1. Define the following terms:
   a. Energy
      ability to do work
   b. Work
      apply a force over a distance
   c. Kinetic energy
      energy of motion
   d. Gravitational potential energy
      energy stored due to object being elevated
   e. Elastic potential energy
      energy store in object when it changes shape
   f. Chemical energy
      energy in molecules
   g. Power
      rate of doing work
   h. Efficiency
      $\frac{\text{work output}}{\text{work input}}$
2. What is the SI unit of work and energy?
   joule
3. What is the original source of practically all of the energy on Earth?
   Sun
4. What does the Law of Conservation of Energy state?
   energy can't be created or destroyed
   only transferred or transform
5. If a force is exerted on an object but it does not move, was work done? Why or why not?
   NO - b/c $w = f \cdot d$ + $d = 0$

6. What is the formula for calculating gravitational potential energy? Define each variable.

GPE = mgh

m = mass g = grav. accel. h = height

7. If an object has 15 J of potential energy at a height of 50 cm, how much PE will it have if raised to a height of 100 cm?

2 x 15 J = 30 J

8. If the object in the previous question is dropped to the ground, how much kinetic energy will it have at the instant before it hits the ground, assuming air friction is so small that we can ignore it?

30 J

9. If one object has 200 J of PE when raised to a certain height, how much PE will a second object have at the same height if the second object has half the mass of the first object?

1/2 · 200 J = 100 J

10. An energy car is elevated to the top of a ramp. What is true about the energy of the car?

grav. PE

11. The energy car is released from the top of the ramp and rolls down the ramp. What is true about the energy of the car?

GPE transforming into KE

12. The energy car bounces off a rubber band at the bottom of the ramp and rolls back up the ramp.
   a. How far will the car roll back up the ramp?

   lower height than starting ht.

   b. Why will it behave in this way (in terms of energy)?

   b/c some energy is lost to system (friction)

13. What is the relationship between the work done to an energy car and the speed that it attains on the track?

direct (more work = more speed)

14. A train traveling at 5 m/s has 10,000 J of KE.
    a. How much KE will it have if velocity increases to 10 m/s?

    2^2 or 4x(10,000 J) = 40,000 J

    b. Does doubling the velocity double the KE? Why or why not?

    NO! 4x more — b/c v^2 ($KE = \frac{1}{2}mv^2$)

For any calculation that you show below, carry out these steps:

- Write the **formula** that you will use to solve the problem
- Re-write the formula, substituting known values **with units**
- Write the answer using the proper **unit**
- Check you answer for the proper number of **significant figures**
- Check you work for accuracy

15. A 25.0 kg bicycle is moving at 7.0 m/s. How much kinetic energy does the bicycle have?

$KE = \frac{1}{2}mv^2 = \frac{1}{2}(25.0\ kg)(7.0\ m/s)^2$

$= 612.5\ J = 610\ J$

16. If the bicycle increases its speed to 14. m/s, how much kinetic energy does the bicycle now have?

4x · 612.5 J = 2450 J

= 2500 J

17. Does doubling the velocity of the bicycle double the kinetic energy of the bicycle? Why or why not?

NO — 4x more!

v^2

18. What happens to the kinetic energy of the bicycle when it is braked to a full stop?

becomes heat

19. If a 12. kg suitcase is lifted to a height of 2.0 m, how much potential energy does the rock now have?

(G) $PE = mgh = (12.\text{ kg})(9.8\text{ m/s}^2)(2.0\text{ m})$

$= 235.2\text{ J} = 240\text{ J}$

20. If the suitcase is dropped to the ground, how much kinetic energy does the suitcase have in the instant before it hits the floor? (assume air friction is so small that we can ignore it)

240 J

21. How much potential energy does the suitcase have when it has fallen halfway to the ground? (again, we can ignore air friction)

$\frac{1}{2} \cdot 240\text{ J} = 120\text{ J}$

22. A force of 5.0 N is exerted on a shopping cart and it moves 3.0 m. How much work was done to the cart?

$W = f \times d = 5.0\text{ N} \cdot 3.0\text{ m} = 15\text{ N}\cdot\text{m}$

$= 15\text{ J}$

23. A bike has 300 J of work done to it, by applying a force of 20 N. How far did the bike move?

$d = W/f = \frac{300\text{ J}}{20\text{ N}} = 15\text{ m} = 20\text{ m}$

24. What is the efficiency of a simple machine that produces 2500 J of useful work from 5000 J of work input?

$eff = \frac{\text{work outpt.}}{\text{work input}} \times 100 = \frac{2500\text{ J}}{5000\text{ J}} \times 100 = 50\%$

25. What is the power output of an engine that does 50,000 J of work in 5 sec

$P = W/t = \frac{50{,}000\text{ J}}{5\text{ s}} = 10{,}000\text{ J/sec} = 10{,}000\text{ W}$

26. For 99% of human history, what was the main source of energy to do work?

muscle

27. What forms of energy made industrialization possible?

fossil fuels

28. Since 1950, how much has human energy consumption increased?

5x

29. Fill in the blanks below.

PE = 2,000 J   KE = 0

PE = 1,500 J   KE = 500 J

PE = 1000 J   KE = 1000 J

PE = 500 J   KE = 1500 J

PE = 0   KE = 2000 J