**請在答案卷上標明題號依序作答，計算題需要標明計算過程及正確單位**

第一部分：單選題（75 points, each 5 points, choose a single correct answer）

1. Equal volumes of two acids are titrated with 0.10 M NaOH, resulting in the titration curves shown on the right. Which of the following descriptions is/are correct? (a) The right curve is the more concentrated acid solution. (b) The left curve is the more concentrated acid solution. (c) The right curve is the acid with a larger K_a value. (d) The left curve is the acid with a larger K_a value.
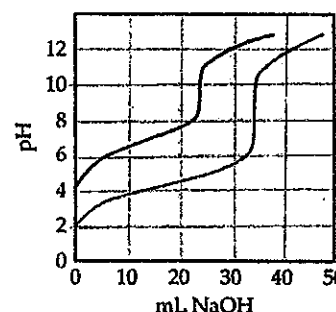
    (A) ac　(B) ad　(C) bc　(D) bd　(E) none of the above

2. Which of the following processes are spontaneous? (a) a ball rolling down a hill; (b) the dissolution of $HCl_{(g)}$ in water to form hydrochloric acid; (c) separating a mixture of N_2 and O_2 into two separate samples, one that is pure N_2 and one that is pure O_2; (d) the reaction of hydrogen gas with oxygen gas to form water vapor at room temperature; (e) the melting of ice cubes at -10 °C and 1 atm pressure.
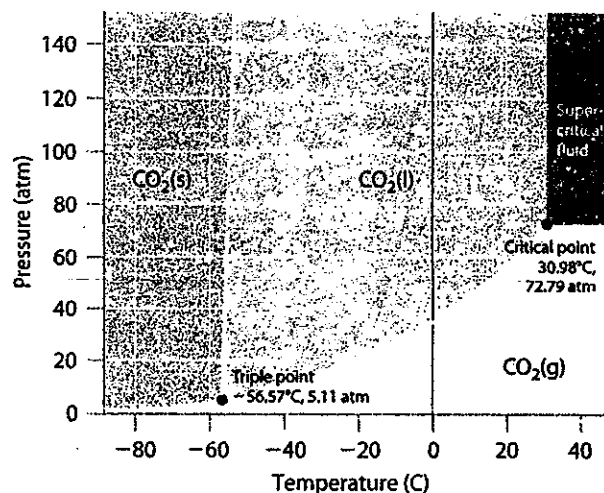
    (A) abe　(B) ac　(C) bcd　(D) abd　(E) bde

■ On the right is the phase diagram of CO_2.

3. What is the normal (at 1 atm) boiling point of CO_2? (5 points)

    (A) -70 K (B) 50 K (C) 100K (D) 180 K (E) none of the above

4. What is approximately the boiling point of CO_2 at 50 atm? (5 points)

    (A) 15K　(B) 168 K　(C) 273 K (D) 290 K　(E) none of the above

■ Accuracy is a description of systematic errors. Precision is a description of random errors. A 10.0000g standard weight is measured by four different balances with four repeats, and the readings are:

W	X	Y	Z
10.02, 9.98, 9.99, 10.01	10.008, 10.005, 10.007, 10.004	9.992, 9.993, 9.989, 10.001	10.0117, 10.0005, 10.0124, 10.0054

5. Which balance is the most precise?

    (A) W　(B) X　(C) Y　(D) Z　(E) none of the above

6. Which balance is the most accurate?

    (A) W　(B) X　(C) Y　(D) Z　(E) none of the above

7. If we start with a block of ice weighing 10.000 g, and cut away a piece that is 4.3 g. Let it sit on a table for 20 min and 31.4% has melted. How much ice is left? (mind the significant figures)

    (A) 3.9 g　(B) 3.91 g　(C) 3.910 g　(D) 3.9102 g　(E) none of the above

■ Glucose ($C_6H_{12}O_6$) is synthesized from CO_2 and water by plants using solar energy. When glucose undergoes combustion, the products are CO_2 and water.

8. What is the ΔG^0 at 298 K for the combustion of glucose?

    (A) $\Delta G^0 = 0$ (B) $\Delta G^0 < 0$ (C) $\Delta G^0 > 0$ (D) it depends on the pressure of O_2 (E) none of the above

9. Is the combustion of glucose a spontaneous reaction at 298K?

    (A) Yes, because glucose is very unstable and catches fire easily. (B) No, because it is thermodynamically

見背面

題號： 65
科目：普通化學
節次： 8

國立臺灣大學 109 學年度碩士班招生考試試題

題號： 65
共 2 頁之第 2 頁

forbidden. (C) No, because heat is required. (D) No, because a catalyst is required. (E) Yes, but the reaction is extremely slow without extra heat or catalysts.

■ In the following reaction, $C_5H_{12}O_2$ is oxidized to $C_5H_8O_2$. Complete and balance the chemical equation under acidic conditions:

$$Cr_2O_7^{2-} + \; HO\!-\!\!\!\bigwedge\!\!\bigwedge\!\!-\!OH \longrightarrow Cr^{3+} + \text{(lactone)}$$
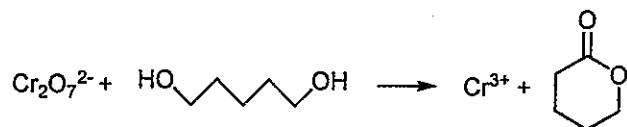
10. In the complete and balanced equation, what is the sum of all the coefficients?

(A) 24 (B) 34 (C) 38 (D) 42 (E) none of the above

11. $C_5H_{12}O_2$ has 5 carbon atoms. How many are oxidized in this reaction? (5 pts)

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

■ Acetic acid, CH_3COOH, has pKa of 4.8.

12. What is the approximate pH of 100 mM acetic acid?

(A) 2.1 (B) 2.4 (C) 2.9 (D) 3.6 (E) 4.8

13. What is the pH of a solution containing 100 mM acetic acid and 200 mM CH_3COONa?

(A) 4.8 (B) 5.1 (C) 5.5 (D) 5.9 (E) 6.3

14. Which of these is not a linear molecule?

(A) C_2H_2 (B) N_3^- (C) CO_2 (D) OCl_2 (E) SCN^-

15. Which properties are accurately defined if an electron is in the 2p orbital of a hydrogen atom? Choose from:
(a) position, (b) linear momentum, (c) orbital angular momentum, (d) spin, and (e) energy.

(A) ace (B) bd (C) bc (D) bde (E) ce

第二部分：簡答與計算題（25 points, please give brief answers）

16. During the hardening of hydraulic cement, 2 molecules of alite (Ca_3SiO_5) react with water to form 1 molecule of calcium silicate and 3 molecules of calcium hydroxide, please write the balanced chemical equation for the hydration process. (5 points)

17. Draw the resonance Lewis structures of ozone (O_3) that satisfy the octet rule. (5 points)

18. The tetraborate ion $[B_4O_5(OH)_4]^{2-}$ has only B-O bonds and O-H bonds. Please draw its chemical structure. Hint: there are two types of boron atoms. (7 points)

19. An unknown compound X contains only four elements: C, H, O, and S (atomic weights are 12.0, 1.0, 16.0, 32.1, respectively). The combustion of 30.450 g of compound X generates 54.426 g of CO_2 and 22.206 g of water. In another experiment, the reaction of 23.725 g of compound X with oxygen generates 10.255 g of sulfur dioxide. What is the molecular formula of compound X? (8 points)

試題隨卷繳回