

H 1.007																	He 4.002
Li 6.941	Be 9.012											B 10.81	C 12.01	N 14.00	O 15.99	F 18.99	Ne 20.18
Na 22.99	Mg 24.30											Al 26.98	Si 28.08	P 30.97	S 32.06	Cl 35.45	Ar 39.94
K 39.09	Ca 40.07	Sc 44.95	Ti 47.86	V 50.94	Cr 51.99	Mn 54.93	Fe 55.84	Co 58.93	Ni 58.69	Cu 63.54	Zn 65.38	Ga 69.72	Ge 72.64	As 74.92	Se 78.96	Br 79.90	Kr 83.79
Rb 85.46	Sr 87.62	Y 88.90	Zr 91.22	Nb 92.90	Mo 95.96	Tc -	Ru 101.0	Rh 102.9	Pd 106.4	Ag 107.8	Cd 112.4	In 114.8	Sn 118.7	Sb 121.7	Te 127.6	I 126.9	Xe 131.2
Cs 132.9	Ba 137.3	57-71	Hf 178.4	Ta 180.9	W 183.8	Re 186.2	Os 190.2	Ir 192.2	Pt 195.0	Au 196.9	Hg 200.5	Tl 204.3	Pb 207.2	Bi 208.9	Po -	At -	Rn -
Fr -	Ra -	89-10 3	Rf -	Db -	Sg -	Bh -	Hs -	Mt -	Ds -	Rg -	Cn -		Fl -		Lv -		

La 138.9	Ce 140.1	Pr 140.9	Nd 144.2	Pm -	Sm 150.3	Eu 151.9	Gd 157.2	Tb 158.9	Dy 162.5	Ho 164.9	Er 167.2	Tm 168.9	Yb 173.0	Lu 174.9
Ac -	Th 232.0	Pa 231.0	U 238.0	Np -	Pu -	Am -	Cm -	Bk -	Cf -	Es -	Fm -	Md -	No -	Lr -

$c = 2.998 \times 10^8 \text{ m}\cdot\text{s}^{-1}$ $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$ $J = \text{kg}\cdot\text{m}^2\cdot\text{s}^{-2}$
 $N_A = 6.022 \times 10^{23}$ $m_e = 9.109 \times 10^{-31} \text{ kg}$ $R = 8.31446 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$
 $E = E^0 - (0.0591/n) \cdot \log(Q)$

Multiple Choice – Choose one answer (10 questions, 5 points each) ※ 注意：請於試卷內之「選擇題作答區」依序作答。

- How many significant figures should be reported for the answer to the following calculation?
 $(12.1 \times 10^{-2}) / (3.45 \times 10^{-3})(1.0045 - 0.0013)$
 a) 1 b) 2 c) 3 d) 4 e) 5
- Which of these atoms does not obey the octet rule?
 (a) S in SF₄ (b) Si in SiCl₄ (c) P in PCl₃ (d) N in N₂ (e) None of the previous answers
- In which of these molecules does carbon have an oxidation state of 0?
 (a) CO₂ (b) H₂CO (c) CH₄ (d) HCCl₃ (e) None of the previous answers
- For the reaction $\text{HCONH}_2(\text{g}) \rightleftharpoons \text{NH}_3(\text{g}) + \text{CO}(\text{g})$, $K_c = 4.84$ at 400 K. If ΔH° for this reaction is 29 kJ/mol, what is the approximate K_c at 300 K?
 (a) 7.9×10^{-4} (b) 1.7×10^{-2} (c) 27 (d) 89 (e) 0.26
- Consider a sample of 1 mol Kr (g) at a given temperature contained in a given volume. Which of the following statements are false?
 (a) The entropy of 1 mol Kr (g) is less than that of 1 mol Kr (s) at the same temperature.
 (b) The entropy of the sample is less than that of a 1 mol sample C₄H₁₀ (g) at the same temperature, contained in the same volume.
 (c) The entropy of the sample increases when the temperature is doubled.
 (d) The entropy of the sample decreases when the volume of the container is reduced (assuming the same initial and final temperatures).
 (e) Rotational and vibrational motions do not contribute to the overall entropy of the sample.

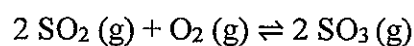
6) What is the characteristic wavelength of an electron with a kinetic energy of 9.00×10^{-16} J?

- (a) 444 nm (b) 369 pm (c) 590 pm (d) 16.4 pm (e) 0.198 pm

7) Which of the following statements is **true**?

- (a) Molecules containing polar bonds must be polar molecules.
(b) Hydrogen bonding is generally stronger than ionic bonding.
(c) London dispersion forces are only present between non-polar molecules.
(d) Resonance structures of a molecule interchange in rapid, reversible, equilibrium
(e) Liquid methanol (CH_3OH) exhibits intermolecular hydrogen bonding interactions.

8) Consider a vessel containing the following exothermic reaction at equilibrium:

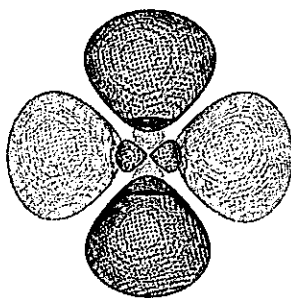


Which changes would **increase** the amount of $\text{O}_2 (\text{g})$ present?

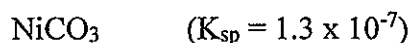
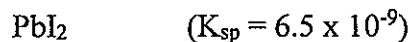
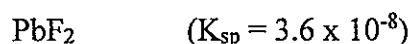
- (a) Cooling the reaction (b) Doubling the volume of the reaction vessel
(c) Adding $\text{SO}_2 (\text{g})$ (d) Adding a catalyst (e) None of the previous answers

9) Identify the orbital in the illustration:

- A) 3d
B) 3p
C) 4d
D) 4p
E) 5d



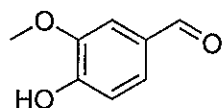
10) Consider the following salts and choose the true statement:



- (a) NiCO_3 has the greatest molar solubility.
(b) NiCO_3 has a greater solubility in g/L than PbF_2 .
(c) PbI_2 has a greater solubility in g/L than NiCO_3 .
(d) Addition of iodide to a solution of PbI_2 will result in a decrease of its K_{sp} .
(e) None of the above statements are true.

Short Answer (6 questions)

11) Label the functional group(s) present in the following molecule in English (5 pts):



12) Phenol (C_6H_5OH) and n-hexanol ($C_6H_{13}OH$) are both alcohols. However, phenol is much more acidic than hexanol. Explain. (5 pts)

13) Combustion analysis of 20.00 mg of an unknown compound containing only C, H, and O gives 49.23 mg CO_2 and 12.96 mg H_2O . The compound has a molecular mass of 250.3 g/mol. What is the probable molecular formula of the compound? (10 pts)

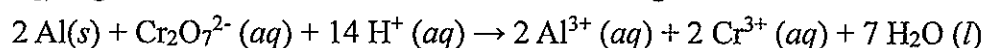
14) Ascorbic acid ($H_2C_6H_6O_6$) is a diprotic acid with $K_{a1} = 7.9 \times 10^{-5}$ and $K_{a2} = 1.6 \times 10^{-12}$.

(a) What is the pH of a solution of 350.0 mg ascorbic acid in 500.0 mL water? Show your calculations. (5 pts)

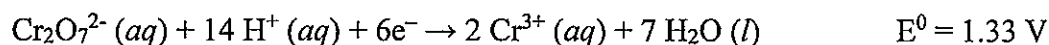
(b) Suppose 150.0 mL of 0.01000 M NaOH (aq) was added to the solution from (a). What would the pH of the resulting solution be? Show your calculations. (5 pts)

15) Radium-226 is a radioactive isotope that decays to form Radon-222 and an alpha particle. This process follows first-order kinetics, and the half-life of Radium-226 is 1600 years. Given a sample of 5.00 g of Radium-226, how many moles of Radon-222 would be present in the sample after two years? (10 pts)

16) A galvanic cell is made based on the following reaction:



With relevant half reactions:



If $[Cr^{3+}] = 0.10 M$, $[Al^{3+}] = 0.10 M$, $[Cr_2O_7^{2-}] = 1.00 M$, and $E_{cell} = 3.02 V$ at 298 K, what is the pH of the cathode compartment? (10 points)

試題隨卷繳回