Energy Practice Test

1. Energy due to position is called
   A. heat energy
   B. bond energy
   C. potential energy
   D. kinetic energy
   E. None of the above

2. Energy due to motion is called
   A. bond energy
   B. heat energy
   C. potential energy
   D. kinetic energy
   E. None of the above

3. As a ball rolls down a hill, the potential energy _____ and the kinetic energy _____.
   A. increases; decreases
   B. increases; increases
   C. decreases; decreases
   D. Potential and kinetic energy are always constant according to the law of conservation of energy.
   E. decreases; increases

4. Which of the following is a measure of the random motions of the components of a substance?
   A. energy
   B. frictional heating
   C. temperature
   D. heat
   E. work

5. The flow of energy due to a temperature difference is called
   A. energy
   B. heat
   C. work
   D. temperature
   E. None of the above

6. Which of the following is exothermic?
   A. A reaction in which the products are higher in potential energy than the reactants.
   B. The melting of a solid.
   C. The condensation of a gas.
   D. Rolling a ball up a hill.
   E. None of the above

7. In an endothermic reaction, energy flows
   A. into the system.
   B. into the surroundings.
   C. into the universe.
   D. out of the system.
   E. None of the above

8. Which of the following is a valid unit for specific heat (or specific heat capacity)?
   A. g °C/cal
   B. °C
   C. cal
   D. cal/g
   E. cal/g °C

9. The amount of energy needed to heat 2.00 g of carbon from 50.0°C to 80.0°C is 42.6 J. The specific heat capacity of this sample of carbon is
   A. 2556 J/g °C
   B. 1.42 J/g °C
   C. 0.710 J/g °C
   D. 639 J/g °C
   E. 0.355 J/g °C

10. A 6.75 g sample of gold (specific heat capacity = 0.130 J/g °C) is heated using 50.6 J of energy. If the original temperature of the gold is 25.0°C, what is its final temperature?
   A. 24.4°C
   B. 57.7°C
   C. 82.7°C
   D. 43.4°C
   E. 32.7°C

11. The specific heat capacity of aluminum is 0.89 J/g °C. Calculate the amount of energy needed to warm 1.92×10^3 g of aluminum from 73.0°C to 155.0°C?

12. Which is larger, one calorie or one joule?

13. When 1 mole of ethylene (C_2H_4) is burned at constant pressure, 1410 kJ of energy is released as heat. Calculate ΔH for a process in which 10.0 g of ethylene is burned at constant pressure.
   A. 705 kJ
   B. -503 kJ
   C. 503 kJ
   D. -705 kJ
   E. None of the above

14. Assume that 372 J of heat is added to 5.00 g of water originally at 23.0°C. What would be the final temperature of the water? (Specific heat capacity of water = 4.184 J/g °C.)

15. The device used to determine the heat associated with a chemical reaction is called a
   A. heatometer
   B. barometer
   C. joulorometer
   D. calorimeter
   E. None of the above

16. How much energy will be needed to heat 60.0 gal of water from 22.0°C to 110.0°C? (Note that 1.00 gal weighs 3.77 kg and that water has a specific heat capacity of 4.184 J/g °C.)

17. The molar heat of fusion of water is 6.02 kJ/mol. Calculate the energy required to melt 14.0 g of water.
    A. 7.74 kJ
    B. 84.3 kJ
    C. 4.68 kJ
    D. 6.02 kJ
    E. None of the above

18. The molar heat of fusion of water is 6.02 kJ/mol. Calculate the energy required to melt 46.8 g of water.
    A. 2.32 kJ
    B. 7.77 kJ
    C. 282 kJ
    D. 6.02 kJ
    E. None of the above

19. Choose the state of water in which the water molecules are farthest apart on average.
    A. ice (solid)
    B. all the same
    C. liquid
    D. steam (vapor)

20. The specific heat capacity of liquid water is 4.18 J/g°C. Calculate the quantity of energy required to heat 10.0 g of water from 26.5°C to 83.7°C.
    A. 2.39×10^3 J
    B. 572 J
    C. 837 J
    D. 239 J
    E. None of the above

21. Calculate the quantity of energy required to change 26.5 g of liquid water to steam at 100°C. The molar heat of vaporization of water is 40.6 kJ/mol.
    A. 59.8 kJ
    B. 1.53 kJ
    C. 27.6 kJ
    D. 1.08×10^3 kJ
    E. None of the above

22. 12,500 J of energy is added to 2.0 mol (36 g) of H_2O as an ice sample at 0°C. The mole heat of fusion is 6.02 kJ/mol. The specific heat of liquid water is 4.18 J/mol K. The molar heat of vaporization is 40.6 kJ/mol. The resulting sample contains which of the following?
    A. ice and water
    B. only water
    C. only water vapor
    D. water and water vapor
    E. only ice

23. Calculate the quantity of energy required to change 3.00 mol of liquid water to steam at 100°C. The molar heat of vaporization of water is 40.6 kJ/mol.
    A. 40.6 kJ
    B. 122 kJ
    C. 300 kJ
    D. 13.5 kJ
    E. None of the above

24. Polonium is a naturally radioactive element decaying with the loss of an alpha particle
    $^{210}_{84}Po \rightarrow {}^{4}_{2}H^{+}$
    What is the second product of this decay?
    A. $^{206}_{85}At$
    B. $^{208}_{80}Hg$
    C. $^{214}_{86}Rn$
    D. $^{206}_{82}Pb$
    E. None of the above

25. Beta particles are
    A. neutrons
    B. electrons
    C. x-rays
    D. helium nuclei
    E. protons

26. Choose the particle having a relative mass of 1 amu and no charge.
    A. proton
    B. beta particle
    C. alpha particle
    D. neutron
    E. None of the above

27. The atomic particle having a mass of 1 amu and a charge of 1+ is
    A. an electron
    B. an alpha particle
    C. a neutron
    D. a proton
    E. None of the above

28. The cesium-131 nuclide has a half-life of 30 years. After 90 years, about 6 g remain. The original mass of the cesium-131 sample is closest to
    A. 50 g
    B. 40 g
    C. 60 g
    D. 30 g
    E. 70 g

29. The element curium ($Z = 242$, $A = 96$) can be produced by positive-ion bombardment when an alpha particle collides with which of the following nuclei? Recall that a neutron is also a product of this bombardment.
    A. $^{249}_{98}Cf$
    B. $^{241}_{95}Am$
    C. $^{241}_{94}Pu$
    D. $^{239}_{92}U$
    E. $^{239}_{94}Pu$

Answer Sheet

1. **C.** potential energy
2. **D.** kinetic energy
3. **E.** decreases; increases
4. **C.** temperature
5. **B.** heat
6. **C.** The condensation of a gas.
7. **A.** into the system.
8. **E.** cal/g °C
9. **C.** 0.710 J/g °C
10. **C.** 82.7°C
11. 140 kJ
12. one calorie
13. **B.** -503 kJ
14. 40.8°C
15. **D.** calorimeter
16. 8.33×10^4 kJ
17. **C.** 4.68 kJ
18. **E.** None of the above
19. **D.** steam (vapor)
20. **A.** 2.39×10^3 J
21. **A.** 59.8 kJ
22. **B.** only water
23. **B.** 122 kJ
24. **D.** $^{206}_{82}Pb$
25. **B.** electrons
26. **D.** neutron
27. **D.** a proton
28. **A.** 50 g
29. **C.** $^{241}_{94}Pu$

Standards Summary

CA 11.d	Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.
CA 11.f*	Students know how to calculate the amount of a radioactive substance remaining after an integral number of half lives have passed.
CA 7.a	Students know how to describe temperature and heat flow in terms of the motion of molecules (or atoms).
CA 7.b	Students know chemical processes can either release (exothermic) or absorb (endothermic) thermal energy.
CA 7.d	Students know how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase change.
NSES B.1.3	The nuclear forces that hold the nucleus of an atom together, at nuclear distances, are usually stronger than the electric forces that would make it fly apart. Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions. Fission is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure, and is the process responsible for the energy of the sun and other stars.
NSES B.1.4	Radioactive isotopes are unstable and undergo spontaneous nuclear reactions, emitting particles and/or wavelike radiation. The decay of any one nucleus cannot be predicted, but a large group of identical nuclei decay at a predictable rate. This predictability can be used to estimate the age of materials that contain radioactive isotopes.
NSES B.2.5	Solids, liquids, and gases differ in the distances and angles between molecules or atoms and therefore the energy that binds them together. In solids the structure is nearly rigid; in liquids molecules or atoms move around each other but do not move apart; and in gases molecules or atoms move almost independently of each other and are mostly far apart.
NSES B.3.2	Chemical reactions may release or consume energy. Some reactions such as the burning of fossil fuels release large amounts of energy by losing heat and by emitting light. Light can initiate many chemical reactions such as photosynthesis and the evolution of urban smog.
NSES B.5.2	All energy can be considered to be either kinetic energy, which is the energy of motion; potential energy, which depends on relative position; or energy contained by a field, such as electromagnetic waves.
NSES B.5.3	Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion.

NSES B.5.4	Everything tends to become less organized and less orderly over time. Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly. Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection and the warming of our surroundings when we burn fuels.