

Name: \_\_\_\_\_  
first (print)
family (print)

Test no 2  
 Thursday, March 26, 2026  
 Room: 4D.2, 10:00 h



**PLEASE turn off  
your cell phone**

**Instructions:**

1. The duration of the exam is 75 minutes.
2. No extra books or paper may be used.
3. Make sure that there are no pages missing: total of 6 pages.
4. A Periodic Table of the Elements with constants has been provided.
5. Answers must be submitted in ink in order to preserve the right to grieve.
6. In order to receive full credit for your answer, your work must be shown.
7. Calculators may not be shared. Programmable calculators are not allowed.
8. Your attention is drawn to the college policy on cheating. This policy will be enforced.
9. Check you numbers twice. A calculator never does mistake, it just calculate the numbers input by the operator. If the number of digits is insufficient throughout the calculation, which gives a result different from the expected one, it will be considered as a calculation error.

For each math error or bad number transcript: -1 mark.

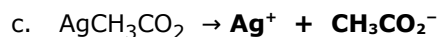
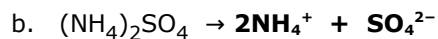
*for questions involving calculations, write your final answer in ink in the appropriate space*

Question 1 : / 4	Question 4 : / 3	Question 7 : / 6
Question 2 : / 3	Question 5 : / 8	Question 8 : / 3
Question 3 : / 4	Question 6 : / 10	Question 9 : / 4

**Total : / 45**

### Question 1

Illustrate how each of the following strong electrolytes dissociates into its constituent ions when dissolved in water. (Example:  $\text{NaBr} \rightarrow \text{Na}^+ + \text{Br}^-$ , no need to write the state of matter) (3 marks)



d. Which of the following solutions of strong electrolytes contains the largest number of moles of chloride ions (circle one): (1 mark)

i) 40.0 mL of 0.15 M  $\text{AlCl}_3$

$$18 \times 10^{-3} \text{ mol Cl}^-$$

ii) 25.0 mL of 0.30 M  $\text{CaCl}_2$

$$15 \times 10^{-3} \text{ mol Cl}^-$$

iii) 100.0 mL of 0.20 M  $\text{KCl}$

$$20 \times 10^{-3} \text{ mol Cl}^-$$

### Question 2

What mass of  $\text{Ba}(\text{OH})_2$  is required to make 250.0 mL of a 0.400 M of  $\text{OH}^-$ (aq) solution? (3 marks)

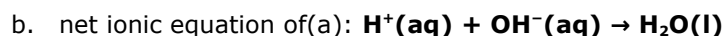
↑  
171.3 g/mol

$$\frac{(250.0 \text{ mL})}{1000 \text{ mL/L}} \left( \frac{0.400 \text{ mol}}{\text{L}} \right) \frac{\text{Ba}(\text{OH})_2}{2 \text{ OH}^-} (171.3 \text{ g/mol}) = 8.57 \text{ g}$$

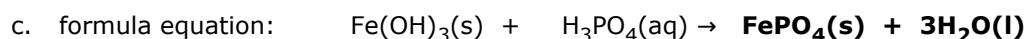
answer: 8.57 g

### Question 3

Complete and balance the formula equation AND write the corresponding balanced net ionic equations (without spectator ions) for each of the following reactions. (4 marks)



(since  $\text{HCN}$  is a weak acid then  $\text{HCN}(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CN}^-(\text{aq})$  must also be accepted)



**Question 4**

A 25.00 mL sample of HCl(aq) solution requires 24.16 mL of 0.106 M NaOH(aq) for complete neutralization. What is the concentration of the original hydrochloric acid solution? (3 marks)

$$\frac{(24.16 \text{ mL}) \times (0.106 \text{ mol/L OH}^-) \times (1 \text{ H}^+ / 1 \text{ OH}^-)}{25.00 \text{ mL}} = 0.102 \text{ mol/L}$$

answer: \_\_\_\_\_ **0.102 mol/L** \_\_\_\_\_

**Question 5**

On the basis of the general solubility rules, predict which of the following compounds are likely to be soluble in water. (4 marks)

	compound	water soluble		
		yes	no	
a.	H <sub>3</sub> PO <sub>4</sub>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Acid
b.	Ba(CH <sub>3</sub> COO) <sub>2</sub>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Acetate
c.	LiCN	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Alkali metal
d.	(NH <sub>4</sub> ) <sub>2</sub> S	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Ammonium

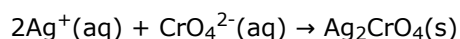
e. Circle the chemical that will form a precipitate if added to an NaOH(aq) solution: (1 mark)

**Zn(OH)<sub>2</sub>(s)**       ZnI<sub>2</sub>      K<sub>2</sub>SO<sub>4</sub>      CsBr

f. Circle the chemical that will NOT form a precipitate if added to an NaCl(aq) solution: (1 mark)

**AgCl(s)**      **PbCl<sub>2</sub>(s)**  
 AgNO<sub>3</sub>      Pb(ClO<sub>3</sub>)<sub>2</sub>       Sn(NO<sub>3</sub>)<sub>2</sub>

g. What mass of Na<sub>2</sub>CrO<sub>4</sub> is required to precipitate all of the silver ions from 75.0 mL of a 0.100 M solution of AgNO<sub>3</sub>? (2 marks)



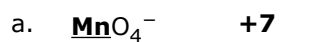
$$(75 \times 10^{-3} \text{ L}) \times (0.100 \frac{\text{mol}}{\text{L}} \text{ Ag}^+) \times (\frac{1 \text{ Na}_2\text{CrO}_4}{2 \text{ Ag}^+}) \times (161.98) \frac{\text{g}}{\text{mol}} = 0.607 \text{ g}$$

answer: \_\_\_\_\_ **0.607 g** \_\_\_\_\_

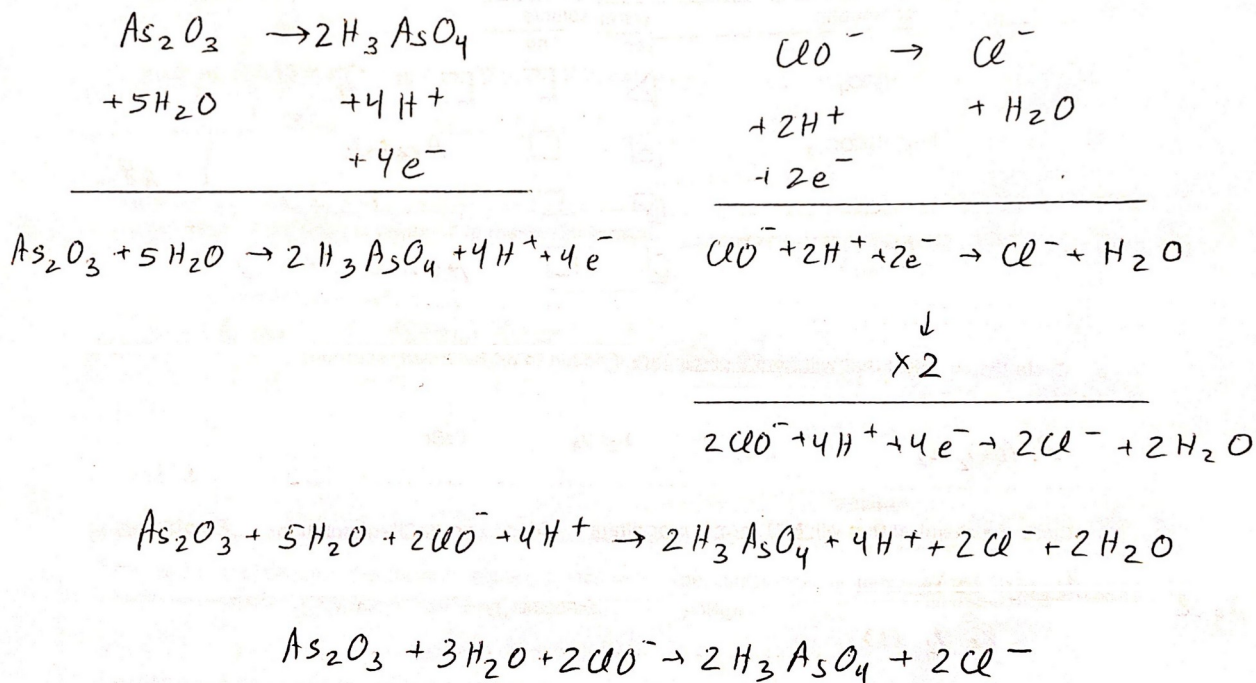
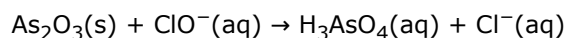
### Question 6

Assign oxidation number (or oxidation state) for the **underlined** atoms in each of the following:

(4 marks)



e. Balance the following oxidation-reduction reaction that occur in an aqueous acidic solution (4 marks)



f. Circle the reactant that is being reduced:  $\text{As}_2\text{O}_3(\text{s})$    $\text{ClO}^-(\text{aq})$   (1 mark)

g. Circle the oxidizing agent:  $\text{As}_2\text{O}_3(\text{s})$    $\text{ClO}^-(\text{aq})$   (1 mark)

### Question 7

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Photosynthesis uses  $\lambda = 660 \text{ nm}$  light to convert  $\text{CO}_2$  and  $\text{H}_2\text{O}$  into glucose and  $\text{O}_2$ .

- a. Calculate the frequency ( $\nu$ ) of this light. (2 marks)

$$c = \lambda \nu$$
$$\nu = \frac{c}{\lambda} = \frac{2.9979 \times 10^8 \text{ m/s}}{660 \times 10^{-9} \text{ m}} = 4.54 \times 10^{14} \text{ s}^{-1} \text{ or Hz}$$

answer:     **$4.54 \times 10^{14}$  Hz**   

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A carbon–oxygen double bond ( $\text{C}=\text{O}$ ) in a certain organic molecule absorbs radiation that has a frequency of  $\nu = 6.0 \times 10^{13} \text{ s}^{-1}$ .

- b. What is the energy for one mole of photons of this radiation? (2 marks)

$$E = h \nu$$
$$E_{\text{photon}} = (6.626 \times 10^{-34} \text{ J}\cdot\text{s})(6.0 \times 10^{13} \text{ s}^{-1}) = 3.98 \times 10^{-20} \text{ J/photon}$$
$$\text{Energy for 1 mol photon} = (3.98 \times 10^{-20} \text{ J/photon})(6.022 \times 10^{23} \text{ mol}^{-1})$$
$$\mathbf{E = 2.4 \times 10^4 \text{ J/mol}}$$

answer:     **$E = 24 \text{ kJ/mol}$**    

- c. To what region of the electromagnetic spectrum does this radiation (part b) belong? (1 mark)

$$\lambda = \frac{c}{\nu} = \frac{2.9979 \times 10^8 \text{ m/s}}{6 \times 10^{13} \text{ s}^{-1}} = 5.0 \times 10^{-6} \text{ m or } 5.0 \mu\text{m} \quad \text{therefore: } \mathbf{\text{Infrared}}$$

- d. A carbon–oxygen bond in a different molecule absorbs radiation at a frequency  $\nu = 5.4 \times 10^{13} \text{ s}^{-1}$ .  
Is this radiation more or less energetic than the radiation of part b? (circle one) (1 mark)

more energetic

less energetic

**lower frequency = less energetic**

### Question 8

Alpha radiation ( $\alpha$ ) is in fact a very high energy particle produced during standard radioactive decay. Calculate the mass of an alpha particle traveling at 4.000% of the speed of light, with a deBroglie wavelength of  $\lambda = 8.315 \times 10^{-15}$  m. (Provide a mass with 4 sig. fig. including the units) (3 marks)

$$\lambda = \frac{h}{f} = \frac{h}{mv}$$

$$m = \frac{h}{\lambda v} = \frac{(6.626 \times 10^{-34} \text{ kg} \cdot \text{m}^2 \cdot \text{s}^{-1})}{(8.315 \times 10^{-15} \text{ m}) \left( \frac{4.000}{100} \cdot 2.998 \times 10^8 \text{ m/s} \right)} = 6.645 \times 10^{-27} \text{ kg}$$

answer: 6.645 × 10<sup>-27</sup> kg

### Question 9

An excited hydrogen atom with an electron in the principal quantum level  $n = 5$  level emits light at a frequency of  $2.34 \times 10^{14}$  Hz after the electron transition to another level. Find the final level of the electron (or  $n_{\text{final}}$  value) (4 marks)

$$E_{\text{photon}} = h\nu = (6.626 \times 10^{-34} \text{ J} \cdot \text{s}) (2.34 \times 10^{14} \text{ s}^{-1}) = 1.55 \times 10^{-19} \text{ J}$$

$$\Delta E_{\text{atom}} = E_f - E_i$$

$$\uparrow -1.55 \times 10^{-19} \text{ J} = -\frac{B}{n^2} - \left(-\frac{B}{5^2}\right)$$

negative  
photon emitted

$$-1.55 \times 10^{-19} \text{ J} = -B \left( \frac{1}{n^2} - \frac{1}{25} \right)$$

$$\frac{-1.55 \times 10^{-19} \text{ J}}{-2.18 \times 10^{-18} \text{ J}} = \frac{1}{n^2} - \frac{1}{25} \Rightarrow n = \sqrt{\left(0.0711 + \frac{1}{25}\right)^{-1}}$$

$$n = 3$$

answer: n = 3