

所別： 材料工程研究所 組別： 不分組 科目： 普化

注意 ☐ 不准 ☐ 一般計算器 ☒ 工程用計算器，考試時間總計：100 分鐘。試題共 2 頁，第 1 頁

1. Explain the meaning of the following: (10 %)  
(a) Hydrogen bonding; (b) London dispersion force; (c) Ionic bonding  
(d) Standard Temperature and Pressure (S.T.P.)
2. Give the Lewis structure for each of the following (20%)  
(a) HF ; (b) NH<sub>3</sub> ; (c) CF<sub>4</sub> ; (d) NO<sup>+</sup>
3. (1) How many protons and neutrons are contained in the nucleus of each of following atoms? Assuming each atom is uncharged, how many electrons are present? (10 %)  
(a)  $^{244}_{94}\text{Pu}$  (b)  $^{241}_{95}\text{Am}$  (c)  $^{227}_{89}\text{Ac}$  (d)  $^{133}_{55}\text{Cs}$  (e)  $^{193}_{77}\text{Ir}$
4. For the following ions , indicate whether electrons must be *gained* or *lost* from the parent neutral atom ,and *how many* electrons must be gained or lost. (10 %)  
(a) O<sup>2-</sup> ; (b) P<sup>3-</sup> ; (c) Cr<sup>3+</sup> ; (d) Rb<sup>+</sup>
5. For the following pairs of ions , use the concept that a chemical compound must have a charge of zero to predict the formula of the simplest compound that the ions are most likely to form. (10 %)  
(a) Cr<sup>3+</sup> and S<sup>2-</sup>; (b) Ca<sup>2+</sup> and P<sup>3-</sup>; (c) Al<sup>3+</sup> and O<sup>2-</sup>; (d) Li<sup>+</sup> and N<sup>3-</sup>
6. Classify each of the following reactions in as many ways as possible. (10 %)  
(a)  $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$   
(b)  $2\text{Al}(\text{s}) + 3\text{Cl}_2(\text{g}) \rightarrow 2\text{AlCl}_3(\text{s})$   
(c)  $\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$   
(d)  $2\text{Cs}(\text{s}) + \text{Br}_2(\text{l}) \rightarrow 2\text{CsBr}(\text{s})$   
(e)  $\text{KOH}(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{KCl}(\text{aq})$
7. For each of the following reactions, complete and balance the equation, indicating clearly which product is the precipitate. (20 %)  
(a)  $\text{KNO}_3(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow$   
(b)  $\text{Na}_2\text{SO}_4(\text{aq}) + \text{Pb}(\text{NO}_3)_2(\text{aq}) \rightarrow$   
(c)  $\text{KOH}(\text{aq}) + \text{Fe}(\text{NO}_3)_3(\text{aq}) \rightarrow$   
(d)  $\text{NaS}(\text{aq}) + \text{Cu}(\text{NO}_3)_2(\text{aq}) \rightarrow$

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8. Mixtures of helium and oxygen are used in the “air” tanks of underwater divers for deep dives. For a particular dive, 12 L of  $O_2$  at  $25^\circ C$  and 1.0 atm and 46 L of He at  $25^\circ C$  and 1.0 atm were both pumped into a 5.0-L tank. Calculate the partial pressure of each gas and the total pressure in the tank at  $25^\circ C$ . (10 %)