注意：考試開始鈴響前，不可以翻閱試題

台灣聯合大學系統107學年度學士班轉學考試題

考試科目：普通化學

參考用

組別：A7

—作答注意事項—

1. 作答中如發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
2. 請核對答案卷（卡）上之准考證號、考試科目是否正確。
3. 本考科可使用電子計算器(一般認知之小型電子計算器)，不限廠牌型號，但不包含手機、平板或其他智慧型手持裝置。
4. 選擇題請在答案卡上作答，非選擇題請在答案卷(作答區內)作答。
5. **考生限在作答區內作答，不可書寫姓名、准考證號或與作答無關之其他文字或符號。**
6. 答案卷用盡不得要求增加。
7. 答案卷限用藍筆或黑色鋼筆、原子筆或鉛筆書寫；答案卡限用2B軟心鉛筆畫記，如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果考生自行負責。
8. 因字跡潦草或作答未標明題號等情事，致評閱人員無法辨識答案者，該部分不予計分。

參考用

一、 單選題 75% (30 題 每題 2.5 分)

1. Which has the least kinetic energy?

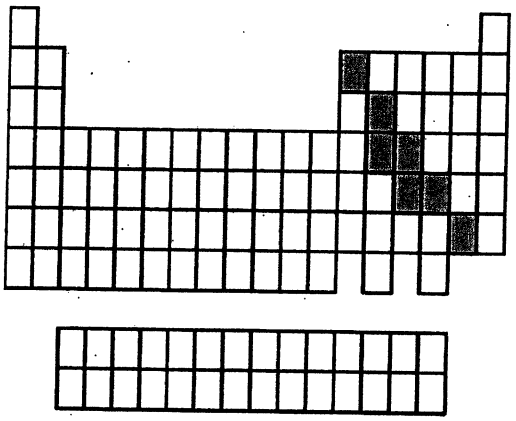
A) a 1200 kg object moving at 90 km/hr

B) a 1400 kg object moving at 85 km/hr

C) a 1600 kg object moving at 80 km/hr

D) a 1800 kg object moving at 75 km/hr

2. What group of elements does the shaded area in the following periodic table indicate?



A) gases

B) metals

C) nonmetals

D) semimetals

3. Aluminum metal reacts with aqueous iron(II) chloride to form aqueous aluminum chloride and iron metal. What is the stoichiometric coefficient for iron when the chemical equation is balanced using the lowest whole-number stoichiometric coefficients?

A) 0 B) 3 C) 5 D) 8

4. What is the first ionization energy for a hydrogen atom in the ground state? The Rydberg constant is $1.097 \times 10^{-2}\ nm^{-1}$.

A) 7.27×10^{-36} J

B) 1.63×10^{-27} J

C) 2.18×10^{-18} J

D) 0.00823 J

注意:背面有試題

5. The symbol [Kr] represents

A) $4s^2 4p^6$.

B) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^6$.

C) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$.

D) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10}$.

6. Which have the largest number of unpaired electrons in *p* orbitals in their ground-state electron configurations?

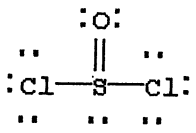
A) N, As, Bi

B) F, At, Br

C) Ne, Ar, Xe

D) B, Ga, Tl

7. Assign formal charges to each atom in the resonance form for $SOCl_2$ given below.



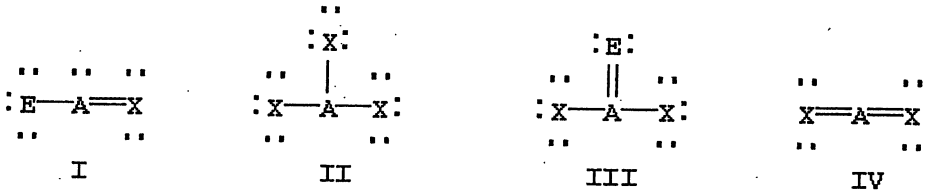
A) 0 for Cl, 0 for S, and 0 for O

B) 0 for Cl, +1 for S, and -1 for O

C) -1 for Cl, +4 for S, and -2 for O

D) -1 for Cl, -2 for S, and -2 for O

8. Which of the following would be expected to have sp^2 hybridization on atom A?



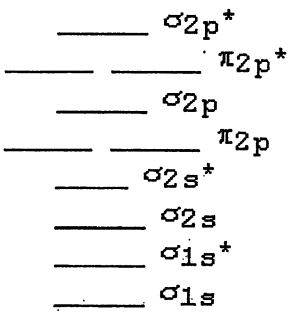
A) II

B) I and III

C) I, II, and III

D) I and IV

9. The MO diagram below is appropriate for B_2 (Boron atom), Based on this diagram, B_2



A) has a bond order of one and is diamagnetic.
B) has a bond order of one and is paramagnetic.
C) has a bond order of two and is diamagnetic.
D) has a bond order of two and is paramagnetic.

10. Calculate the work energy, *w*, gained or lost by the system when a gas expands from 20 L to 35 L against a constant external pressure of 2.0 atm. [1 L · atm = 101 J]

A) -5.3 kJ
B) -3.0 kJ
C) +3.0 kJ
D) +5.3 kJ

11. When 50.0 mL of 0.400 M $Ca(NO_3)_2$ is added to 50.0 mL of 0.800 M NaF, CaF_2 precipitates, as shown in the net ionic equation below. The initial temperature of both solutions is 30.00°C. Assuming that the reaction goes to completion, and that the resulting solution has a mass of 100.00 g and a specific heat of 4.18 J/(g · °C), calculate the final temperature of the solution.

$$Ca^{2+}_{(aq)} + 2\ F^-_{(aq)} \rightarrow CaF_{2(s)}\ \ \Delta H° = -11.5\ kJ$$

A) 29.45°C
B) 30.55°C
C) 31.10°C
D) 31.65°C

12. Use the given standard enthalpies of formation to calculate $\Delta H°$ for the following reaction

$3\ Fe_2O_3(s) + CO(g) \rightarrow 2\ Fe_3O_4(s) + CO_2(g)$.

Species	$\Delta H°_f$, kJ/mol
Fe_2O_3 (s)	-824.2
Fe_3O_4 (s)	-1118.4
CO (g)	-110.5
CO_2 (g)	-393.5

參考用

A) -5213.4 kJ

B) -577.2 kJ

C) -47.2 kJ

D) +47.2 kJ

13. For the conversion of water to ice at 25°C and 1 atm,

A) ΔG is negative and ΔH is negative.

B) ΔG is negative and ΔH is positive.

C) ΔG is positive and ΔH is negative.

D) ΔG is positive and ΔH is positive.

14. Each of three identical 15.0-L gas cylinders contains 7.50 mol of gas at 295 K. Cylinder A contains HCN, cylinder B contains NO_2, and cylinder C contains O_3. According to the kinetic molecular theory, which gas has the highest average kinetic energy?

A) HCN

B) NO_2

C) O_3

D) All have identical average kinetic energies

15. While mercury is very useful in barometers, mercury vapor is toxic. Given that mercury has a ΔH_{vap} of 59.11 kJ/mol and its normal boiling point is 356.7°C, calculate the vapor pressure in mm Hg at room temperature, 25°C.

A) 2.68 × 10-3 mm Hg

B) 2.99 mm Hg

C) 372 mm Hg

D) 753 mm Hg

The plots below represent vapor pressure vs. temperature curves for diethyl ether, ethanol, mercury, and water, not necessarily in that order.

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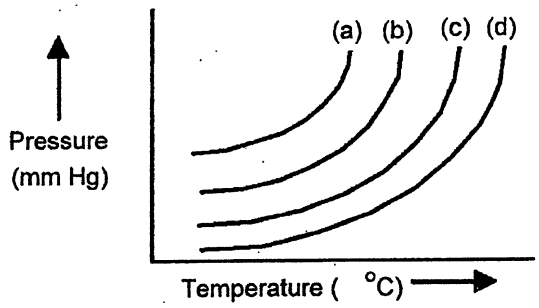


參考用

16. Based on the relative strengths of the intermolecular forces of attraction of each substance, which is the most likely vapor pressure vs. temperature curve for diethyl ether?

A) curve (a)
B) curve (b)
C) curve (c)
D) curve (d)

17. How much heat is released when 95.0 g of steam at 100.0°C is cooled to ice at -15.0°C? The enthalpy of vaporization of water is 40.67 kJ/mol, the enthalpy of fusion for water is 6.01 kJ/mol, the molar heat capacity of liquid water is 75.4 J/(mol · °C), and the molar heat capacity of ice is 36.4 J/(mol · °C).

A) 54.8 kJ
B) 247 kJ
C) 289 kJ
D) 314 kJ

18. Barium has a radius of 224 pm and crystallizes in a body-centered cubic structure. What is the edge length of the unit cell?

A) 259 pm
B) 317 pm
C) 448 pm
D) 517 pm

19. When a particular solid begins to dissolve in water, the temperature rises dramatically. For the dissolving of this solid in pure water

A) ΔH_{soln} is always negative and ΔS_{soln} may be negative or positive.
B) ΔH_{soln} is always negative and ΔS_{soln} is always positive.
C) ΔH_{soln} is always positive and ΔS_{soln} may be negative or positive.
D) ΔH_{soln} is always positive and ΔS_{soln} is always positive.

20. The second-order reaction, $2\ Mn(CO)_5 \rightarrow Mn_2(CO)_{10}$ has a rate constant equal to $3.0 \times 109\ M^{-1}s^{-1}$ at 25°C. If the initial concentration of $Mn(CO)_5$ is 1.0×10^{-5} M, how long will it take for 90.% of the reactant to disappear?

A) 3.3×10^{-16} s

B) 3.7×10^{-15} s

C) 3.0×10^{-4} s

D) 3.0×10^{3} s

21. The first-order isomerization reaction: cyclopropane → propene, has a rate constant of $1.10 \times 10^{-4}\ s^{-1}$ at 470°C and $5.70 \times 10^{-4}\ s^{-1}$ at 500°C. What is the activation energy, E_a, for the reaction?

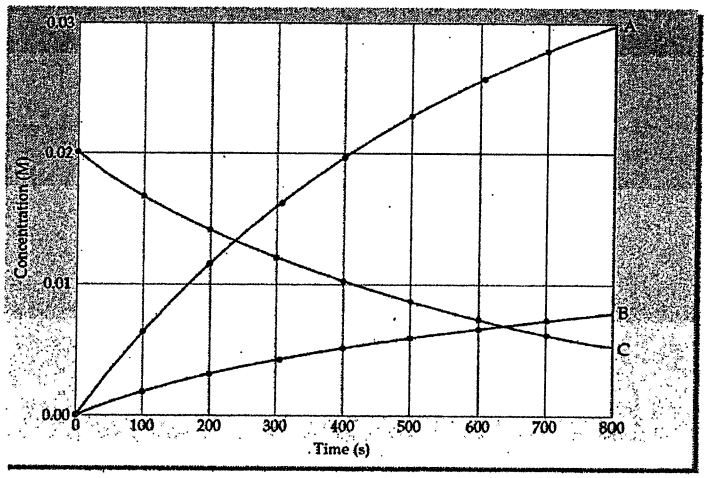
A) 46 kJ/mol

B) 110 kJ/mol

C) 260 kJ/mol

D) 380 kJ/mol

22. The following figure depicted the variation of A,B,and C concentration variation with reaction time



Which equation best represents the reaction?

A) $4A(g) \rightarrow B(g) + 2C(g)$

B) $4A(g) + B(g) \rightarrow 2C(g)$

C) $2C(g) \rightarrow 4A(g) + B(g)$

D) $2C(g) + B(g) \rightarrow 4A(g)$

注意:背面有試題

23. An equilibrium mixture of CO, O_2 and CO_2 at a certain temperature contains 0.0010 M CO_2 and 0.0015 M O_2. At this temperature, *K*c, equals 1.4×10^2 for the reaction:

$$2\ CO(g) + O_2(g) \rightleftharpoons 2\ CO_2(g).$$

What is the equilibrium concentration of CO?

A) 4.8×10^{-6} M

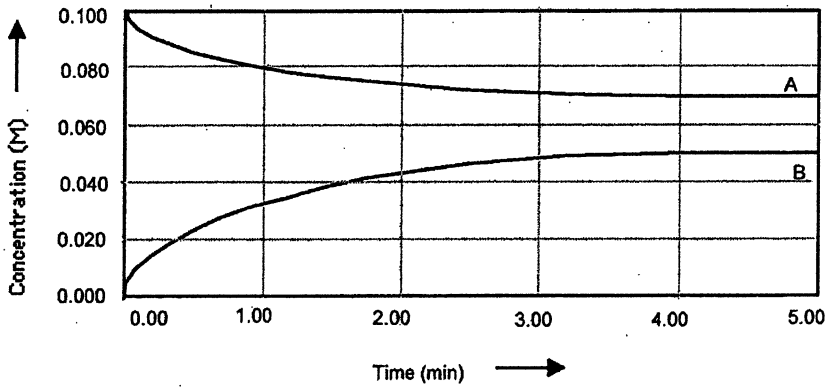
B) 2.2×10^{-3} M

C) 9.3×10^{-2} M

D) 3.1×10^{-1} M

參考用

24. Shown below is a concentration vs. time plot for the reaction A ⇌ 2B. For this reaction the value of the equilibrium constant is



A) *K*c < 1. B) *K*c = 0. C) *K*c = 1. D) *K*c > 1.

25. An acidic solution at 25°C has

A) $[H3O^+] > [OH^-] > 1 \times 10^{-7}$ M.

B) $[H3O^+] > 1 \times 10^{-7}$ M > $[OH^-]$.

C) $[H3O^+] = [OH^-] > 1 \times 10^{-7}$ M.

D) $[H3O^+] < 1 \times 10^{-7}$ M > $[OH^-]$.

26. For the hypothetical reaction A + 2 $B^x \rightarrow A^y$ + 2 B, E° = 1.50 V = and $\Delta G°$ = -305 kJ. For this reaction, if the value of *x* is 4, then the value of *y* = _____.

A) 1 B) 2 C) 3 D) 4

注意:背面有試題

27. Given: $Ag^+_{(aq)} + e^- \rightarrow Ag_{(s)}$ $E° = +0.799$ V

$AgI_{(s)} + e^- \rightarrow Ag_{(s)} + I^-_{(aq)}$ $E° = -0.152$ V

$Ni^{2+}_{(aq)} + 2\ e^- \rightarrow Ni_{(s)}$ $E° = -0.267$ V

Which of the following reactions should be spontaneous under standard conditions?

I. $2\ AgI_{(s)} + Ni_{(s)} \rightarrow 2\ Ag_{(s)} + 2\ I^-_{(aq)} + Ni^{2+}_{(aq)}$

II. $Ag^+_{(aq)} + I^-_{(aq)} \rightarrow AgI_{(s)}$

參考用

A) I and II are both nonspontaneous.

B) I is nonspontaneous and II is spontaneous.

C) I is spontaneous and II is nonspontaneous.

D) I and II are both spontaneous.

28. Consider the following table of standard reduction potentials:

Reduction Half-Reaction	E^0 (V)
$A^+ + e^- \rightarrow A$	0.70
$B^{2+} + 2\ e^- \rightarrow B$	0.43
$C_3 + 3\ e^- \rightarrow 3\ C^-$	0.27

Which substance is the strongest reducing agent?

A) A B) B C) C_3 D) C^-

29. Which reaction below represents $^{15}_{8}O$ decay by positron (正子) emission?

A) $^{15}_{8}O \rightarrow {}^{-1}_{0}e + {}^{15}_{9}Ra$

B) $^{15}_{8}O \rightarrow {}^{1}_{0}e + {}^{15}_{7}N$

C) $^{15}_{8}O \rightarrow {}^{-1}_{0}e + {}^{18}_{6}N$

D) $^{15}_{8}O \rightarrow {}^{1}_{0}e + {}^{14}_{8}N$

30. If a sample of ^{233}Pa takes 62.7 days to decrease to 20.0% of its original mass, what is its half-life?

A) 0.0370 days

B) 27.0 days

C) 157 days

D) 195 days

注意:背面有試題

參考用

二、計算題 (25%, 每題五分)

[1]. How many grams of calcium chloride are needed to produce 10.0 g of potassium chloride? (atomic weight Ca: 40, C:12, O:16, K:39 , Cl:35.5)

$$CaCl_2(aq) + K_2CO_3(aq) \rightarrow 2\ KCl(aq) + CaCO_3(aq)$$

[2]. Balance the chemical equation given below, and calculate the volume of nitrogen monoxide gas produced when 8.00 g of ammonia is reacted with 9.00 g of oxygen at 25°C? The density of nitrogen monoxide at 25°C is 1.23 g/L.

$$\_\_\_\_\_\ NH_3(g) + \_\_\_\_\_\ O_{2(g)} \rightarrow \_\_\_\_\_\ NO_{(g)} + \_\_\_\_\_\ H_2O_{(l)}$$

[3]. The following data shows hydrogen peroxide decomposes to water and oxygen according to the reaction below: $2\ H_2O_{2(aq)} \rightarrow 2\ H_2O_{(l)} + O_{2(g)}$

What is the average rate of disappearance of $H_2O_2(aq)$ in M/s in the first 45.0 seconds of the reaction if 1.00 L of H_2O_2 reacts at 25°C and 1.00 atm pressure?

Time (s)	O_2 (g) Collected (mL)
0.0	0.0
45.0	2.00
90.0	4.00
135.0	6.00

[4]. The second-order reaction $2\ Mn(CO)_5 \rightarrow Mn_2(CO)_{10}$, has a rate constant equal to $3.0 \times 10^9\ M^{-1}\ s^{-1}$ at 25°C. If the initial concentration of $Mn(CO)_5$ is 5.0×10^{-5} M, how long will it take for 90.% of the reactant to disappear?

[5]. Phosphorus pentachloride decomposes to phosphorus trichloride at high temperatures according to the reaction:

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

At 250°C, 0.250 M PCl_5 is added to a flask. If $K_c = 1.80$, what are the equilibrium concentrations of each gas?