

題號：2032

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科目：普通化學丙

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1 H 1.00794																	1 H 1.00794	2 He 4.002602					
3 Li 6.941	4 Be 9.012182																	5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.9984032	10 Ne 20.1797
11 Na 22.989770	12 Mg 24.3050																	13 Al 26.981538	14 Si 28.0855	15 P 30.973761	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.955910	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.938049	26 Fe 55.845	27 Co 58.933200	28 Ni 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80						
37 Rb 85.4678	38 Sr 87.62	39 Y 88.90585	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.90550	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.710	51 Sb 121.760	52 Te 127.60	53 I 126.90447	54 Xe 131.29						
55 Cs 132.90545	56 Ba 137.327	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.96655	80 Hg 200.59	81 Tl 204.3833	82 Pb 207.2	83 Bi 208.98038	84 Po (209)	85 At (210)	86 Rn (222)						

本試題含單選題 25 題(75 分)，及三題敘述與計算題(25 分)，總分 100 分

(I). 單選題 (選出一個最適當的答案): 每題 3 分. (答案直接填入“選擇題作答區”內)

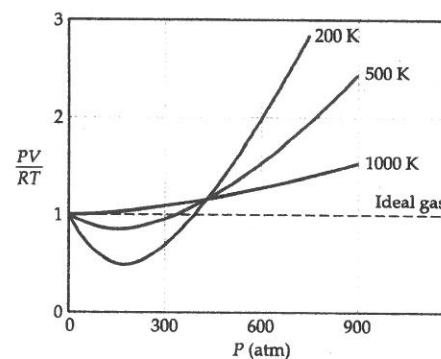
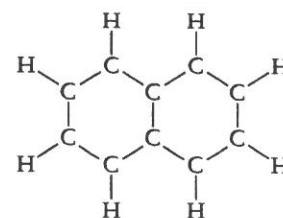
- How many significant figures are in the number 500?
(A) 4 (B) 3 (C) 2 (D) 1 (E) None of the above
- 0.325 mole of an ideal gas is put inside a box whose width, length, and height are 15.5, 27.3, and 5.4 cm, respectively. What is the pressure of the system at 298.0 K with the correct significant figures?
(A) 3 atm (B) 3.5 atm (C) 3.45 atm (D) 3.453 atm (E) 3.4529 atm
- What is the chemical formula of sodium sulfite?
(A) NaSO_3 (B) NaSO_4 (C) Na_2SO_3 (D) Na_2SO_4 (E) None of the above
- The formula of 1-butene is
(A) C_4H_{10} (B) C_4H_8 (C) C_4H_6 (D) C_4H_4 (E) None of the above
- How many moles of chloride ions are in 0.30 g of aluminum chloride?
(A) 2.02×10^{-2} (B) 6.75×10^{-3} (C) 3.38×10^{-3} (D) 1.69×10^{-3} (E) None of the above
- Sodium iodide reacts with ozone in aqueous solution. How many grams of ozone can be removed with 1.75 g of sodium iodide?
(A) 1.75 (B) 0.56 (C) 0.28 (D) 0.19 (E) None of the above
- If a particle in a 1-D box has a ground-state energy of 0.1 eV, what is the ground-state energy of the particle in a box with twice the length?
(A) 0.025 eV (B) 0.05 eV (C) 0.1 eV (D) 0.2 eV (E) None of the above
- Which orbital has the quantum numbers $l=3$ and $n=5$?
(A) 3d (B) 4d (C) 4f (D) 5d (E) None of the above
- What is the degeneracy of the $n=4$ energy level of the hydrogen atom?
(A) 1 (B) 4 (C) 9 (D) 16 (E) 18
- Which group would generally have the lowest first ionization energy?
(A) Transition Metals (B) Alkali Metals (C) Noble Gases
(D) Alkaline Earth Metals (E) Halogens
- What is the formal charge of the nitrogen atom in NO_3^- ?
(A) -2 (B) -1 (C) 0 (D) +1 (E) +2
- The Haber process is the industrial process that produces Ammonia. Which one in the following is not necessary in the Haber process?
(A) pure N_2 (B) high temperature (C) high pressure (D) catalyst (E) condenser
- Which one has the largest lattice energy?
(A) CaO (B) SrO (C) MgF_2 (D) KCl (E) RbCl
- The molecular geometry of ICl_3 is
(A) trigonal pyramidal (B) tetrahedral (C) seesaw (D) square planar (E) T-shape
- Which of the following solutions has the largest concentration of solvated protons?
(A) 0.1 M NaOH (B) 0.1 M nitrous acid (C) 1.0 M sulfuric acid (D) 0.2 M acetic acid (E) Pure water
- Which one of the following substance is the most volatile?
(A) CCl_4 (B) CBr_4 (C) CH_2Cl_2 (D) CH_3Cl (E) CH_3Br
- A 0.10 M solution of a monoprotic acid has a pH of 2.38. The K_a of this acid is approximately
(A) 4.2×10^{-2} (B) 4.2×10^{-4} (C) 1.8×10^{-3} (D) 1.8×10^{-4} (E) None of the above
- A 0.035 M solution of HNO_2 contains 3.7×10^{-3} M $\text{H}^+(\text{aq})$. What is its percent ionization?
(A) 0.37% (B) 3.5% (C) 9.8% (D) 10.6% (E) 14.8%

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19. Consider a cell: $\text{Ni}(s)/\text{Ni}^{2+}(aq) 0.001 \text{ M} \parallel \text{Ni}^{2+}(aq) 1.0 \text{ M}/\text{Ni}(s)$. What is the cell potential?
 (A) 0.04V (B) 0.09V (C) 0.18V (D) 0.28V (E) None of the above
20. Assume that the reaction $\text{CaO}(s) + \text{CO}_2(g) \rightarrow \text{CaCO}_3(s)$ occurs at constant pressure. If you are given ΔH for the process, what additional information do you need to determine ΔE ?
 (A) ΔV (B) ΔG (C) ΔS (D) w (E) q
21. The air bags that provide protection in cars expand in the event of an accident. From the viewpoint of the reactants as the system, what do you expect for the signs of q and w in this process?
 (A) $w > 0, q < 0$ (B) $w > 0, q > 0$ (C) $w < 0, q = 0$ (D) $w < 0, q < 0$ (E) $w < 0, q > 0$
22. Which one of the following statements is correct?
 (A) $\Delta S = 0$ for an adiabatic process (B) the entropy tends to zero for ice at zero Kelvin (C) a constant-pressure process with $\Delta S < 0$ and $\Delta H > 0$ is impossible (D) the internal energy of a system must decrease in a spontaneous process (E) none of the above
23. A sample of N_2O_5 was placed in a container to allow the reaction to occur:
 $2\text{N}_2\text{O}_5(g) \rightarrow 4\text{NO}_2(g) + \text{O}_2(g)$.
 The partial pressure of $\text{N}_2\text{O}_5(g)$ was measured during the reaction as shown in the table. Which of the following is true?
 (A) the reaction is a zero-order reaction (B) the reaction is a first-order reaction (C) the reaction is a second-order reaction (D) the overall reaction order is 3 (E) none of the above
- | Time (min) | $P_{\text{N}_2\text{O}_5}$ (atm) | $\ln(P_{\text{N}_2\text{O}_5})$ | $1/P_{\text{N}_2\text{O}_5}$ (atm^{-1}) |
|------------|----------------------------------|---------------------------------|--|
| 0 | 150 | 5.0 | 0.0067 |
| 100 | 75 | 4.3 | 0.013 |
| 200 | 38 | 3.6 | 0.027 |
| 300 | 19 | 2.9 | 0.053 |
24. Which one of the following statements regarding the Michaelis-Menten model is correct?
 (A) The overall reaction is first-order with respect to the enzyme concentration (B) at high substrate concentration, the reaction rate is independent of the enzyme concentration (C) at low substrate concentration, the reaction rate is independent of the substrate concentration (D) the binding of the substrate is the rate-determining step (E) none of the above
25. Which substance is more likely to serve as a reductant?
 (A) Fe_2O_3 (B) CaCO_3 (C) HClO_4 (D) Ag (E) KMnO_4

(II). 敘述與計算題 (共 25 分, 用中、英文作答皆可):

26. Naphthalene, C_{10}H_8 , is a molecule that consists of two six-membered rings of carbon fused along an edge, as shown in the incomplete Lewis structure on the right. Answer the following questions:
 (26A) (3%) Draw all of the resonance structures of naphthalene. How many are there?
 (26B) (3%) Not all of the C-C bond lengths in naphthalene are equivalent. How many C-C bonds in the molecule do you expect to be shorter than the others? Identify these bonds.
 (26C) (4%) Compare to other alkenes, naphthalene is rather stable and does not undergo normal addition reactions. Explain the phenomenon by identifying a special property of the electronic structure of the molecule.
27. The normal boiling point of $\text{Br}_2(l)$ is 58.8°C , and its molar enthalpy of vaporization is $\Delta H_{\text{vap}} = 29.6 \text{ kJ/mol}$.
 (27A) (3%) When $\text{Br}_2(l)$ boils at its normal boiling point, does its entropy increase or decrease? Why?
 (27B) (5%) Calculate the value of ΔS when 1.00 mol of $\text{Br}_2(l)$ is vaporized at 58.8°C .
28. The figure on the right shows the effect of temperature and pressure on the behavior of 1 mole of nitrogen gas. Answer the following questions:
 (28A) (2%) Why all curves approach $PV/RT=1$ as $P \rightarrow 0$.
 (28B) (3%) At 200K, why $PV/RT < 1$ at low pressure? Why $PV/RT > 1$ at high pressure?
 (28C) (2%) Nitrogen gas behaves more like an ideal gas as the temperature increases. Is this always true for gases? Explain why or why not.



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