請按順序一題答一行，選擇題四選一，只要寫出號碼，如 1. a, 2. b, 3. c

A. 選擇題（每題 2.5 分，共 20 題）

1. which crystal has the least cohesive energy (energy required to evaporate crystal to gas)
   (a) Fe(s)   (b) Li(s)   (c) $CS_2(s)$ (d) NaCl(s)

2. When temperature increases from 25°C to 50°C, the value of $K_w = [H^+][OH^-]$
   (a) increases   (b) is the same   (c) decreases

3. The cubic closest packed structure is also known as
   (a) body-centered cubic structure   (b) simple cubic structure
   (c) face-centered structure   (d) hexagonal structure

4. Which of the following defect in the crystal is occupied by electron
   (a) Schottky defect   (b) F-center   (c) Frenkel defect
   (d) self-interstitial

5. The Bohr radius for n=1 is a_0, therefore the radius for n=2 is
   (a) $2a_0$ (b) $4a_0$ (c) $8a_0$ (d) $16 a_0$

6. Which electronic configuration is incorrect
   (a) Cr, $3d^5 4s$ (b) V, $3d^3 4s^2$ (c) Ni, $3d^9 4s^1$ (d) Cu, $3d^{10} 4s^1$

7. Which statment is incorrect
   (a) Cl^- is larger than Na^+
   (b) Na+Cl is less stable than $Na^+ + Cl^-$ at infinite separation
   (c) Cl^- and K^+ have the same electronic configuration
   (d) in CsCl crystal, each ion is surrounded by eight opposite ions.

8. Which statement is incorrect
   (a) He_2^+ is a stable molecule
   (b) O_2^+ has a shorter bond distance than O_2
   (c) F_2^+ has longer bond distance than F_2
   (d) Be_2^+ has a greater dissociation energy than Be_2

9. Which has the greatest heat of hydration
   (a) Rb^+ (b) K^+ (c) Na^+ (d) Li^+

10. Which element has the least value (absolute value) for electron affinity
    (a) B (b) C (c) N (d) O

11. Which ion has the least radius
    (a) Na^+ (b) Mg^{2+} (c) Ca^{2+} (d) Al^{3+}

12. Which statement is incorrect
    (a) ClF_3 is T-shaped   (b) I_3^- is linear
    (c) BrF_5 is trigonal bipyramidal   (d) ICl_4^- is square planar

13. Which compound is in solid state at room temperature
    (a) $AlCl_3$ (b) $SiCl_4$ (c) PCl_3 (d) S_2Cl_2
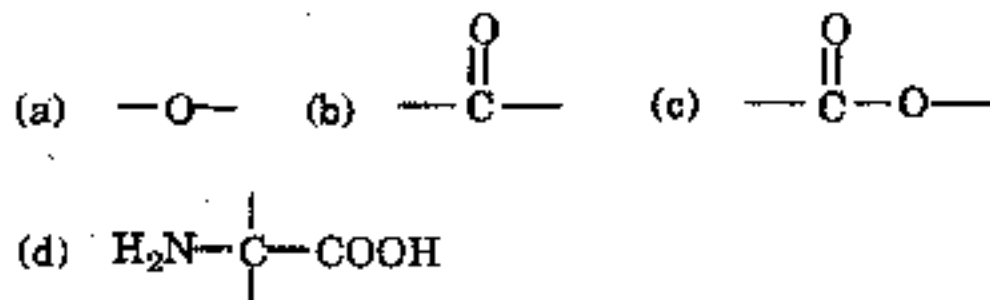
14. Which has the biggest solubility product
    (a) $Be(OH)_2$ (b) $Mg(OH)_2$ (c) $Ca(OH)_2$ (d) $Sr(OH)_2$

15. Which compound does not exist
    (a) XeF_2 (b) XeF_4 (c) XeF_6 (d) XeF_8

16. Which compound does not exist (very unstable)
    (a) $V(CO)_4$ (b) $Fe(CO)_4$ (c) $Mn_2(CO)_{10}$ (d) $CO_2(CO)_8$

17. Ketones has the functional group

(a) $-O-$ (b) $-\overset{\overset{O}{\|}}{C}-$ (c) $-\overset{\overset{O}{\|}}{C}-O-$

(d) $H_2N-\overset{|}{\underset{|}{C}}-COOH$

18. The half-life of ^{40}K radiation is 1.3×10^9 years. The strength of radiation of a sample of ^{40}K after 5.2×10^9 year is about

(a) 1/2   (b) 1/4   (c) 1/16   (d) 1/64

of the original strength

19. Which of the following nuclear reaction is incorrect

(a) $^{14}_{7}N + ^{1}_{0}n \longrightarrow ^{14}_{6}C + ^{1}_{1}H$ (b) $^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + ^{1}_{0}n$

(c) $^{12}_{6}C + ^{4}_{2}He \longrightarrow ^{16}_{7}N + ^{0}_{+1}\beta$ (d) $4^{1}_{1}H \longrightarrow ^{4}_{2}He + 2^{0}_{+1}\beta$
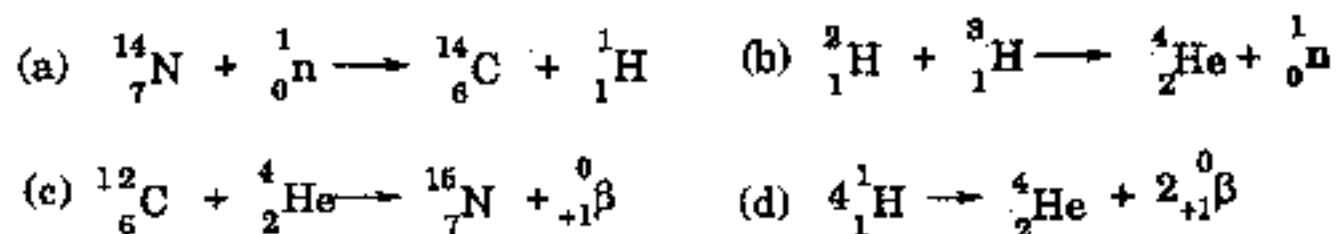
20. Which orbital has the most radial node

(a) 4s   (b) 4p   (c) 4d   (d) 4f

填空題：請將各空格之理想答案（儘量用英文）依題次順序寫在答案紙上，每格兩分。

21. Ammonia gas is synthesized in industry through the Haber reaction of $N_2 + 3H_2 \rightleftharpoons 2NH_3$. The thermodynamic data of molecules involved in this reaction at 300 K have been found as:

Molecule	$\Delta_f H^0$ /kJ mol^{-1}	S^0 /JK^{-1}mol^{-1}
H_2		130
N_2		200
NH_3	−50	200

The change in enthalpy ($\Delta_r H^0$), entropy ($\Delta_r S^0$) and free energy
($\Delta_r G^0$) of this reaction at 300 K should be _____ , _____ and
_____ respectively. The equilibrium constant of this equilibrium
can be related to the pressure of these gases as $K_p =$ _____ and
has a value of _____ at 300 K. The equilibrium is an ____ -thermic
reaction and will shift to the _____ –hand side of the chemical
equation on increasing the system temperature.   (14%)

22. The rate constant (k) of a reaction depends on the reaction temperature
    (T) and can be expressed by the Arrhenius equation of _____ .
    According to this equation, the activation energy (E_a) may be obtained
    graphically by plotting ___ agaist _____ . Obtained plot should
    yield a straight line with a slope of _____ and an intercept of
    _____ .   (10%)

23. A catalyst is a substance that can _____ rates of chemical
    reactions by decreasing their required _____ energies but cannot
    change their _____ .   (6%)

24. The rate of an elementary reaction A → P may be expressed as
    $d[A]/dt = -k[A]^n$, where n is the _____ . On assuming the
    concentration of A at t=0 is $[A]_0$ M, the half life ($t_{1/2}$) of A should be
    _____ and the unit of k is _____ when n=1, and becomes _____
    and _____ respectively when n=2.   (10%)

25. Predict the changes (>0, >0 or =o) of the following thermodynamic functions on the phase change of $H_2O_{(s)} \rightarrow H_2O_{(l)}$ at the standard state (0°C and 1 atm): ΔG_{sys} _____ ΔH_{sys} _____ , ΔS_{sys} _____ , ΔS_{uni} _____ , and ω_{sys} _____ . (10%)