1. May be used in combination with a calorimeter to compare the specific heats of two substances

- A. Thermometer
- B. Conductivity tester
- C. Salt bridge
- D. Buret
- E. Graduated cylinder

2. Is used to measure the volume of a solid by water displacement

- A. Thermometer
- B. Conductivity tester
- C. Salt bridge
- D. Buret
- E. Graduated cylinder

3. Useful for adding small quantities of acid into a base

- A. Thermometer
- B. Conductivity tester
- C. Salt bridge
- D. Buret
- E. Graduated cylinder

4. Completes the circuit of an electrochemical cell

- A. Thermometer
- B. Conductivity tester
- C. Salt bridge
- D. Buret
- E. Graduated cylinder

5. Always amphoteric in nature

- A. Nucleic acids
- B. Proteins
- C. Carbohydrates
- D. Lipids
- E. Electrolytes

6. Found as both straight-chained and branched polymers

- A. Nucleic acids
- B. Proteins
- C. Carbohydrates

○ D. Lipids

○ E. Electrolytes

7. Deoxyribose in DNA nucleotides belongs to this family of biologically important molecules

○ A. Nucleic acids

○ B. Proteins

○ C. Carbohydrates

○ D. Lipids

○ E. Electrolytes

8. Always ionic in nature

○ A. Nucleic acids

○ B. Proteins

○ C. Carbohydrates

○ D. Lipids

○ E. Electrolytes

9. Tend not to be water soluble, and aggregate into droplets or molecular bilayers

○ A. Nucleic acids

○ B. Proteins

○ C. Carbohydrates

○ D. Lipids

○ E. Electrolytes

10. Represents the decomposition of a compound into its constituent elements

○ A. $Ag^+ + Br^- \rightarrow AgBr$

○ B. $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$

○ C. $^{234}_{92}U \rightarrow ^{230}_{90}Th + ^{4}_{2}He$

○ D. $+ ^{30}_{15}P \rightarrow ^{30}_{14}Si + ^{0}_{1}e$

○ E. $2HgO \rightarrow 2Hg + O_2$

11. Represents alpha decay

○ A. $Ag^+ + Br^- \rightarrow AgBr$

○ B. $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$

○ C. $^{234}_{92}U \rightarrow ^{230}_{90}Th + ^{4}_{2}He$

○ D. $+ ^{30}_{15}P \rightarrow ^{30}_{14}Si + ^{0}_{1}e$

○ E. $2HgO \rightarrow 2Hg + O_2$

12. Represents an oxidation-reduction reaction

○ A. $Ag^+ + Br^- \rightarrow AgBr$

○ B. $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$

○ C. $^{234}_{92}U \rightarrow ^{230}_{90}Th + ^{4}_{2}He$

○ D. $+ ^{30}_{15}P \rightarrow ^{30}_{14}Si + ^{0}_{1}e$

○ E. $2HgO \rightarrow 2Hg + O_2$

13. Causes the neutron-to-proton ratio in a nucleus to be lowered

○ A. $Ag^+ + Br^- \rightarrow AgBr$

○ B. $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$

○ C. $^{234}_{92}U \rightarrow ^{230}_{90}Th + ^{4}_{2}He$

○ D. $+ ^{30}_{15}P \rightarrow ^{30}_{14}Si + ^{0}_{1}e$

○ E. $2HgO \rightarrow 2Hg + O_2$

14. Is the activation energy of the reverse reaction
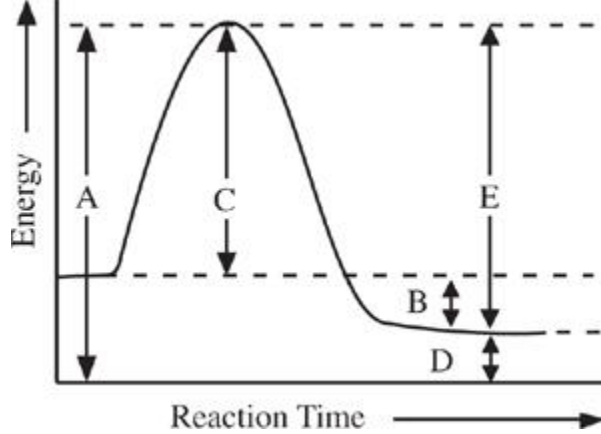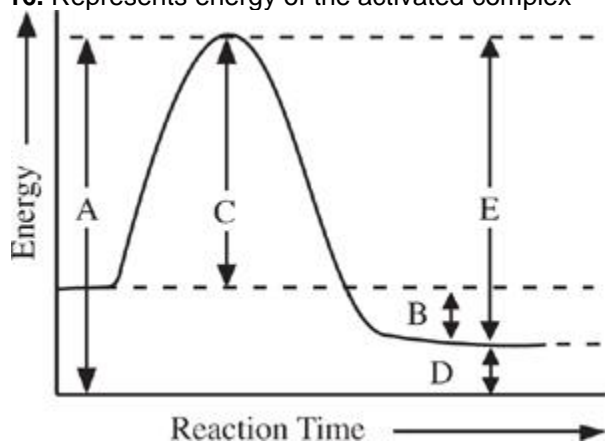

○ A.

○ B.

○ C.

○ D.

○ E.

15. Is the enthalpy change of the forward reaction
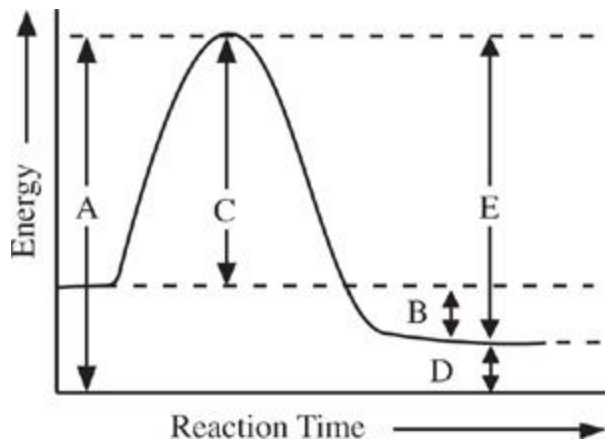
- ○ A.
- ○ B.
- ○ C.
- ○ D.
- ○ E.

16. Represents energy of the activated complex

- ○ A.
- ○ B.
- ○ C.
- ○ D.
- ○ E.

17. Holds a sample of barium iodide, BaI₂, together

- ○ A. Hydrogen bonding
- ○ B. Ionic bonding
- ○ C. Metallic bonding

   ○ D. Nonpolar covalent bonding

   ○ E. Polar covalent bonding

18. Allows solids to conduct electricity

   ○ A. Hydrogen bonding

   ○ B. Ionic bonding

   ○ C. Metallic bonding

   ○ D. Nonpolar covalent bonding

   ○ E. Polar covalent bonding

19. Attracts atoms of hydrogen to each other in an H_2 molecule

   ○ A. Hydrogen bonding

   ○ B. Ionic bonding

   ○ C. Metallic bonding

   ○ D. Nonpolar covalent bonding

   ○ E. Polar covalent bonding

20. Responsible for relatively low vapor pressure of water

   ○ A. Hydrogen bonding

   ○ B. Ionic bonding

   ○ C. Metallic bonding

   ○ D. Nonpolar covalent bonding

   ○ E. Polar covalent bonding

21. Gives off a purplish vapor as it sublimes

   ○ A. Iron(III) chloride, $FeCl^3(s)$

   ○ B. Iodine, $I_2(s)$

   ○ C. Sodium hydroxide, $NaOH(s)$

   ○ D. Sucrose, $C_{12}H_{22}O_{11}(s)$

   ○ E. Graphite, $C(s)$

22. Can conduct electricity in the solid state

   ○ A. Iron(III) chloride, $FeCl^3(s)$

   ○ B. Iodine, $I_2(s)$

   ○ C. Sodium hydroxide, $NaOH(s)$

   ○ D. Sucrose, $C_{12}H_{22}O_{11}(s)$

   ○ E. Graphite, $C(s)$

23. Its dissolution in water is highly exothermic

A. Iron(III) chloride, $FeCl^3(s)$

B. Iodine, $I_2(s)$

C. Sodium hydroxide, $NaOH(s)$

D. Sucrose, $C_{12}H_{22}O_{11}(s)$

E. Graphite, $C(s)$

24. What is the number of protons and neutrons in an atom with mass number 89 and atomic number 39?

A. 50 protons and 50 neutrons

B. 50 protons and 39 neutrons

C. 39 protons and 89 neutrons

D. 39 protons and 50 neutrons

E. 39 protons and 39 neutrons

25. $...C_4H_{10}(g) + ...O_2(g) \rightarrow ...CO_2(g) + ...H_2O(l)$
When the above equation is balanced using the lowest whole-number terms, the coefficient of CO_2 is

A. 2

B. 4

C. 8

D. 10

E. 13

26. Which of the following is closest in mass to a proton?

A. Alpha particle

B. Positron

C. Neutron

D. Electron

E. Hydrogen molecule

27. What is the approximate percentage composition by mass of the element oxygen in the compound $HClO_4$?

A. 16%

B. 32%

C. 50%

D. 64%

E. 75%

28. If two atoms that differ in electronegativity combine by chemical reaction and share electrons, the bond that joins them will be

A. metallic

B. ionic

C. a hydrogen bond

D. nonpolar covalent

E. polar covalent

29. When the temperature of a 20-gram sample of water is increased from 10°C to 30°C, the heat transferred to the water is

A. 600 calories

B. 400 calories

C. 200 calories

D. 30 calories

E. 20 calories

30. What is the oxidation state of chromium, Cr, in the compound potassium dichromate, $K_2Cr_2O_7$?

A. 1

B. 2

C. 3

D. 6

E. 12

31. An aqueous solution with pH 5 at 25°C has a hydroxide ion (OH⁻) concentration of

A. 1×10^{-11} molar

B. 1×10^{-9} molar

C. 1×10^{-7} molar

D. 1×10^{-5} molar

E. 1×10^{-3} molar

32. $2H_2O(g) \rightarrow 2H_2(g) + O_2(g)$
The volume of water vapor required to produce 44.8 liters of oxygen by the above reaction is

A. 11.2 liters

B. 22.4 liters

C. 44.8 liters

D. 89.6 liters

E. 100.0 liters

33. When 190 grams of $MgCl_2$ are dissolved in water and the resulting solution is 500 milliliters in volume, what is the molar concentration of $MgCl_2$ in the solution?

A. 2.0 *M*

B. 4.0 *M*

C. 8.0 *M*

D. 12.0 *M*

E. 16.0 *M*

34. When a fixed amount of gas has its Kelvin temperature doubled and its pressure doubled, the new volume of the gas is

A. four times greater than its original volume

B. twice its original volume

C. unchanged

D. one-half its original volume

E. one-fourth its original volume

35. In 12.4 hours, a 100 gram sample of an element decays so that its mass is 25 grams. What is the approximate half-life of this radioactive substance?

A. 1.6 hours

B. 3.1 hours

C. 6.2 hours

D. 24.8 hours

E. 49.6 hours

36. In the equation $Q \rightarrow {}^{4}_{2}He + {}^{216}_{85}At$, the species represented by Q is

A. ${}^{220}_{87}Fr$

B. ${}^{212}_{83}Bi$

C. ${}^{220}_{87}At$

D. ${}^{212}_{83}Fr$

E. ${}^{216}_{85}Bi$

37. A compound with a molecular weight of 56 amu has an empirical formula of CH_2. What is its molecular formula?
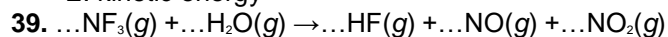
A. C_2H_2

B. C_2H_4

C. C_4H_8

D. C_4H_{10}

E. C_6H_{12}

38. The change in heat energy for a reaction is best expressed as a change in

A. enthalpy

B. absolute temperature

C. specific heat

○
   D. entropy

○
   E. kinetic energy

39. $\ldots NF_3(g) + \ldots H_2O(g) \rightarrow \ldots HF(g) + \ldots NO(g) + \ldots NO_2(g)$

When the equation for the reaction above is balanced, how many moles of NF_3 would be required to react completely with 6 moles of H_2O?

○
   A. 0.5 mole

○
   B. 1 mole

○
   C. 2 moles

○
   D. 3 moles

○
   E. 4 moles

40. Which characteristic is associated with bases?

○
   A. React with metal to produce hydrogen gas

○
   B. Donate an unshared electron pair

○
   C. Always contain the hydroxide ion in their structure

○
   D. Taste sour

○
   E. Formed by the reaction of a nonmetal oxide and water

41. An element has the following properties: shiny, brittle, poor electrical conductivity, and high melting point. This element can be best classified as a(n)
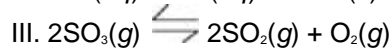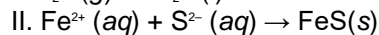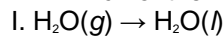
○
   A. alkali metal

○
   B. halogen

○
   C. metalloid

○
   D. transition metal

○
   E. noble gas

42. Which of the following forward processes produces a decrease in entropy?

I. $H_2O(g) \rightarrow H_2O(l)$

II. $Fe^{2+} (aq) + S^{2-} (aq) \rightarrow FeS(s)$

III. $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$

○
   A. I only

○
   B. III only

○
   C. I and II only

○
   D. II and III only

○
   E. I, II, and III

43. Which of the following will raise the boiling point of a sample of water?

○
   A. Heat the water

○
   B. Mix gasoline into the water

○
   C. Bring the water sample to a higher altitude

○ D. Place the water sample on a magnetic stirrer

○ E. Dissolve table sugar into the water

44. Elements H and J lie in the same period. If the atoms of H are smaller than the atoms of J, then compared to atoms of J, atoms of H are most likely to

○ A. exist in a greater number of isotopes

○ B. exist in a lesser number of isotopes

○ C. exist in a greater number of oxidation states

○ D. have a greater positive charge in their nuclei

○ E. have a lesser positive charge in their nuclei

45. ...$Al(s) +...O_2(g) \rightarrow ...Al_2O_3(s)$

When the equation representing the reaction shown above is completed and balanced and all coefficients are reduced to lowest whole-number terms, the coefficient of $O_2(g)$ is

○ A. 1

○ B. 2

○ C. 3

○ D. 4

○ E. 6

46. Which of the following solids has a brilliant blue color?

○ A. $Ca(OH)_2$

○ B. KCl

○ C. NaBr

○ D. Fe_2O_3

○ E. $CuSO_4$