選擇題，共25題，每題4分，共100分，答錯不倒扣。

1. What is the coefficient for oxygen when the following equation is balanced ?

$NH_3(g) + O_2(g) \rightarrow NO_2(g) + H_2O(g)$

(a) 3, (b) 6, (c) 7, (d) 12, (e) 14.

2. Consider the following reaction : $2A + B \rightarrow 3C + D$

3.0 mol *A* and 2.0 mol *B* react to form 4.0 mol *C*. What is the percent yield of this reaction ?

(a) 50%, (b) 67%, (c) 75%, (d) 89%, (e) 100%.

3. Naturally occurring copper exists in two isotopic forms: ^{63}Cu and ^{65}Cu. The atomic mass of copper is 63.55 amu. What is the approximate natural abundance of ^{63}Cu ?

(a) 63%, (b) 90%, (c) 70%, (d) 50%, (e) 30%.

4. Consider two organic molecules, ethanol and benzene. One dissolves in water and the other does not. Why ?

(a) They have different molar masses. (b) One is ionic, the other is not. (c) One is an electrolyte, the other is not. (d) Ethanol contains a polar O—H bond, and benzene does not. (e) Two of these.

5. The equilibrium constant, K_p, equals 3.40 at 25°C for the isomerization reaction :

cis-2-butene $\rightleftharpoons$ *trans*-2-butene. If a flask initially contains 1.00 atm of each gas, what direction will the reaction shift to reach equilibrium?

(a) It will shift left, (b) it will shift right, (c) the reaction is already at equilibrium, (d) the reaction is already at equilibrium initially and then will shift right, (e) all are correct.

6. In the best Lewis structure for NO^+, what is the formal charge on N?

(a) –1, (b) 0, (c) +1, (d) +2, (e) -2.

7. Using the following data, calculate the standard heat of formation of the compound ICl in kJ/mol:

	$H°$ (kJ/mol)
$Cl_2(g) \rightarrow 2Cl(g)$	242.3
$I_2(g) \rightarrow 2I(g)$	151.0
$ICl(g) \rightarrow I(g) + Cl(g)$	211.3
$I_2(s) \rightarrow I_2(g)$	62.8

(a) –211 kJ/mol, (b) –14.6 kJ/mol, (c) 16.8 kJ/mol, (d) 245 kJ/mol, (e) 439 kJ/mol.

8. Which of the following statements is (are) true ?

I. An excited atom can return to its ground state by absorbing electromagnetic radiation.
II. The energy of an atom is increased when electromagnetic radiation is emitted from it.
III. The energy of electromagnetic radiation increases as its frequency increases.
IV. An electron in the $n = 4$ state in the hydrogen atom can go to the $n = 2$ state by emitting electromagnetic radiation at the appropriate frequency.
V. The frequency and wavelength of electromagnetic radiation are inversely proportional to each other.

(a) II, III, IV, (b) III, V, (c) I, II, III, (d) III, IV, V, (e) I, II, IV.

9. Which of the following molecules has a bond order of 1.5 ?
(a) O_2^+, (b) N_2, (c) O_2^-, (d) C_2, (e) none of these.

10. For a reaction in which A and B react to form C, the following initial rate data were obtained:

[A] (mol/L)	[B] (mol/L)	Initial Rate of Formation of C (mol/L.s)
0.10	0.10	1.00
0.10	0.20	4.00
0.20	0.20	8.00

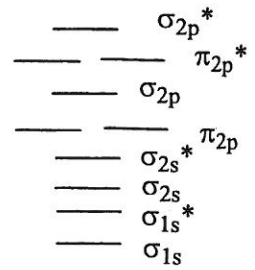
What is the rate law for the reaction ?
(a) Rate = k[A][B], (b) Rate = k[A]^2[B], (c) Rate = k[A][B]^2, (d) Rate = k[A]^2[B]^2, (e) Rate = k[A]^3.

11. For the conversion of ice to water at 0°C and 1 atm,
(a) ΔG is zero, ΔH is positive, and ΔS is negative,
(b) ΔG is zero, ΔH is positive, and ΔS is positive,
(c) ΔG is negative, ΔH is negative, and ΔS is positive,
(d) ΔG is positive, ΔH is negative, and ΔS is positive,
(e) none is correct.

12. Which of the following statements correctly describes the signs of q and w for the following exothermic process at P = 1 atm and T = 370 K ? $H_2O(g) \rightarrow H_2O(l)$
(a) q and w are negative, (b) q is positive, w is negative, (c) q is negative, w is positive, (d) q and w are both positive, (e) q and w are both zero.

13. A 100-mL sample of water is placed in a coffee cup calorimeter. When 1.0 g of an ionic solid is added, the temperature decreases from 21.5°C to 20.8°C as the solid dissolves. For the dissolving of the solid
(a) $H < 0$, (b) $S_{univ} > 0$, (c) $S_{sys} < 0$, (d) $S_{surr} > 0$, (e) none of thes.

14. The following MO diagram is appropriate for Li_2 and Be_2. Based on this diagram,
(a) both are stable and diamagnetic,
(b) Li_2 is stable and diamagnetic, but Be_2 is unstable,
(c) Be_2 is stable and diamagnetic, but Li_2 is unstable,
(d) Be_2 is stable and paramagnetic, but Li_2 is unstable.
(e) none is correct.



15. The sign of ΔG, ΔH and ΔS at 25 °C are shown below for three reactionbs.

Reaction	ΔG	ΔH	ΔS
I.	-	+	+
II.	-	-	+
III.	-	-	-

Which reaction could go in the reverse direction at high temperature?
(a) I, (b) II, (c) III, (d) I and II, (e) none is correct.

16. The number of orbitals having a given value of l is equal to
(a) $2l + 1$, (b) $2n + 2$, (c) $3l$, (d) $l + m_l$, (e) the number of lobes in each orbital

17. Consider the following processes :

$$2A \rightarrow 1/2B + C \qquad \Delta H_1 = 5 \text{ kJ/mol}$$
$$(3/2)B + 4C \rightarrow 2A + C + 3D \qquad \Delta H_2 = -15 \text{ kJ/mol}$$
$$E + 4A \rightarrow C \qquad \Delta H_3 = 10 \text{ kJ/mol}$$

Calculate ΔH for : $C \rightarrow E + 3D$

(a) 0 kJ/mol, (b) 10 kJ/mol, (c) –10 kJ/mol, (d) –20 kJ/mol, (e) 20 kJ/mol.

18. The configuration $(\sigma_{2s})^2 (\sigma_{2s}^*)^2(\pi_{2p})^1(\pi_{2p})^1$
is the molecular orbital description for the ground state of

(a) Li_2^+, (b) Be_2, (c) B_2, (d) B_2^{2-}, (e) C_2.

19. A certain metal fluoride crystallizes in such a way that the fluoride ions occupy simple cubic lattice sites, while the metal atoms occupy the body centers of half the cubes. The formula for the metal fluoride is:

(a) MF_2, (b) M_2F, (c) MF, (d) MF_8, (e) none of these.

20. How many significant figures are there in the number 0.0006042?

(a) 7, (b) 3, (c) 8, (d) 4, (e) 0.

21. Given the reaction : $2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$
determine the number of electrons involved in this reaction.

(a) 10, (b) 8, (c) 6, (d) 4, (e) 2.

22. For the dissociation reaction of the acid HF

$$HF(aq) \rightleftharpoons H^+(aq) + F^-(aq)$$

ΔS is observed to be negative. The best explanation is:

(a) This is the expected result since each HF molecule produces two ions when it dissociates.
(b) Hydration of the ions produces the negative value of ΔS.
(c) The reaction is expected to be exothermic and thus ΔS should be negative.
(d) The reaction is expected to be endothermic and thus ΔS should be negative.
(e) None of these can explain the negative value of ΔS.

23. Which of the following is true for the cell shown here ?

$$Zn(s) \,|\, Zn^{2+}(aq) \,||\, Cr^{3+}(aq) \,|\, Cr(s)$$

(a) The electrons flow from the cathode to the anode.
(b) The electrons flow from the zinc to the chromium.
(c) The electrons flow from the chromium to the zinc.
(d) The chromium is oxidized.
(e) The zinc is reduced.

24. Consider the gaseous reaction $CO_{(g)} + Cl_{2(g)} \rightleftharpoons COCl_{2(g)}$. What is the expression for K_P in terms of K_C?

(a) K(RT), (b) K/(RT), (c) $K(RT)^2$, (d) $K/(RT)^2$, (e) 1/K(RT).

25. For an electron in a given atom, the larger n, the

(a) larger the average distance from the nucleus and the higher the orbital energy.

(b) larger the average distance from the nucleus and the lower the orbital energy.

(c) smaller the average distance from the nucleus and the higher the orbital energy.

(d) smaller the average distance from the nucleus and the lower the orbital energy.

(e) all are correct.