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Continuing Education Course #502
Basics of Energy, Momentum, and Power
Part 1 - Basics of Energy for All Engineers

1. A new Venus rover is being built at JPL in California. Its design mass is 1920 kg. What will be its mass on Venus?
 - a. 1736 kg
 - b. 2123 kg
 - c. 1920 kg
 - d. 17,030 N

2. Another rover vehicle is planned for Mars. Its weight on Earth is estimated to be 3500 N. What will be its estimated weight on Mars? Mars gravity = 3.71 m/s^2 , Earth gravity = 9.81 m/s^2 .
 - a. It is the same, 3500 N
 - b. 750 N
 - c. 284 N
 - d. 1324 N

3. The correct official term for the measurement system now in use in the United States is:
 - a. Imperial System
 - b. United States Customary System
 - c. English System
 - d. Foot-Pound-Second system

4. Energy is also described or defined as:
 - a. Force of one newton acting for one meter distance
 - b. Force of one pound force acting for one foot distance
 - c. Work
 - d. All of the above

5. James Joule performed experiments on converting mechanical energy to thermal energy. Which of the following best describes his experiment?
 - a. His experiments were surprisingly accurate in spite of energy losses
 - b. Joule calculated an average value of 772.7 ft-lbf/Btu
 - c. Joule's work was performed in 1843
 - d. All the above

6. A drive shaft is turned to hoist a freight elevator. The shaft turns at 6 RPM for a total of three minutes, and torque on the shaft is 1500 lbf-ft. What is the total energy expended?
 - a. 169,500 ft-lbf
 - b. 210,100 ft-lbf
 - c. 54,000 ft-lbf
 - d. 32,000 ft-lbf

7. Is there any practical reason to include the suffix "e", as in "ge" when referring to gravitational acceleration on Earth?

- a. No, gravitation is the same everywhere
- b. No, sometime we have to make assumptions.
- c. No, everyone will know we are referring to Earth's gravity.
- d. Yes, we are in the 21st century and our project may be somewhere other than Earth.

8. At a scientific outpost in Antarctica, a shipping crate of mass 200 kg is pulled 30 m across a horizontal floor and then raised 10 m to a storage shelf. The coefficient of friction of the floor is 0.15. What is the total energy expended? ($g = 9.832$ at the poles).

- a. 19,959 J
- b. 28,513 J
- c. 16,500 J
- d. 23,200 J

9. A steel ball of mass 12 kg is dropped from a height of 50 m. What is its kinetic energy just before it hits the ground? Ignore air resistance. Earth gravity = $g_e = 9.81$

- a. 10,000 J
- b. 6420 J
- c. 5886 J
- d. 3680 J

10. An asteroid has a mass of 4 kg just before impacting Earth at a velocity of 20 km/s. What is the linear kinetic energy of the asteroid at impact? (mJ = mega joule = 10^6 J)

- a. 200 mJ
- b. 600 mJ
- c. 800 mJ
- d. 1200 mJ

11. In James Joule's 1843 experiment he compared the change in potential energy to the increase in temperature of water. What fundamental law did this experiment demonstrate?

- a. Importance of thermal insulation in experiments
- b. Energy cannot be created or destroyed, but can only change in form
- c. Rotational kinetic energy conversion to linear kinetic energy
- d. How to heat water economically

12. A flywheel with angular moment of inertia $250 \text{ kg}\cdot\text{m}^2$ is rotating at 1800 RPM. What is the angular kinetic energy of the flywheel?

- a. 3,340,000 J
- b. 4,465,000 J
- c. 7,250,000 J
- d. 5,350,000 J

13. A machine compresses a spring with a spring constant $k = 100 \text{ N/m}$, compressing it from its rest length of 0.50 m to 0.30 m. What is the elastic potential energy stored in the spring?

- a. 5.0 J
- b. 1.5 J
- c. 2.0 J
- d. 2.5 J

14. A steel rod of emissivity $e = 0.8$ has a surface area of 1.0 m^2 and temperature $827 \text{ }^\circ\text{C}$. Using the Stefan-Boltzmann law, calculate the power emitted by the hot steel rod.

- a. 20,000 W
- b. 45,000 W
- c. 66,400 W
- d. 75,000 W

15. Calculate total potential energy of water stored in an elevated tank. Center of gravity of the water is 50 ft above ground level, and the tank holds 150,000 gallons of water. Water weighs = 8.35 lbf/gallon.

- a. 85,500,000 ft-lbf
- b. 62,625,000 ft-lbf
- c. 42,500,000 ft-lbf
- d. 90,500,000 ft-lbf

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