



考試科目：普通化學

系所名稱：日食科二(食科組)

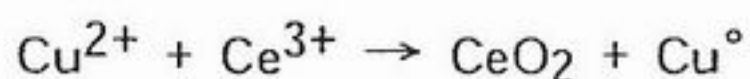
\*使用計算機

1. 答案以橫式由左至右書寫。2. 請依題號順序作答。

For each item, choose your answer in the space provided on a separate sheet of paper.

- 1) What is the mass percent composition of oxygen in phosphoric acid ( $\text{H}_3\text{PO}_4$ )?  
A) 52.5%                      B) 50.4%                      C) 45.8%                      D) 72.5%                      E) 65.3%
- 2) The molar mass of a substance is expressed as the unit:  
A) mole/L                      B) g/L                          C) mg/mole                      D) kg/L                          E) g/mole
- 3) What is the definition of a compound in Dalton's Atomic Theory?  
A) The relative numbers of each kind of atom in a compound form a simple ratio.  
B) All compounds are alike in mass and other properties.  
C) Compounds are composed of divisible small particles.  
D) Compounds are formed when atoms of different elements unite in the same proportions.  
E) All compounds contain the same numbers of protons and neutrons.
- 4) A chemical formula that shows how atoms are attached to one another is called a:  
A) mass number formula  
B) empirical formula  
C) structural formula  
D) cation formula  
E) molecular formula
- 5) The mass of a molecular substance relative to the mass of a carbon-12 atom is:  
A) chemical body mass  
B) structural mass  
C) empirical mass  
D) atomic mass  
E) molecular mass
- 6) The correct equation for which the enthalpy change defines the standard enthalpy of formation for  $\text{C}_2\text{H}_5\text{OH}$  (l) is:  
A)  $\text{CH}_2=\text{CH}_2(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{CH}_3\text{CH}_2\text{OH}(\text{l})$   
B)  $\text{CH}_3\text{CHO}(\text{l}) + \text{H}_2(\text{g}) \rightarrow \text{CH}_3\text{CH}_2\text{OH}(\text{l})$   
C)  $4\text{C}(\text{gr}) + 6\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{CH}_3\text{CH}_2\text{OH}(\text{l})$   
D)  $2\text{C}(\text{gr}) + 6\text{H}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{C}_2\text{H}_5\text{OH}(\text{l})$   
E)  $2\text{C}(\text{gr}) + 3\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{C}_2\text{H}_5\text{OH}(\text{l})$
- 7) Which is correct regarding an endothermic reaction?  
A) The reaction does not occur.  
B) The enthalpy of the reactants is higher than the enthalpy of the products.  
C) The sign of the  $\Delta H$  is positive.  
D) The reaction liberates heat.  
E) The temperature increases when the reaction is carried out in a calorimeter.

8) After balancing the following redox equation, the sum of the stoichiometric coefficients on the right hand side of the equation is:



- A) 2.                      B) 9.                      C) 11.                      D) 7.                      E) 3.

9) In the reaction  $\text{Cu (s)} + 2 \text{Ag}^+ \text{ (aq)} \rightarrow \text{Cu}^{2+} \text{ (aq)} + 2 \text{Ag (s)}$ , the reducing agent (if any) is

- A)  $\text{Cu}^{2+}$ .  
B)  $\text{Ag}^+$ .  
C) Ag.  
D) Cu.  
E) none of these (not a redox reaction)

10) The maximum wavelength of light that will cause ejection of a photoelectron in silver metal is 262 nm. What is the threshold energy or minimum energy, in J, required to eject an electron from silver? (Planck's constant:  $6.626 \times 10^{-34} \text{ J s}$ )

- A)  $7.59 \times 10^{-19}$                       B)  $7.59 \times 10^{19}$                       C)  $1.31 \times 10^{18}$                       D)  $1.21 \times 10^{15}$                       E)  $8.73 \times 10^{-16}$

11) How many electrons are there in a complete filled  $n = 3$  principal shell?

- A) 2                      B) 6                      C) 8                      D) 18                      E) 32

12) For which subshell notation is correct for the set of quantum numbers with  $n = 2$  and  $l = 0$ ?

- A) 2s                      B) 3p                      C) 2p                      D) 3s                      E) 3d

13) How many valence electrons are there in the electron configuration for  $\text{F}^-$ ?

- A) 9                      B) 6                      C) 1                      D) 8                      E) 7

14) Which of the following is the correct Lewis symbol for  $\text{Br}^-$ ?

- A)  $\text{:}\ddot{\text{Br}}\text{:}$                       B)  $\text{:}\ddot{\text{Br}}\text{:}$                       C)  $\cdot\ddot{\text{Br}}\cdot$                       D)  $\text{:}\ddot{\text{Br}}\cdot$

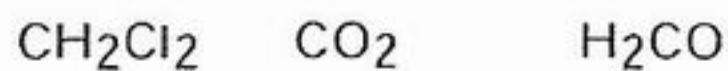
15) What mass of glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ , in grams, should be added to 50.0 g  $\text{H}_2\text{O}$  to raise the boiling point to  $100.45^\circ\text{C}$ ? ( $K_b = 0.512^\circ\text{C } m^{-1}$ )

- A) 16.0                      B) 50                      C) 160                      D) 7.9                      E) 0.88

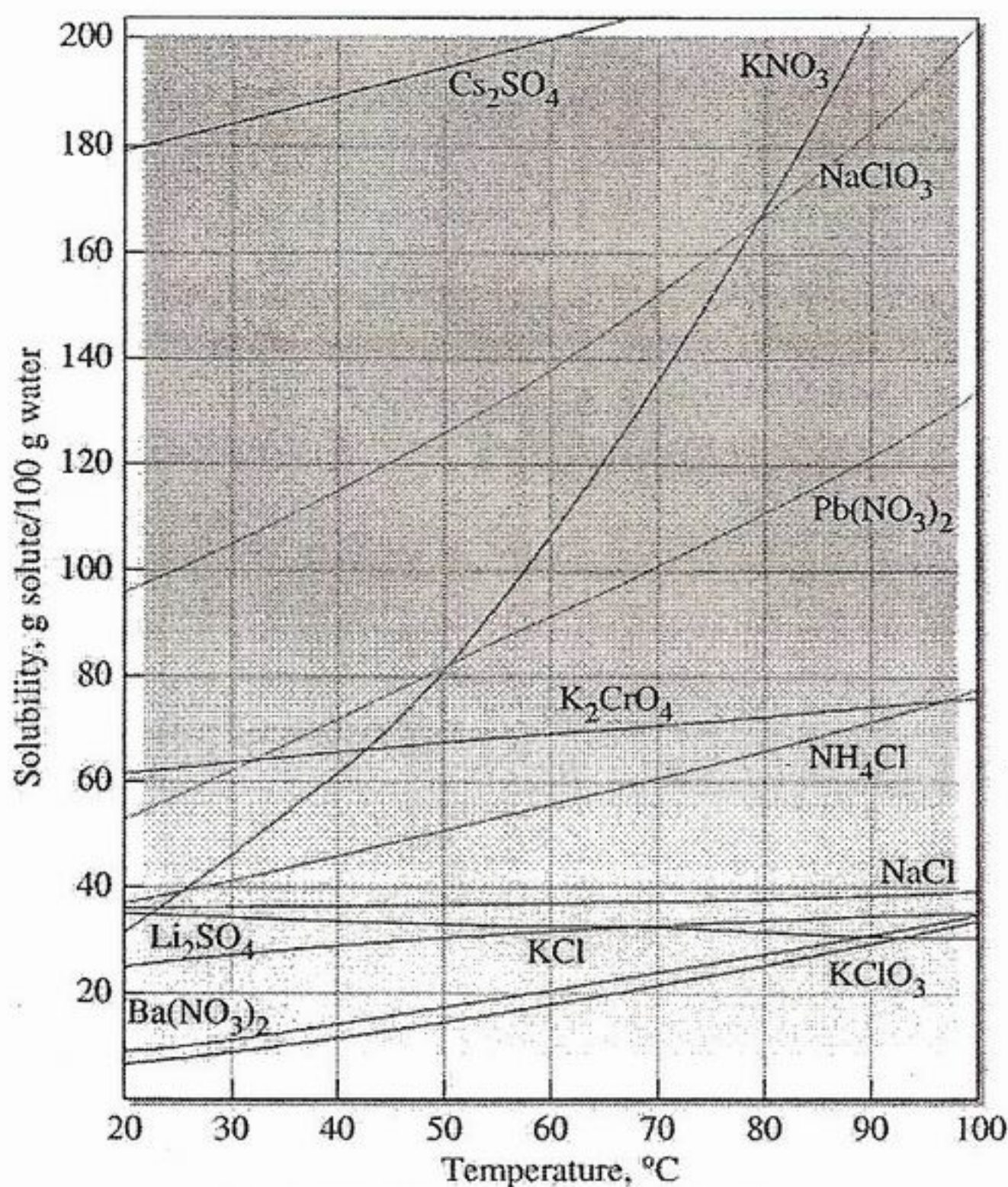
16) For which of the following is hydrogen-bonding not an important intermolecular force?

- A) HF  
B)  $\text{CH}_3\text{NH}_2$   
C)  $\text{H}_2\text{O}$   
D)  $\text{CH}_3\text{CH}_2\text{OH}$   
E)  $\text{N}_2$

17) Which series correctly identifies the hybridization of the central atom in the following species?



- A) sp    sp    sp<sup>3</sup>
- B) sp<sup>2</sup> sp<sup>3</sup> sp<sup>3</sup>
- C) sp    sp<sup>2</sup> sp<sup>2</sup>
- D) sp<sup>3</sup> sp<sup>2</sup> sp
- E) sp<sup>3</sup> sp    sp<sup>2</sup>



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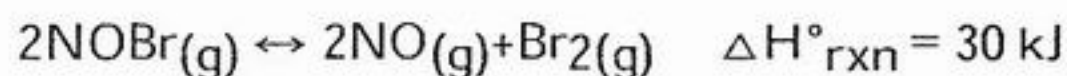
18) What will happen if 60.0g KNO<sub>3</sub> is added to 100g water at 60°C?

- A) All of the KNO<sub>3</sub> will dissolve.
- B) None of the KNO<sub>3</sub> will dissolve.
- C) All of the KNO<sub>3</sub> will dissolve, but then it will precipitate.
- D) Some of the KNO<sub>3</sub> will not dissolve.
- E) The solution will become supersaturated.

19) How many electrons are there in the 3d orbitals of ground state calcium atom?

- A) 0
- B) 1
- C) 2
- D) 5
- E) 10

20) For the following reaction at equilibrium in a reaction vessel, which one of the changes below would cause the  $\text{Br}_2$  concentration to increase?

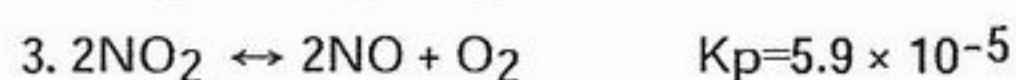
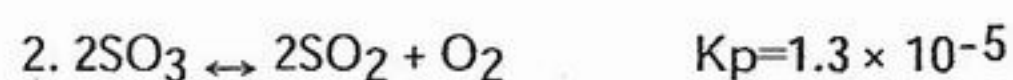
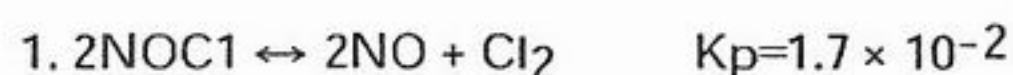


- A) Remove some NO.
- B) Compress the gas mixture into a smaller volume.
- C) Lower the temperature.
- D) Remove some NOBr.

21) The reaction  $\text{A} + 2\text{B} \rightarrow \text{products}$  was found to have the rate law,  $\text{rate} = k[\text{A}][\text{B}]^2$ . Predict by what factor the rate of reaction will increase when the concentration of A is doubled and the concentration of B is also doubled.

- A) 6
- B) 8
- C) 4
- D) 2
- E) 9

22) The following reactions occur at  $500^\circ\text{K}$ . Arrange them in order of increasing tendency to proceed to completion (least  $\rightarrow$  greatest tendency).

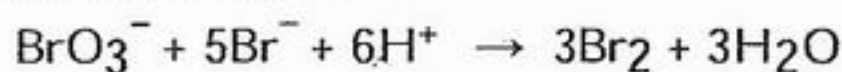


- A)  $3 < 2 < 1$
- B)  $2 < 1 < 3$
- C)  $3 < 1 < 2$
- D)  $2 < 3 < 1$
- E)  $1 < 2 < 3$

23) Which one of the following changes would alter the rate constant ( $k$ ) for the reaction  $2\text{A} + \text{B} \rightarrow \text{products}$ ?

- A) measuring  $k$  again after the reaction has run for a while
- B) increasing the temperature
- C) increasing the concentration of B
- D) increasing the concentration of A

24) For the reaction

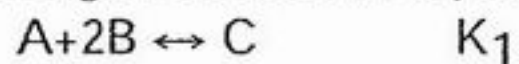


$$-\Delta[\text{BrO}_3^-] / \Delta t = 1.5 \times 10^{-2} \text{ M/s} \text{ at a particular time.}$$

What is  $-\Delta[\text{Br}^-] / \Delta t$  at the same instant?

- A)  $1.5 \times 10^{-2} \text{ M/s}$
- B)  $7.5 \times 10^{-2} \text{ M/s}$
- C)  $13 \text{ M/s}$
- D)  $3.0 \times 10^{-3} \text{ M/s}$
- E)  $330 \text{ M/s}$

25) For the following reactions the equilibrium constants are defined:



Then for the reaction



The equilibrium constant must be equal to:

A)  $K_c = (K_1)(K_2)$

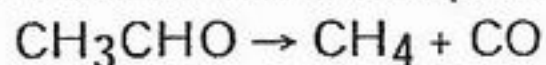
B)  $K_c = K_1 + K_2$

C)  $K_c = K_1 / K_2$

D)  $K_c = K_2 / K_1$

E)  $K_c = K_1 - K_2$

26) The thermal decomposition of acetaldehyde is a second-order reaction.



The following data were obtained at 518 °C. The initial pressure of CH<sub>3</sub>CHO is 364 mmHg.

time, s	Pressure CH <sub>3</sub> CHO, mmHg
42	330
105	290
720	132

Calculate the rate constant for the decomposition of acetaldehyde from the above data.

A) 0.70 mmHg/s

B)  $5.2 \times 10^{-5} / \text{mmHg s}$

C)  $6.7 \times 10^{-6} / \text{mmHg s}$

D)  $2.2 \times 10^{-3} / \text{mmHg s}$

E)  $2.2 \times 10^{-3} / \text{s}$

27) In the first order reaction,  $A \rightarrow \text{Products}$ , the initial concentration of A is 1.56 M and 0.869 M after 48.0 minutes.

What is the value of the rate constant,  $k$ , in  $\text{min}^{-1}$ ?

A)  $2.92 \times 10^{-2}$

B)  $5.68 \times 10^{-2}$

C)  $1.90 \times 10^{-2}$

D)  $3.84 \times 10^{-2}$

E)  $1.22 \times 10^{-2}$

28) The Arrhenius equation is  $k = A e^{-(E_a / RT)}$

The slope of a plot of  $\ln k$  vs.  $1/T$  is equal to:

A)  $k$

B)  $-k$

C)  $A$

D)  $-E_a/R$

E)  $E_a$

29)  $\text{Zn}(\text{OH})_2$  is amphoteric. In which of the following solutions would the solubility of  $\text{Zn}(\text{OH})_2$  be lowest?

A) pure water

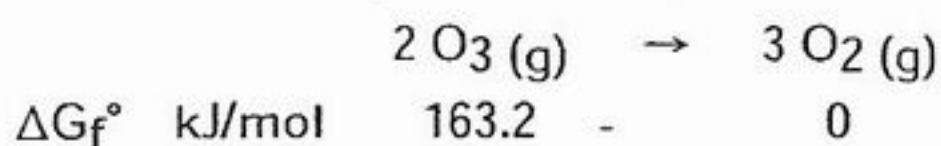
B) 1 M  $\text{NH}_3$

C) 1 M  $\text{HCl}$

D) 1 M  $\text{NaOH}$

E) 1 M  $\text{ZnCl}_2$

30) Consider the following data and calculate  $\Delta G^\circ$ , in kJ, for the following reaction at 25°C.



A) 163.2

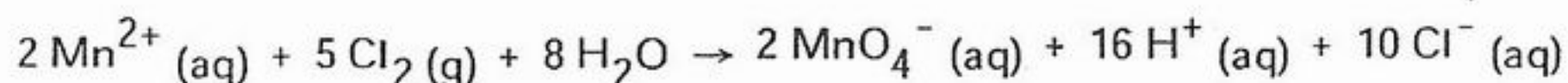
B) -163.2

C) 489.6

D) 326.4

E) -326.4

- 31) A certain first-order reaction  $A \rightarrow B$  is 25% complete in 42 min at 25 . What is the half-life of the reaction?  
 A) 42 min                      B) 84 min                      C) 21 min                      D) 101 min                      E) 120 min
- 32) Would a precipitate be observed if equal volumes of a 0.040 M  $\text{AgNO}_3$  solution and a 0.030 M  $\text{NaNO}_2$  solution are mixed? ( $K_{\text{sp}} \text{AgNO}_2 = 6.0 \times 10^{-4}$ )  
 A) Yes, because  $Q_{\text{ip}} > K_{\text{sp}}$ .  
 B) No, because  $Q_{\text{ip}} < K_{\text{sp}}$ .  
 C) No, because  $Q_{\text{ip}} > K_{\text{sp}}$ .  
 D) Yes, because  $Q_{\text{ip}} < K_{\text{sp}}$ .  
 E) No, because  $Q_{\text{ip}} = K_{\text{sp}}$ .
- 33) Determine the number of electrons transferred in the following reaction.



- A) 7                              B) 10                              C) 2                              D) 16                              E) 5
- 34) Why is  $\alpha$ -particle emission less hazardous than  $\gamma$ -ray or X-ray emission as long as it is outside the body?  
 A)  $\alpha$ -particles are very high in energy and can pass through living tissue without harming it.  
 B) Less  $\alpha$ -particle emission occurs naturally than  $\gamma$ -ray or X-ray emission.  
 C)  $\gamma$ -rays and X-rays are hazardous because the rays are highly penetrating, causing damage inside the body quite easily.  
 D)  $\alpha$ -particles are less hazardous because they are electrons, while  $\gamma$ -rays and X-rays have much more mass.  
 E) None of these are hazardous to living creatures— $\beta$ -particles are hazardous.
- 35) What is the ionization constant of a weak acid with  $\text{p}K_{\text{a}} = 8.00$ ?  
 A)  $1.0 \times 10^8$                       B)  $1.0 \times 10^{-8}$                       C)  $-9.0 \times 10^{-1}$                       D) -2.1                              E)  $1.0 \times 10^{-6}$
- 36) The reaction of 11.0g 1-propanol with excess HI produces how many grams of water?  

$$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{HI} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{I} + \text{H}_2\text{O}$$
  
 A) 3.30                              B) 0.611                              C) 11.0                              D) 6.60                              E) 0.183
- 37) Which of the following could not be a ligand?  
 A)  $\text{H}_2\text{O}$                               B)  $\text{Br}^-$                               C)  $\text{NH}_3$                               D)  $\text{CN}^-$                               E)  $\text{Co}^{2+}$
- 38) Which type of electromagnetic radiation interacts primarily with the  $\pi$  electrons in a molecule?  
 A) radio-TV                              B) UV                              C) IR                              D) microwave                              E) X-ray

39) What is the energy, in kJ/mol, associated with infrared radiation of  $1740\text{ cm}^{-1}$ ?

( Planck's constant :  $6.626 \times 10^{-34}\text{ J}\cdot\text{s}$  ; light speed :  $3 \times 10^{10}$  )

A)  $4.64 \times 10^{-8}\text{ kJ/mol}$

B)  $658\text{ kJ/mol}$

C)  $464\text{ kJ/mol}$

D)  $20.8\text{ kJ/mol}$

E)  $72.3\text{ kJ/mol}$

40) Which of the following is the formula of an alkane?

A)  $\text{C}_6\text{H}_{12}$

B)  $\text{C}_3\text{H}_8$

C)  $\text{C}_3\text{H}_{10}$

D)  $\text{C}_6\text{H}_{10}$

E)  $\text{C}_3\text{H}_6$