選擇題，四選一，每題 4 分。

1. An $^{56}Fe^{2+}$ particle contains

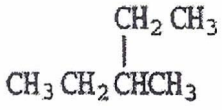
(A) 28 protons, 28 neutrons and 26 electrons.

(B) 26 protons, 30 neutrons and 24 electrons.

(C) 26 protons, 26 neutrons and 26 electrons.

(D) 54 protons, 56 neutrons and 52 electrons.

2. Select the proper systematic name for the following compound:



(A) 2-ethylbutane

(B) 3-ethylbutane

(C) 3-methylpentane

(D) 3-methylhexane

3. Based on the following equations:

$$2\ CO_2\ (g) \rightarrow O_2\ (g) + 2\ CO\ (g) \qquad \Delta H = +566.0\ kJ$$

$$2\ C\ (graphite) + O_2\ (g) \rightarrow 2\ CO\ (g) \qquad \Delta H = -221.0\ kJ$$

Determine the enthalpy change (ΔH) for the following reaction:

$$C\ (graphite) + O_2\ (g) \rightarrow CO_2\ (g)$$

(A) 393.5 kJ/mol

(B) -393.5 kJ/mol

(C) 172.5 kJ/mol

(D) 345.0 kJ/mol

4. A mass spectrometer is a device that separates gaseous ions according to their

(A) size.

(B) charge.

(C) mass.

(D) mass to charge ratio.

5. Calculate the energy change, in joules, that occurs when an electron is raised from the n = 3 to the n = 5 energy level of a hydrogen atom.

(A) 0.872

(B) −1.55

(C) $1.55 \times 10^{-19}$

(D) −2.42

6. How many electrons are there in a filled 4f subshell?

(A) 4

(B) 6

(C) 10

(D) 14

7. Which anion would have the following electron configuration?

$1s^2 2s^2 2p^6 3s^2 3p^6$

(A) $Cl^-$

(B) $F^-$

(C) $O^{2-}$

(D) $Ca^{2+}$

8. How many electrons are transferred in the following reaction?

$$6\ Br^-(aq) + Cr_2O_7^{2-}(aq) + 14\ H^+(aq) \rightarrow 2\ Cr^{3+}(aq) + 7\ H_2O + 3\ Br_2(l)$$

(A) 1

(B) 2

(C) 3

(D) 6

9. What should be the pH of a solution in the cathode half-cell if the following voltaic cell is to have $E°_{cell} = 3.000$ V?

$$Li\,|\,Li^+(0.1\ M)\ \|\ H^+(?)\,|\,H_2\ (g, 1\ atm), Pt$$

$$Li^+ + e^- \rightarrow Li \qquad E° = -3.040\ V$$

(A) 0.0668

(B) 2.351

(C) 1.176

(D) 0.040

10. The half-life of a radioisotope is 22.0 days. How many days will it take for the activity of a 1 gram sample of this isotope to be reduced to 25% of its original activity?

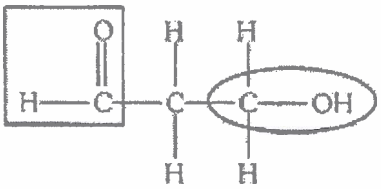
(A) 44.0

(B) 22.0

(C) 0.0315

(D) 5.50

11. Name the functional groups in the following molecule (circle first and the square second).




(A) aldehyde, carboxylic acid

(B) alcohol, ester

(C) alcohol, aldehyde

(D) alcohol, ketone

12. Which type of spectroscopy would be most useful in characterizing the carbon-hydrogen framework in a molecule?

(A) IR

(B) UV-Vis

(C) NMR

(D) MS

13. Which of the following amino acids has an acidic sidechain?

(A) glycine

(B) glutamic acid

(C) methionine

(D) lysine

14. Which non-metal is the most abundant in the Earth's crust?

(A) Si

(B) O

(C) Fe

(D) Al

15. Some metals behave as insulators because

(A) the valence band is not full of electrons.

(B) the conduction band lies below the valence band.

(C) the conduction band is full of electrons.

(D) the conduction band is much higher in energy than the valence band.

16. Which of the following statements is incorrect?

(A) In addition polymerization, all of the atoms in the monomer end up in the polymer.

(B) In condensation polymerization, monomer molecules combine and small-molecule byproducts are "split out" from the polymer.

(C) Cross-linking of polymer chains results in strength and rigidity.

(D) High-density polyethylene consists primarily of branched chains.

17. Why does the temperature in the thermosphere rise as high as 1500 K?

(A) Collisions between the molecules of air give the thermosphere the high temperature.

(B) Absorption of electromagnetic radiation from the sun by air molecules causes the high temperatures.

(C) The thermosphere contains the ozone layer which absorbs UV light.

(D) The friction of molecules and ions caused by collisions give rise to the temperature.

18. Which of the following reactions contributes to the reason CFC's are most damaging to the ozone layer?

(A) $NO + O_3 \rightarrow NO_2 + O_2$

(B) $Cl\bullet + O_3 \rightarrow ClO\bullet + O_2$

(C) $O_2 + O\bullet \rightarrow O_3$

(D) $2\ HgO \rightarrow 2\ Hg + O_2$

19. Cadmium poisoning is considered deadly because the $Cd^{2+}$ ion

(A) replaces $Ca^{2+}$ in bones.

(B) replaces $Fe^{2+}$ in blood.

(C) increases the $Na^+ / K^+$ ratio in cellular fluid.

(D) interferes with the transmission of nerve impulses.

20. The photochemical decomposition of $NO_2$ produces O radicals and NO radicals. How many L O radicals are produced from 7.70 L $NO_2$ at STP?

(A) 7.70

(B) 15.4

(C) 11.6

(D) 3.85

簡答題，每題 10 分。

1. Briefly state the operational principle of a pH meter.
2. Design an sensor to differentiate $CH_3OH$ and $CH_3CH_2OH$, justify your selection.