FPS – Unit 4 Review – Chapter 14-15 KEY

Name_____ Period_____

Conceptual Understanding

1. Define work in scientific terms, and give the formula. What is it measured in?

   Work is a force applied over a distance to move and object. Force applied and object's motion are in the SAME direction. Work = force x distance ; measured in Joules

2. Define power in scientific terms, and give the formula. How is it measured?

   Power is the amount of work done in a period of time. Power = work/time ; measured in Watts

3. Define kinetic & potential energy in scientific terms, and give the formula(s). What is the unit?

   Energy is the ability to do work; kinetic energy is the energy of motion and potential energy is energy stored due to position or shape. KE = ½ mv^2 and PE= mgh both measured in Joules

4. Which factors affect gravitational potential energy? Kinetic energy?

   Mass, force of gravity (as the acceleration) and height from reference point affects gravitational potential energy. Mass and velocity affect kinetic energy.

5. How can machines make work easier for you?

   Machines can increase the distance moved, change the direction of force, and increase the force applied to make work easier.

6. What is mechanical energy? Give the formula and an example.

   Mechanical energy is the total energy associated with moving objects. For example, a cart moving up and down a coaster track has varying mechanical energy. ME = KE + PE

7. What is chemical energy? Explain and give an example.

   The energy stored in the chemical bonds of compounds which can be released when broken down. Eg.: food, gasoline

8. What is thermal energy? Explain and give an example.

   The energy associated with the total potential and kinetic energy of the particles that make up objects. Their motion generates thermal energy (heat). Eg.: your body, lava

9. What is electrical energy? Explain and give an example.

   The energy associated with electric charges doing work. Eg.: lightning

10. What is electromagnetic energy? Explain and give an example.

    The energy that travels through space as waves, which includes MANY examples. Eg.: visible light, x-rays, microwave

11. What is nuclear energy? Explain and give an example.

The energy contained within the nuclei of atoms which can be released with nuclear fission or fusion. Eg.: ALL atoms! Released in nuclear power plants or on sun

12. Define the law of conservation of energy.

The Law of Conservation of Energy states that energy cannot be created or destroyed; it can only be converted/transferred.

13. List the energy types from your foldable and give examples.

Nuclear plants – convert nuclear energy to electrical energy.

Hydropower/hydroelectricity – mechanical energy of water converts to electrical energy

Solar energy – many energies at play – electromagnetic energy enters solar panels and converts to electrical energy or thermal energy.

Geothermal energy – thermal energy beneath the Earth's surface, thermal energy producing steam drives electrical energy

Biomass energy – chemical emerged stored in living things

Renewable sources – one example is hydrogen cells

Nonrenewable – uranium, fossil fuels, natural gas, coal,

Applying Concepts

14. What energy conversions occur when lighting a match? Use complete sentences, and be sure to mention AT LEAST 4 different types of energies.

(I will summarize—you should be able to write in complete sentences in full thoughts.) When lighting a match, muscles move converting chemical energy → kinetic energy. Match rubs with friction, converting to thermal energy. Chemical reaction in match releases chemical energy. Flame converts to visible light (which is electromagnetic energy). Converts some to thermal energy again.

15. Recall the watermelon experiment. Using the list of words provided and in complete sentences, describe in terms of **energy** what occurred and why.

a. elastic
c. converted
b. potential energy
d. force
e. surface area
f. overcome
g. propagated

Rubber bands stored elastic potential energy which were focused in a small surface area in the middle of the watermelon. The force applied in the small surface area overcame the forces/pressures pushing outward from within the watermelon. Due to this, a crack in the rind was created and the large amount of stored elastic potential energy was converted to kinetic energy as the crack propagated and the watermelon burst.

16. How many watts are in one horsepower? Convert 12,000 watts to horsepower.

    1 hp = 746 watts. 12,000 watts / 746 = 16.1 horsepower

17. How can you increase power?

    To increase power, you can **increase** the amount of work you do in a given amount of time, or you can do a given amount of work in **less** time.

18. How does gravitational potential energy change on the moon? Why?

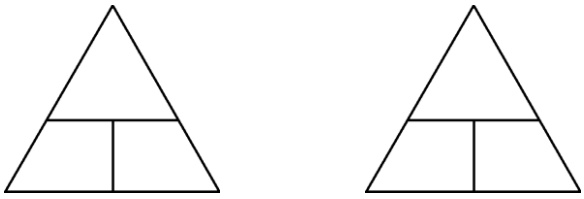
    GPE is less on moon because gravity is LESS

Graphical and Mathematical Problems

The triangles below may help you with work and power. You will have all necessary formulas on the test, but NOT units or how to rearrange them. Write the formulas in the space provided to complete the math problems below.

$Work = F \cdot d$ $Power = \frac{work}{t}$ $KE = \frac{1}{2}m \cdot v^2$ $PE = m \cdot g \cdot h$ $ME = KE + PE$

1 hp = 746 watts



19. What is the force necessary for an engine to do 632 J of work over 30 meters?

    F= w/d = 632/30 = 21 N

20. What is the work done over 10 meters with 1200 N of force?

    W = Fxd = 1200 x 10 = 12,000 J

21. Cheryl is a young girl climbing up a 2 m flight of 10 stairs. She is essentially "carrying" herself up the stairs, and her weight is 60 N. What is the work done ***per step***?

    W = 2 x 60 = 120J / 10 steps = 12 J per step

22. How long does it take Cheryl to cut the grass if her lawnmower has 40 watts of power and she needs to do 6,000 J of work?

t = w/P = 6,000/40 = 150 sec

23. How powerful is a horse that can do 50,000 J of work in 40 s? How much horsepower does it have? (1 hp = 746 watts)

P = w/t = 50,000/40 = 1250 watts/746 = 1.68 horsepower

24. Cheryl and her friend James are playing in a parking lot while their parents shop. James wants to push Cheryl (who weighs 50N) in a shopping cart which weighs 18 N across the parking lot. The parking lot is 42 meters long, and it takes James 3 minutes to push her all the way across. Showing all your work, how powerful is James? (Hint: find work done first, and make sure all units are correct before solving.)

Work = Force x distance = (50N + 18 N) x (42 m) = 2856 J

Power = Work / time = (2856 J) / (3 min x 60) = 15.87 watts

25. If a plane is traveling at 150 m/s and has a mass of 8930 kg, how much energy does it have?

KE = ½ (8930kg) $(150)^2$ = 100462500 J

26. A 49 kg skateboarder is sitting at the top of a 34 m ramp ON THE MOON (g=1.6 m/s^2). How much energy does she have?

PE = (49kg) (1.6 m/s^2) (34m) = 2665.6 J

27. A 59 kg skateboarder is sitting at the top of a 34 m ramp ON THE EARTH (g=9.8 m/s^2). How much energy does she have?

PE = (59kg)(9.8m/s^2) (34m) = 19658.8 J

28. A system has 10 J of kinetic energy and 11 J of potential energy. What is the mechanical energy?

ME = 10J + 11J = 21 J

29. A system has 100 J of mechanical energy and 21 J of potential energy. What is the kinetic energy?

(100J) = 21J + KE

KE = 79 J

30. On Earth ($g=9.8\ m/s^2$), a machine with a mass of 15 kg has 100 J of mechanical energy and 25 J of kinetic energy. How high up is the object? (Hint: solve for the potential energy first.)

(100J) = (25J) + PE

PE = 75 J = (15kg)(9.8m/s²) h (divide both sides by 147, which is product of 9.8x15)

h = 0.51 m

31. The bonus questions will come from the Understanding Car Crash video notes. Please review those notes/videos to prepare for the bonus!