Work, Energy, & Power Practice Quiz Name____

VOCABULARY: IDENTIFY THE FOLLOWING

1. The SI units for energy and work JOULES
2. SI unit for power that is equivalent to Joules/second. WATTS
3. Type of energy associated with the motion of an object. KINETIC
4. Type of stored energy associated with the position of an object in a gravitational field. GRAVITATIONAL POTENTIAL
5. Type of stored energy associated with the configuration of an object that is stretchy or springy. ELASTIC POTENTIAL
6. Transfer of energy that occurs when a force acts through a distance. WORK
7. Measure of how quickly work is done or energy is transferred. POWER
8. The sum of the kinetic and potential energy in a system. TOTAL MECHANICAL ENERGY
9. Level where the height and gravitational potential energy are set at zero. REFERENCE LEVEL
10. Type of force that does not change the total mechanical energy of a system when it does work on it. Examples include gravitational forces, electrical forces, and spring forces. CONSERVATIVE FORCE
11. Type of a force that adds or removes energy from a system when it does work. Examples include frictional forces, air resistance, and applied forces. NON-CONSERVATIVE FORCE
12. Energy can be converted to different forms or transferred to different places but the total amount of energy does not change. LAW OF CONSERVATION OF ENERGY

True/False

13. A force acting in the direction an object is moving does positive work. TRUE
14. Kinetic energy is a vector quantity. FALSE
15. The gravitational potential energy of a moving object is always zero. FALSE
16. When mechanical energy is conserved, the kinetic energy you end up with always equals the gravitational potential energy you start with. FALSE
17. A force acting perpendicular to an object's displacement does negative work. FALSE
18. Energy can be converted from one form to another form. TRUE
19. The force needed to lift an object at a constant speed is equal to the weight of the object. TRUE
20. Centripetal forces do zero work on an object. TRUE
21. The harder you push on a wall the more work you do. FALSE
22. Doing the same amount of work in less time requires a greater power output. TRUE
23. The SI units of power, watts, are equivalent to joules times seconds. FALSE
24. The SI units of energy, joules, are equivalent to newtons times meters TRUE

Straight forward calculations. To receive credit be sure to: Identify Knowns/Unknowns, Write the Formula, Box answer with correct units on a separate sheet of paper.

25. How much kinetic energy does a 5.0 kg object have when it is moving at 3.0 m/s? By what factor does its kinetic energy change if its speed doubles? Ek=22.5 J, Ek depends on square of velocity so doubling velocity quadruples the Ek.

26. How much does the gravitational potential energy of a 1.2 kg textbook increase if you lift it upward 32 cm? 3.8 J

27. How long must a 12 W compact fluorescent light bulb be turned on to convert 18 kJ of electrical energy into light energy? 25 minutes

28. How much work is done by you when you lift a 9.0 kg object 0.50 meters off of the ground? 44 J

29. How much work is done by you when apply a horizontal force of 48 N to push a 35 kg box 8.0 meters down the hallway at a constant speed? 340 J (rounded to 2 sig. fig)

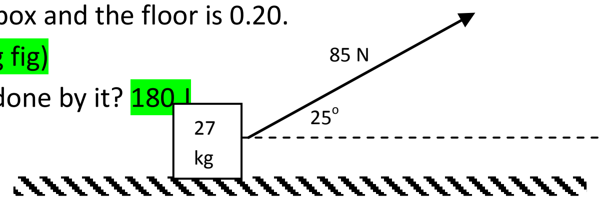
30. In the previous problem, how much work is done by the frictional force? By the normal force? By the gravitational force? $W_{friction}$= *negative* 340 J $W_{normal}=0$ $W_{grav}=0$

31. What power output is required of a motor that needs to lift a 450 kg elevator car 12 meters in 8.0 seconds? 6.6 kW

32. How long does it take a motor with an output of 8.0 W to lift a 2.0 kg object 88 cm? 2.2 s

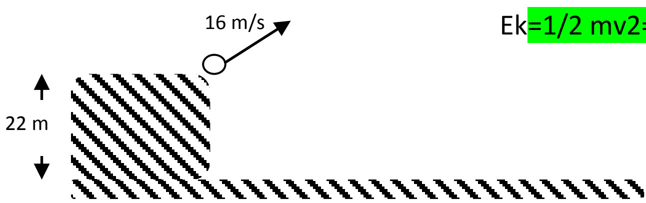
<u>More challenging problems</u> You are encouraged to solve all problems, but "starred" questions are not required.

33. A 27 kg box is dragged 4.0 meters across the floor by a rope that is angled at 25° above horizontal. The tension in the rope is 85 N and the coefficient of friction between the box and the floor is 0.20.
    a) How much work is done by the tension force? 310 J (2 sig fig)
    b) *How large is the frictional force and how much work is done by it? 180 J
    c) *How much kinetic energy is gained by the box? 130 J

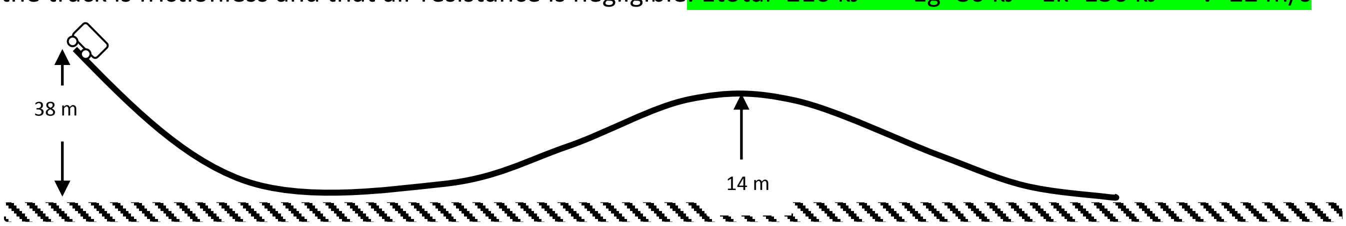


34. A 0.40 kg ball is launched at a speed of 16 m/s from a 22 m cliff.
    a) What are its kinetic energy, potential energy, and total mechanical energy at the instant it was launched? (Use the base of the cliff for your reference level.) Ek=51 J Eg=86 J Etot=137 J
    b) If air resistance is negligible what is the kinetic energy just before it hits the ground? Does this answer depend on the direction the ball was launched? Ek=137 J
    c) At what speed will the ball be moving just prior to striking the ground if air resistance is negligible? 26 m/s
    d) *If the ball is actually moving at 22 m/s just before hitting the ground, how much work was done by air resistance?

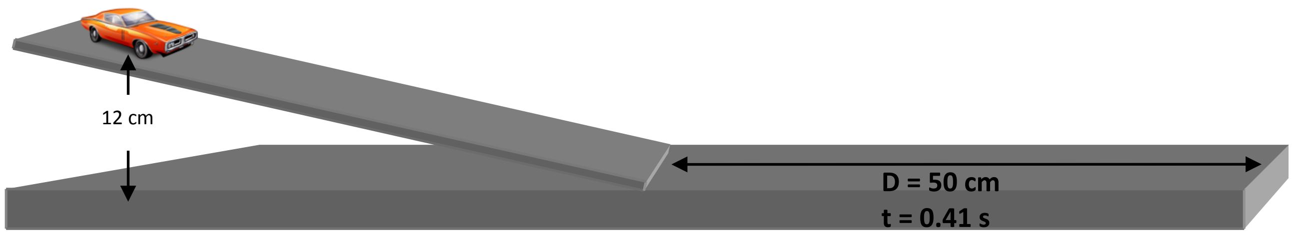
Ek=1/2 mv2=97 J Wair=DEtherm=40 J



35. A 580 kg rollercoaster car starts at rest atop a 38 meter hill. Find the gravitational potential energy, kinetic energy, mechanical energy, and speed of the car when it goes over the second hill which is 14 meters high. You may assume the track is frictionless and that air resistance is negligible. Etotal=216 kJ Eg=80 kJ Ek=136 kJ v=22 m/s



36. A 35 g matchbox car starts from rest at the top of a ramp that is 12 cm above the table top. When it reaches the flat table it travels 50.0 cm in 0.41 seconds. Describe the energy transformations that occur during this process. (A complete discussion will require you to calculate the initial and final mechanical energy of the car and compare them).



Initial: Ek + Eg = 0 + mgh = 41 mJ

Final: Ek + Eg= ½ mv2 + 0 = 26 mJ (Assume constant speed on flat part: v=d/t=1.22 m/s)

Discussion: At the top of the ramp the car had 41 millijoules of gravitational potential energy (relative to the table top) but did not have any kinetic energy since it was not yet moving. As the car descended its gravitational potential energy was dropping but it gained kinetic energy as it accelerated and gained speed. At the bottom of the ramp it no longer had any gravitational potential energy but had a kinetic energy of about 26 millijoules (based on Its average speed over the 50 cm distance). Since the total mechanical energy dropped significantly (from 41 mJ to 26 mJ) we can infer that the thermal energy of the ramp, table top, and surrounding air increased by about 25 mJ. The Law of Conservation of energy states that energy is not created or destroyed, so the loss of mechanical energy must be a result of non-conservative forces such as friction and air resistance that warmed up the table and the air.