

國立高雄大學九十七學年度轉學招生考試試題

科目：普通化學
考試時間：80 分鐘

系所：
應用化學系轉二年級
本科原始成績：100 分

是否使用計算機：是

I. Multiple choice: (本大題為選擇題。)(2.5 points each, total: 75 points)

1. Which among the following represent a set of isotopes? A atomic nuclei containing:

- I. 20 protons and 20 neutrons.
- II. 21 protons and 19 neutrons.
- III. 22 neutrons and 18 protons.
- IV. 20 protons and 22 neutrons.
- V. 21 protons and 20 neutrons.

- a) I, II, III
- b) III, IV
- c) I, V
- d) I, IV and II, V
- e) No isotopes are indicated.

2. What is the correct formula for barium phosphate?

- a) BaPO_4
- b) $\text{Ba}_3(\text{PO}_4)_2$
- c) $\text{Ba}_2(\text{PO}_4)_3$
- d) Ba_2PO_4
- e) Ba_3PO_4

3. Indium has atomic number 49 and atomic mass 114.8 g. Naturally occurring indium contains a mixture of indium-112 and indium-115, respectively, in an atomic ratio of approximately

- a) 6/ 94.
- b) 25/ 75.
- c) 50/ 50.
- d) 75/ 25.
- e) 94/ 6.

4. Which of the following solutions contains the greatest total ion concentration?

- a) One mole of potassium chloride dissolved in 1.0 L of solution.
- b) One mole of iron(II) nitrate dissolved in 1.0 L of solution.
- c) One mole of potassium hydroxide dissolved in 1.0 L of solution.
- d) One mole of sodium phosphate dissolved in 1.0 L of solution.
- e) At least two of the above solutions have an equal number of ions, and these contain the greatest total ion concentration.

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5. A solution contains the ions Ag^+ , Pb^{2+} , and Ni^{2+} . Dilute solutions of NaCl , Na_2SO_4 , and Na_2S are available to separate the positive ions from each other. In order to effect separation, the solutions should be added in which order?

- a) Na_2SO_4 , NaCl , Na_2S
- b) Na_2SO_4 , Na_2S , NaCl
- c) Na_2S , NaCl , Na_2SO_4
- d) NaCl , Na_2S , Na_2SO_4
- e) NaCl , Na_2SO_4 , Na_2S

6. A balloon contains 10.0 g neon gas. While keeping the temperature constant, 10.0 g of argon gas is added. What happens?

- a) The balloon doubles in volume.
- b) The volume of the balloon expands by more than 2 times.
- c) The volume of the balloon expands by less than 2 times.
- d) The balloon stays the same size but the pressure increases.
- e) none of these

7. For the reaction $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$, what is the relationship between K and K_p at temperature T ?

- a) $K = K_p$
- b) $K = K_p(\text{RT})^2$
- c) $K_p = K(\text{RT})^2$
- d) $K = K_p(\text{RT})$
- e) $K_p = K(\text{RT})$

8. The value of the equilibrium constant, K , is dependent on

- I. The temperature of the system.
- II. The nature of the reactants and products.
- III. The concentration of the reactants.
- IV. The concentration of the products.

- a) I, II
- b) II, III
- c) III, IV
- d) It is dependent on three of the above choices.

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e) It is not dependent on any of the above choices.

9. Nitrogen gas (N_2) reacts with hydrogen gas (H_2) to form ammonia (NH_3). At $200^\circ C$ in a closed container, 1.0 atm of nitrogen gas is mixed with 2.0 atm of hydrogen gas. At equilibrium, the total pressure is 2.0 atm. Calculate the partial pressure of hydrogen gas at equilibrium.

- a) 2.0 atm
- b) 0.50 atm
- c) 1.5 atm
- d) 0.0 atm
- e) none of these

10. According to the Bronsted-Lowry definition, an acid is

- a) a substance that increases the hydroxide concentration ion concentration in a solution.
- b) a substance that increases the hydrogen ion concentration ion concentration in a solution.
- c) a substance that can accept a proton from another species in solution.
- d) a substance that can donate a proton to another species.
- e) an electron pair acceptor.

11. Calculate the pH of a solution that contains 3.25 M HCN ($K_a = 6.2 \times 10^{-10}$), 1.00 M NaOH and 1.50 M NaCN.

- a) 9.25
- b) 8.86
- c) 8.28
- d) 7.46
- e) none of these

12. Calculate the concentration of chromate ion, CrO_4^{2-} , in a saturated solution of $CaCrO_4$. ($K_{sp} = 7.1 \times 10^{-4}$)

- a) 0.027 M
- b) 5.0×10^{-7} M
- c) 7.1×10^{-4} M
- d) 3.5×10^{-4} M
- e) 3.5×10^{-2} M

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

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- a) Enthalpy is a state function.
- b) In exothermic reactions, the reactants are lower in potential energy than the products.
- c) A chemist takes the surroundings point of view when determining the sign for work or heat.
- d) The heat of reaction and change in enthalpy can always be used interchangeably.
- e) At least two of the above statements are true.

14. 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) $\Delta H > 0$
- b) $\Delta S_{\text{univ}} > 0$
- c) $\Delta S_{\text{sys}} < 0$
- d) $\Delta S_{\text{surr}} > 0$
- e) none of these

15. The reaction below occurs in basic solution. In the balanced equation, what is the sum of the coefficients?



- a) 12
- b) 15
- c) 19
- d) 23
- e) 27

16. For a reaction in a voltaic cell both ΔH° and ΔS° are positive. Which of the following statements is true?

- a) E°_{cell} will increase with an increase in temperature.
- b) E°_{cell} will decrease with an increase in temperature.
- c) E°_{cell} will not change when the temperature increases.
- d) $\Delta G^\circ > 0$ for all temperatures.
- e) None of the above statements is true.

17. An atom of fluorine contains 9 electrons. How many of these electrons are in s orbitals?

- a) 2

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- b) 4
- c) 6
- d) 8
- e) none

18. Choose the compound with the most ionic bond.

- a) LiCl
- b) KF
- c) NaCl
- d) LiF
- e) KCl

19. As indicated by Lewis structures, which of the following species could probably not exist as a stable molecule?

- a) NH_3
- b) N_2H_2
- c) N_2H_4
- d) N_2H_6
- e) N_2O_4

20. What is the hybridization of Cl in the molecule ClF_3 ?

- a) sp
- b) sp^2
- c) sp^3
- d) dsp^3
- e) d^2sp^3

21. Which of the following statements is true?

- a) Electrons are never found in an antibonding MO.
- b) All antibonding MOs are higher in energy than the atomic orbitals of which they are composed.
- c) Antibonding MOs have electron density mainly outside the space between the two nuclei.
- d) None of the above is true.
- e) Two of the above statements are true.

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22. The rate constant k is dependent on
- the concentration of the reactant.
 - the concentration of the product.
 - the temperature.
 - the order of the reaction.
 - none of these
23. At a particular temperature the half-life of a zero-order reaction is 20.0 min. How long will it take for the reactant concentration to be depleted by a factor of 8?
- 20.0 min
 - 35.0 min
 - 60.0 min
 - 140 min
 - 160 min
24. Which of the following statements is true about p -type silicon?
- It is produced by doping Si with P or As.
 - Electrons are the mobile charge carriers.
 - It does not conduct electricity as well as pure Si.
 - All are true.
 - None is true.
25. An aqueous solution contains 45.0 g KNO_3 in 250.0 mL solution. The molarity of the solution is
- 0.455 M KNO_3
 - 1.78 M KNO_3
 - 2.25 M KNO_3
 - 8.99 M KNO_3
 - none of these
26. Which elements have chemical properties determined by the valence-level s and p electrons?
- representative elements
 - transition metals
 - lanthanides
 - actinides
 - none of these

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27. Choose the element that is the strongest reducing agent in aqueous solution.

- a) Li
- b) Na
- c) K
- d) Rb
- e) Cs

28. Choose the species with the smallest hydration energy (absolute value).

- a) F^-
- b) Cl^-
- c) Br^-
- d) I^-
- e) all the same

29. Which of the following coordination compounds will form a precipitate when treated with an aqueous solution of $AgNO_3$?

- a) $[Cr(NH_3)_3Cl_3]$
- b) $[Cr(NH_3)_6]Cl_3$
- c) $[Cr(NH_3)Cl]SO_4$
- d) $Na_3[Cr(CN)_6]$
- e) $Na_3[CrCl_6]$

30. The product of ethane undergoing dehydrogenation is called

- a) propene
- b) methene
- c) ethene
- d) propane
- e) none of these

II. Provide a concise but thorough explanation of the following: (注意：本大題為名詞解釋，並非翻譯，答案只有英文翻中文，不計分。)(5 points each, total: 25 points)

31. Chelating ligand

32. Enthalpy

33. The three laws of thermodynamics

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34. Heisenberg uncertainty principle

35. Mole

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hydrogen 1 H 1.0079																	helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122																boron 5 B 10.811
sodium 11 Na 22.990	magnesium 12 Mg 24.305																carbon 6 C 12.011
potassium 19 K 39.098	calcium 20 Ca 40.078																nitrogen 7 N 14.007
rubidium 37 Rb 85.468	strontium 38 Sr 87.62																oxygen 8 O 15.999
cesium 55 Cs 132.91	barium 56 Ba 137.33																fluorine 9 F 18.998
francium 87 Fr [223]	radium 88 Ra [226]																neon 10 Ne 20.180
	scandium 21 Sc 44.956																argon 18 Ar 39.948
	titanium 22 Ti 47.867																potassium 39 K 39.098
	vanadium 23 V 50.942																calcium 20 Ca 40.078
	chromium 24 Cr 51.996																scandium 21 Sc 44.956
	manganese 25 Mn 54.938																titanium 22 Ti 47.867
	iron 26 Fe 55.845																vanadium 23 V 50.942
	cobalt 27 Co 58.933																chromium 24 Cr 51.996
	nickel 28 Ni 58.693																manganese 25 Mn 54.938
	copper 29 Cu 63.546																iron 26 Fe 55.845
	zinc 30 Zn 65.39																cobalt 27 Co 58.933
	gallium 31 Ga 69.723																nickel 28 Ni 58.693
	germanium 32 Ge 72.61																copper 29 Cu 63.546
	arsenic 33 As 74.922																zinc 30 Zn 65.39
	selenium 34 Se 78.96																gallium 31 Ga 69.723
	bromine 35 Br 79.904																arsenic 33 As 74.922
	krypton 36 Kr 83.80																selenium 34 Se 78.96
	rubidium 37 Rb 85.468																bromine 35 Br 79.904
	strontium 38 Sr 87.62																krypton 36 Kr 83.80
	yttrium 39 Y 88.906																rubidium 37 Rb 85.468
	zirconium 40 Zr 91.224																strontium 38 Sr 87.62
	niobium 41 Nb 92.906																yttrium 39 Y 88.906
	molybdenum 42 Mo 95.94																zirconium 40 Zr 91.224
	technetium 43 Tc [98]																niobium 41 Nb 92.906
	ruthenium 44 Ru 101.07																technetium 43 Tc [98]
	rhodium 45 Rh 102.91																ruthenium 44 Ru 101.07
	palladium 46 Pd 106.42																rhodium 45 Rh 102.91
	silver 47 Ag 107.87																palladium 46 Pd 106.42
	cadmium 48 Cd 112.41																silver 47 Ag 107.87
	indium 49 In 114.82																cadmium 48 Cd 112.41
	tin 50 Sn 118.71																indium 49 In 114.82
	antimony 51 Sb 121.76																tin 50 Sn 118.71
	tellurium 52 Te 127.60																antimony 51 Sb 121.76
	iodine 53 I 126.90																tellurium 52 Te 127.60
	xenon 54 Xe 131.29																iodine 53 I 126.90
	barium 56 Ba 137.33																xenon 54 Xe 131.29
	lanthanum 57 La 138.91																barium 56 Ba 137.33
	cerium 58 Ce 140.12																lanthanum 57 La 138.91
	praseodymium 59 Pr 140.91																cerium 58 Ce 140.12
	neodymium 60 Nd 144.24																praseodymium 59 Pr 140.91
	promethium 61 Pm [145]																neodymium 60 Nd 144.24
	samarium 62 Sm 150.36																promethium 61 Pm [145]
	europium 63 Eu 151.96																samarium 62 Sm 150.36
	gadolinium 64 Gd 157.25																europium 63 Eu 151.96
	terbium 65 Tb 158.93																gadolinium 64 Gd 157.25
	dysprosium 66 Dy 162.50																terbium 65 Tb 158.93
	holmium 67 Ho 164.93																dysprosium 66 Dy 162.50
	erbium 68 Er 167.26																holmium 67 Ho 164.93
	thulium 69 Tm 168.93																erbium 68 Er 167.26
	ytterbium 70 Yb 173.04																thulium 69 Tm 168.93
	lutetium 71 Lu 174.97																ytterbium 70 Yb 173.04
	hafnium 72 Hf 178.49																lutetium 71 Lu 174.97
	tantalum 73 Ta 180.95																hafnium 72 Hf 178.49
	tungsten 74 W 183.84																tantalum 73 Ta 180.95
	rhenium 75 Re 186.21																tungsten 74 W 183.84
	osmium 76 Os 192.22																rhenium 75 Re 186.21
	iridium 77 Ir 192.22																osmium 76 Os 192.22
	platinum 78 Pt 195.08																iridium 77 Ir 192.22
	gold 79 Au 196.97																platinum 78 Pt 195.08
	mercury 80 Hg 200.59																gold 79 Au 196.97
	thallium 81 Tl 204.38																mercury 80 Hg 200.59
	lead 82 Pb 207.2																thallium 81 Tl 204.38
	bismuth 83 Bi 208.98																lead 82 Pb 207.2
	polonium 84 Po [209]																bismuth 83 Bi 208.98
	astatine 85 At [210]																polonium 84 Po [209]
	radon 86 Rn [222]																astatine 85 At [210]
	thorium 90 Th 232.04																radon 86 Rn [222]
	protactinium 91 Pa 231.04																thorium 90 Th 232.04
	uranium 92 U 238.03																protactinium 91 Pa 231.04
	neptunium 93 Np [237]																uranium 92 U 238.03
	plutonium 94 Pu [244]																neptunium 93 Np [237]
	americium 95 Am [243]																plutonium 94 Pu [244]
	curium 96 Cm [247]																americium 95 Am [243]
	berkelium 97 Bk [247]																curium 96 Cm [247]
	californium 98 Cf [251]																berkelium 97 Bk [247]
	einsteinium 99 Es [252]																californium 98 Cf [251]
	fermium 100 Fm [257]																einsteinium 99 Es [252]
	mendelevium 101 Md [258]																fermium 100 Fm [257]
	nobelium 102 No [259]																mendelevium 101 Md [258]
	lawrencium 103 Lr [260]																nobelium 102 No [259]

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
* Lanthanide series													
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]
** Actinide series													

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Physics 單選題 每題五分 共五十分

1. In order to jump off the floor, the floor must exert a force on you

- a) in the direction of and equal to your weight.
- b) opposite to and equal to your weight.
- c) in the direction of and less than your weight.
- d) opposite to and less than your weight.
- e) opposite to and greater than your weight.

2. A 2.0-kg body moving along the x axis has a velocity $v_x = 5.0 \text{ m/s}$ at $x = 0$. The only force acting on the object is given by $F_x = (-4.0x) \text{ N}$, where x is in m. For what value of x will this object first come (momentarily) to rest?

- a) 4.2 m
- b) 3.5 m
- c) 5.3 m
- d) 6.4 m
- e) 5.0 m

3. A 2.0-kg object moving 5.0 m/s collides with and sticks to an 8.0-kg object initially at rest. Determine the kinetic energy lost by the system as a result of this collision.

- a) 20 J
- b) 15 J
- c) 30 J
- d) 25 J
- e) 5.0 J

4. A solid sphere, spherical shell, solid cylinder and a cylindrical shell all have the same mass m and radius R . If they are all released from rest at the same elevation and roll without slipping, which reaches the bottom of an inclined plane first?

- a) solid sphere
- b) spherical shell
- c) solid cylinder
- d) cylindrical shell
- e) all take the same time

5. Three pendulums with strings of the same length and bobs of the same mass are pulled out to angles θ_1 , θ_2 and θ_3 respectively and released. The approximation $\sin \theta = \theta$ holds for all three angles, with $\theta_3 > \theta_2 > \theta_1$. How do the angular frequencies of the three pendulums compare?

- a) $\omega_3 > \omega_2 > \omega_1$
- b) Need to know amplitudes to answer this question.
- c) Need to know $\sqrt{g/L}$ to answer this question.
- d) $\omega_1 > \omega_2 > \omega_3$
- e) $\omega_1 = \omega_2 = \omega_3$

6. A box contains about 5.0×10^{21} hydrogen atoms at room temperature (21°C). Determine the thermal energy of these atoms.

- a) 10 J
- b) 20 J
- c) 30 J
- d) 5.0 J
- e) 1.0 J

7. Which of the following is an almost reversible process?

- a) The explosion of hydrogen and oxygen to form water.
- b) Heat transfer through thick insulation.
- c) The adiabatic free expansion of a gas.
- d) A slow isothermal compression of a gas.
- e) A slow leakage of gas into an empty chamber through a small hole in a membrane.

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8. Three point charges are positioned on the x axis. If the charges and corresponding positions are $+32 \mu\text{C}$ at $x = 0$, $+20 \mu\text{C}$ at $x = 40 \text{ cm}$, and $-60 \mu\text{C}$ at $x = 60 \text{ cm}$, what is the magnitude of the electrostatic force on the $+32\text{-}\mu\text{C}$ charge?

- a) 84 N b) 12 N c) 36 N d) 50 N e) 48 N

9. A particle (charge = $+2.0 \text{ mC}$) moving in a region where only electric forces act on it has a kinetic energy of 5.0 J at point A. The particle subsequently passes through point B which has an electric potential of $+1.5 \text{ kV}$ relative to point A. Determine the kinetic energy of the particle as it moves through point B.

- a) 3.0 J b) 2.0 J c) 5.0 J d) 8.0 J e) 10.0 J

10. A circular loop (area = 0.20 m^2) turns in a uniform magnetic field with $B = 0.13 \text{ T}$. At an instant when the angle between the magnetic field and the normal to the plane of the loop is (π) rads and is decreasing at the rate of 0.50 rad/s , what is the magnitude of the emf induced in the loop?

- a) zero b) 13 mV c) 26 mV d) 20 mV e) 18 mV

Calculus 每題十分 共五十分 請化簡並清楚標示最後答案

1. Evaluate $\int e^x \sin x dx$

2. Find $\int \frac{dx}{x^2 - a^2}$ where $a \neq 0$

3. Evaluate $\int_C (2 + x^2 y) ds$ where C is upper half of the unit circle $x^2 + y^2 = 1$

4. Find $\int \sin^5 x \cos^2 x dx$

5. The curvature of the curve $f(x)$ is given as $\kappa(x) = \frac{|f''(x)|}{[1 + (f'(x))^2]^{3/2}}$. Find the curvature of the parabola

$y = x^2$ at the points $(0,0)$, $(1,1)$, and $(2,4)$