國立高雄大學

108 學年度第一學期

理學院

普通化學會考

January 10, 2020 (Friday)

17:30 ~ 19:30

姓名: _____ **學號:** _____

－作答注意事項－

考試時間：120分鐘

作答方式：總分：100分

作答方式：

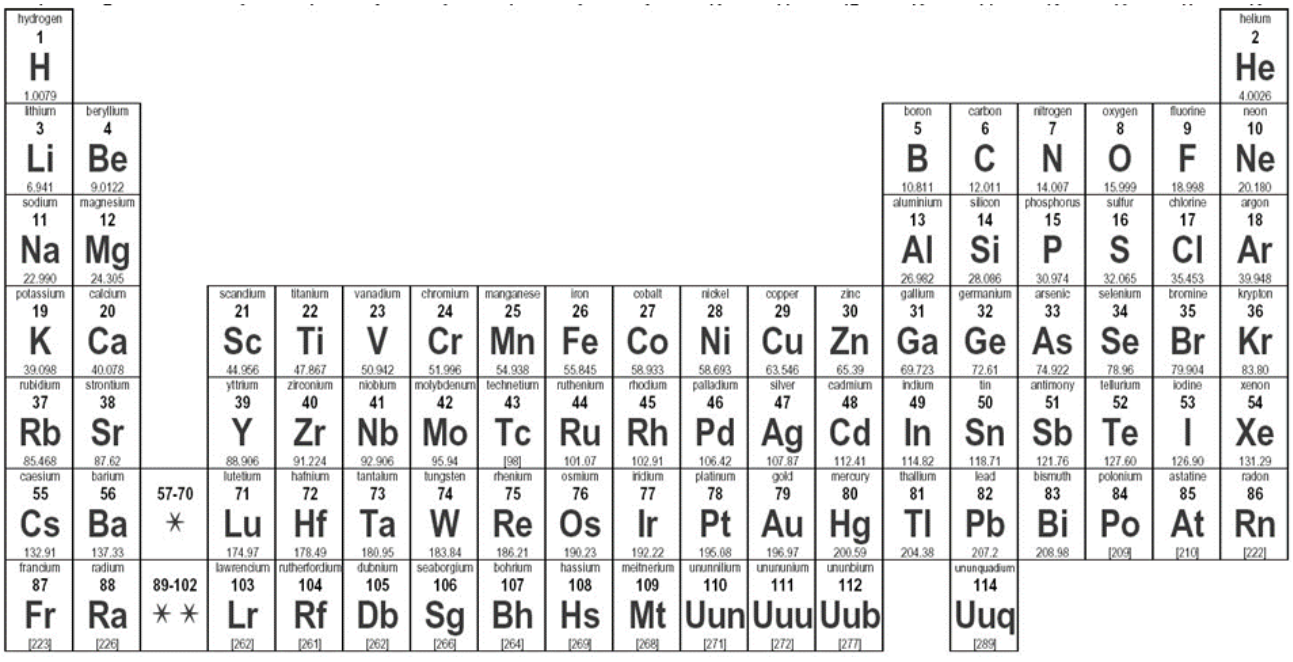
- 選擇題用原子筆在「答案卷」上作答。
- 未依規定畫記答案卡，致無法辨識答案；其後果由考生自行承擔。
- 答案卷每人一張，不得要求增補。

˙第 1 題至第 6 題為多選題，每題六分，多選或少選擇一個選項扣兩分，該題分數扣完之後不再倒扣。

˙第 7 題至第 22 題為單選題，每題四分。

參考資料

一、元素週期表



二、理想氣體常數和亞佛加厥常數

$R = 8.314\ J/mol{\cdot}K = 0.0821\ L{\cdot}atm/K{\cdot}mol;\ Avogadro's\ number = 6.022 \times 10^{23}$

For Question 1~6, there may be more than one correct answer.

1. Which of the following statements are true?
   (A) If a substance is soluble, it must be an electrolyte
   (B) System does work on the surroundings when an ideal gas expands against a constant external pressure
   (C) Atoms or molecules with an even number of electrons are diamagnetic
   (D) The surface tension and viscosity of liquid A are greater than those of liquid B if liquid A exhibits stronger intermolecular forces than liquid B
   (E) Molecular solids generally have high melting points

2. Urea [$(NH_2)_2CO$] is prepared by reacting ammonia with carbon dioxide:
   $2NH_{3(g)} + CO_{2(g)} \rightarrow (NH_2)_2CO(aq) + H_2O_{(l)}$
   In one process, 637.2 g of NH_3 are treated with 1142 g of CO_2, which of the following statements are true?
   ($M_w(NH_3)$ = 17.03 g/mol, $M_w(CO_2)$ = 44.01 g/mol, $M_w((NH_2)_2CO)$ = 66.06 g/mol,)
   (A) NH_3 is the limiting reagent.
   (B) CO_2 is the limiting reagent.
   (C) 18.71 moles of $(NH_2)_2CO$ formed.
   (D) This reaction has no limiting reagent.
   (E) 319 g of excess reagent (in grams) is left at the end of the reaction.

3. Which of the following statements are true?
   (A) The number of protons is the same for all neutral atoms of an element.
   (B) Alkaline earth metals form ions with a 2+ charge when they react with nonmetals.
   (C) A combustion reaction is not an oxidation–reduction reaction.
   (D) The oxidation number of carbon in CO_3^{2-} is +4.
   (E) Internal energy of a system increases when more work is done by the system than when heat was flowing into the system.

4. Which ions are planar ?
   (A) NH_4^+ (B) CO_3^{2-} (C) IF_4^- (D) NCl_3 (E) BeF_3^-

5. Diborane (B_2H_6) is a highly reactive boron hydride that was once considered as a possible rocket fuel for the U.S. space program. The synthesis of diborane from its elements, according to the following equation:

$2B_{(s)} + 3H_{2(g)} \rightarrow B_2H_{6(g)}$ $\Delta H = +36$ kJ

Which of the following statements are *true*?

(A) The reaction is exothermic.

(B) The reaction is endothermic

(C) When 0.5 mol boron (B) is reacted, 9 kJ of energy is released

(D) When 21.6 g of boron (B) is reacted, 36 kJ of energy is released.

(E) When 4.0 mol boron (B) is reacted, 2.0 mol B_2H_6 is produced

6. Which of the following statements is incorrect?

(A) The binding forces in a molecular solid include London dispersion forces

(B) A material is made from Al, Ga, and As. The mole fraction of each element is 0.25, 0.26, and 0.49, respectively. This material would be an n-type semiconductor

(C) A nonpolar covalent bond results from the unequal sharing of a pair of electrons between atoms in a molecule.

(D) The N_2 molecule has two pairs of nonbonding electrons.

(E) The number of protons and neutrons is always the same in the neutral atom.

For Questions 7~22, each question has only one correct answer.

7. How many the percent composition by mass of H is in phosphoric acid compound (H_3PO_4)? (H = 1.0 amu, P = 31.0 amu, O = 16.0 amu)

(A) 0.10%% (B) 1.02% (C) 2.04% (D) 3.06% (E) none of these

8. How many grams of neon will contain the same number of atoms as 1,000 g of bromine?

(A) 4 g Ne (B) 40g Ne (C) 300g Ne (D) 400g Ne (E) none of these

9. At constant temperature and volume, 3.8×10^{-3} mol of helium (He) is added to a 1.0 L sample of xenon (Xe) at 0.081 atm and 325 K. What is the total pressure (atm) of the gas mix?

(A) 0.18 (B) 0.074 (C) 0.21 (D) 0.26 (E) none of these

10. Given that: $NO_{2(g)} + H_2O_{(l)} \rightarrow HNO_{3(aq)} + NO_{(g)}$ (unbalanced). What quantity (L) of NO_2 is required to completely react 325 grams of water. Assume that the gases are at standard temperature and pressure and hence 1.00 mole occupies 22.4 L of volume.

(A) 404 (B) 1213 (C) 44 (D) 1012 (E) none of these

11. A certain gas expands in volume from 1.0 L to 2.0 L at constant temperature. Calculate the work done by the gas if it expands against a vacuum. (1 L•atm = 101.3 J).
(A) +101.3 J (B) –101.3 J (C) +202.6 J (D) 0 J (E) none of these

12. Which of the following 50.0 g samples contains the greatest number of atoms?
(A) Be (B) Zn (C) Ag (D) Ca (E) Na

13. Suppose we have a 2.8 L sample containing 2.0 mole of ozone gas (O_3) at a pressure of 1 atm and a temperature of 300 K. If all this O_3 were converted to oxygen (O_2) at the same temperature and pressure, what would be the volume (L) of the oxygen?
(A) 5.6 (B) 8.1 (C) 4.2 (D) 8.4 (E) none of these

14. Which of the following compounds has the lowest boiling point?
(A) C_4H_{10} (B) C_2H_6 (C) C_5H_{12} (D) C_6H_{14} (E) C_8H_{18}

15. The vapor pressure of water at 373 K is 760 torr, and the heat of vaporization of water at 760 K is 40.7 kJ/mol. Calculate the vapor pressure of water at 338 K
(A) 559 torr (B) 320 Torr (C) 225 torr (D) 195 torr (E) none of these

16. Estimate the enthalpy change (kJ/mol) for the reaction $H_2O_2 + CH_3OH \rightarrow H_2CO + 2H_2O$, given the following bond energies
BE(C–H) = 413 kJ/mol BE(C–C) = 347 kJ/mol BE(C=C) = 614 kJ/mol
BE(C=O) = 799 kJ/mol BE(C–O) = 358 kJ/mol BE(O–H) = 463 kJ/mol
BE(O–O) = 146 kJ/mol
(A) –155 (B) –1759 (C) –345 (D) –2021 (E) – 221 (F) none of these

17. What type of structure does the XeF_4 molecule have?
(A) Square planar (B) Tetrahedral (C) See-saw (D) Trigonal pyramid (E) none of these

18. What is the bond order of B_2?
(A) 0.5 (B) 1 (C) 2 (D) 3 (E) none of these

19. Analysis of a carbohydrate showed that it consisted of 40.0 % C, 6.71 % H and 53.3 % O by mass. Its molecular mass was found to be between 140 and 160 amu. What is the molecular formula of this compound?
(A) $C_4H_8O_6$ (B) $C_5H_{10}O_5$ (C) $C_5H_{12}O_5$ (D) $C_6H_{12}O_4$ (E) none of these

20. How many significant figures does the result of the following operation contain? 10.234 x 17.1

(A) 2 (B) 3 (C) 4 (D) 5 (E) none of these

21. For a particular process $q = -20$ kJ and $w = 32$ kJ. Which of the following statements is incorrect?

(A) Heat flows from the system to the surroundings. (B) $\Delta E = +12$ kJ

(C) The system does work on the surroundings. (D) The process is exothermic.

(E) none of these

22. Which of the following is the most polar bond without being considered ionic?

(A) C–O (B) Ca–O (C) N–O (D) O–O (E) O–F