A grasshopper with a mass of .70g is ready to pounce to the ground from a leaf that is 27cm high. The wind is blowing from the west with a force of .06N. The grasshopper ate a piece of a leaf 2,499 seconds ago. The grasshopper pounces to the ground. With the grasshopper just .0010 cm from the ground, the grasshopper is traveling at .045 m/s. After landing on the ground, the grasshopper eats an aphid with a mass of .03 g. Answer the following questions; report all answers in scientific notation.

A. What is the gravitational potential energy of the grasshopper before he jumps?

B. What is the kinetic energy of the grasshopper when he is .001 cm from the ground?

C. What is the gravitational potential energy of the grasshopper when he is .001 cm from the ground?

D. What is the gravitational potential energy of the grasshopper after he eats the aphid?

44. A planet with a mass of 4.5 x 10^{16} kg is traveling through space at a velocity of 25,240 km/hr. What is the planet's kinetic energy?
Physical Science Chapter 9 Test
Answer Section

MULTIPLE CHOICE

1. C
2. D
3. C
4. B
5. D
6. D
7. B
8. D
9. C
10. B
11. B
12. A
13. C
14. C
15. C
16. C
17. C
18. D
19. B
20. D
21. C
22. B
23. D

MATCHING

24. B
25. A
26. D
27. F
28. E
29. G
30. C
31. H

PROBLEM

32. \[ W = Fd = (500N)(2m) = 1000J \]
33. \[ d = \frac{w}{F} = \frac{0.56J}{0.0035N} = 16m \]
34. \[ W = Fd = (165N)(.800m)(30) = 3960J \]
35. \[ P = \frac{W}{t} = \frac{Fd}{t} = \frac{(75N)(20m)}{2.65s} = \frac{600J}{s} = 600W \]
36. \[ t = \frac{W}{P} = \frac{37J}{27J} = 1.4s \]
37. \[ P = \frac{W}{t} = \frac{Fd}{t} = \frac{mgd}{t} = \frac{(5430g)(\frac{1kg}{1000g})(\frac{9.8m}{s^2})(565cm)(\frac{1m}{100cm})}{14.5s} = 21W \]
38. \[ W = Fd = (75.0N)(3.0m) = 225J \]

\[ W = Fd = (225N)(1m) = 225J \]
39. \[ MA = \frac{L_{\text{effort}}}{L_{\text{resistance}}} = \frac{5.7m}{2.0m} = 2.8 \]

\[ F_{\text{resistance}} = (MA)(F_{\text{effort}}) = (2.8)(27N) = 76N \]
40. \[ L_{\text{ramp}} = (MA)(H_{\text{ramp}}) = (15)(20m) = 300m \]
41. \[ KE = \frac{1}{2}mv^2 = (.5)(155kg)(42m/s)^2 = 140,000J \]
42. \[ PE = mgh = (4,500kg)(9.8m/s^2)(1,800m) = 7.9 \times 10^7 J \]
43. \[ A. PE = mgh = (.70g)(\frac{1kg}{1000g})(9.8m/s^2)(27cm)(\frac{1m}{100cm}) = 1.9 \times 10^{-3} J \]
\[ B. KE = \frac{1}{2}mv^2 = (.5)(.70g)(\frac{1kg}{1000g})(.045m/s)^2 = 7.1 \times 10^{-7} J \]
\[ C. PE = mgh = (.70g)(\frac{1kg}{1000g})(9.8m/s^2)(.0010cm)(\frac{1m}{100cm}) = 6.9 \times 10^{-8} J \]
\[ D. 0J (He's on the ground) \]
44. \[ KE = \frac{1}{2}mv^2 = (.5)(4.5 \times 10^{16} kg)(\frac{25,240km}{hr})(\frac{1000m}{1km})(\frac{1hr}{3600s})^2 = 1.1 \times 10^{24} J \]