



### Question 1

How many significant figures are in each of the following:

(3 marks)

	Number of sig. fig.
a. 300.00 K	5
b. 1100 L	2
c. 0.00470 M	3

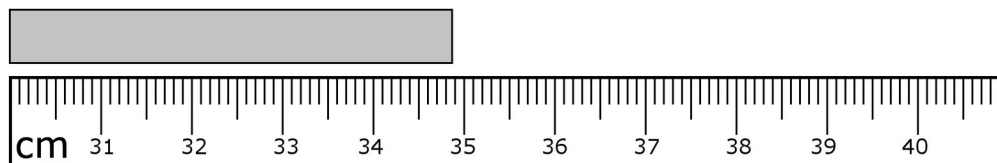
Without performing the calculation, indicate the correct number of significant figures in the final answer for each calculation. (2 marks)

	Number of sig. fig.
d. $22.144 + 2.856 =$	25.000 (5)
e. $0.0230 \times 2.3756 \times 10^3 =$	54.6 (3)
g. $6.29 \times 10^{-2} - 1.9 \times 10^{-3} =$	0.0610 (3)
h. $(12 + 94) \times 113 \div 695 =$ <div style="margin-left: 20px; color: red;"> <math>\underbrace{12 + 94}_{106 \text{ (3 s.f.)}}</math> </div>	17.2 (3)

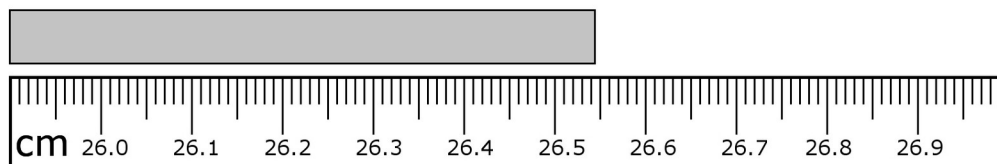
$$\begin{array}{r}
 62.9 \times 10^{-3} \\
 - 1.9 \times 10^{-3} \\
 \hline
 61.0 \times 10^{-3}
 \end{array}$$

i. Measure the length of the stick with the correct number of significant figures.

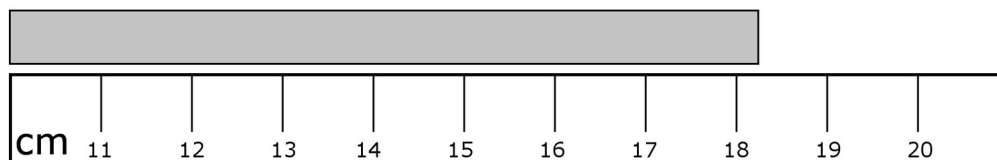
(3 marks)



34.89



26.545



18.2

For problem i, no partial marks given if the number of significant figures in the answer is incorrect.

## Question 2

Complete the following table

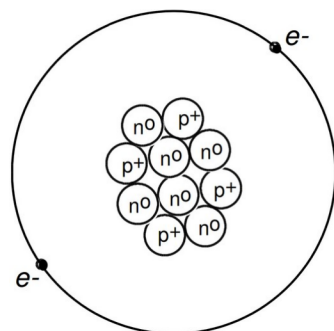
(5 marks)

	Symbol *	element name	number of protons	number of electrons	number of neutrons	net charge	metal or nonmetal
a.	${}^{136}_{56}\text{Ba}^{2+}$	barium	56	54	80	+2	M
b.	${}^{81}_{35}\text{Br}^{-}$	bromine	35	36	46	-1	non-M

\* For the symbol, you need to write the correct  ${}^A_Z\text{X}^{\text{charge}}$  representation to get your mark.

c. Give the  ${}^A_Z\text{X}^{\text{charge}}$  symbol for the following atom or ion:

(2 marks)



Symbol:  ${}^4_4\text{Be}^{2+}$

d. Which of the following water sample have the greatest number of hydrogen atoms?

(1 mark)

i)  $1 \times 10^{-20}$  moles

$$1 \times 10^{-20} \text{ mol} \\ \downarrow \\ \times N_A \times 2\text{H/water} \\ \downarrow \\ \approx 12000 \text{ H atom}$$

ii)  $1 \times 10^6$  molecules

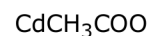
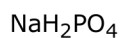
$$1 \times 10^6 \\ \downarrow \\ \times 2\text{H/water} \\ \downarrow \\ 2 \times 10^6 \text{ H atom}$$

iii)  $1 \times 10^{-19}$  grams

$$1 \times 10^{-19} \text{ g} \\ \downarrow \\ \div 18.015 \text{ g/mol} \\ \times N_A \\ \times 2\text{H/water} \\ \downarrow \\ \approx 7000 \text{ H atom}$$

e. Out of the following list of ionic compounds, **TWO do not exist**. Circle those (2 MAX)

(2 marks)



### Question 3

Provide the missing formula or systematic name.

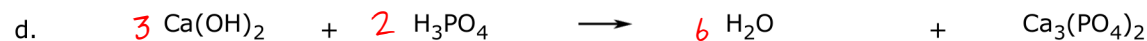
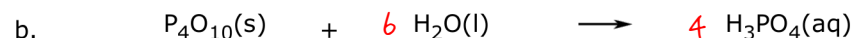
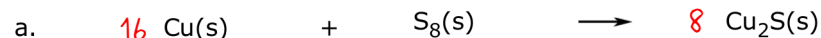
(10 marks)

	Molecular formula	Systematic name
a.	Hg(NO <sub>2</sub> ) <sub>2</sub>	mercury(II) nitrite
b.	N <sub>2</sub> O	dinitrogen monoxide
c.	NaH <sub>2</sub> PO <sub>4</sub>	sodium dihydrogen phosphate
d.	HIO <sub>2</sub> (aq)	iodous acid
e.	HCN	hydrogen cyanide
f.	H <sub>2</sub> S(aq)	hydrosulfuric acid
g.	Be(OH) <sub>2</sub>	beryllium hydroxide
h.	P <sub>3</sub> N <sub>5</sub>	triphosphorous pentanitride
i.	PbH <sub>4</sub>	Lead(IV) hydride
j.	CuSO <sub>4</sub> •5H <sub>2</sub> O	copper(II) sulfate pentahydrate

### Question 4

Write the balanced equation for each of the following (no fraction allowed):

(4 marks)



### Question 5

Calculate the mass% of hydrogen in (NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>

(3 marks)

$$\begin{array}{cccc} \text{(NH}_4\text{)}_2\text{Cr}_2\text{O}_7 & & & \\ \begin{array}{cccc} 14.01 & 1.0079 & 52.00 & 16.00 \\ \times 2 & \times 8 & \times 2 & \times 7 \end{array} & & & \\ \hline & 252.08 \text{ g/mol} & & \end{array}$$

$$\text{Mass \%} = \frac{8 \text{ H}}{\text{(NH}_4\text{)}_2\text{Cr}_2\text{O}_7} = \frac{8.064}{252.08} \times 100\%$$

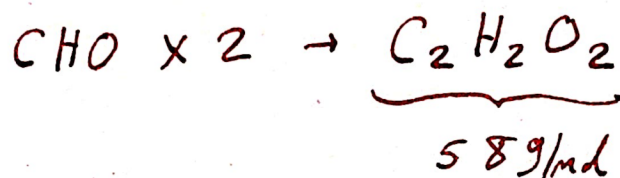
↑  
g/mol

answer: Mass % = 3.199 %

### Question 6

Glyoxal is a molecule composed only of carbon, hydrogen and oxygen. It has a molar mass between 50 g/mol and 70 g/mol. If the percent composition by mass of glyoxal is 55.14% O and 3.47% H, give the molecular formula of glyoxal. (4 marks)

$$\begin{array}{l}
 100 \text{ g} \left\{ \begin{array}{l}
 \rightarrow 55.14 \text{ O} \rightarrow \div 16.00 \text{ g/mol} = 3.44 \text{ mol O} \\
 \rightarrow 3.47 \text{ H} \rightarrow \div 1.008 \text{ g/mol} = 3.44 \text{ mol H} \\
 \rightarrow 41.39 \text{ C} \rightarrow \div 12.01 \text{ g/mol} = 3.44 \text{ mol C}
 \end{array} \right. \begin{array}{l}
 \text{empirical} \\
 \text{formula} \\
 \text{CHO} \\
 29 \text{ g/formula}
 \end{array}
 \end{array}$$



answer: C<sub>2</sub>H<sub>2</sub>O<sub>2</sub>

### Question 7

A weather balloon is filled with hydrogen gas.

- a. What mass, in g, of hydrogen is required to fill this balloon to a volume is 4.0 m<sup>3</sup> at STP? (2 marks)

at STP : 1 mol gas = 22,42 L

S.F.

$$4.0 \text{ m}^3 \times \frac{1000 \text{ L}}{\text{m}^3} \times \frac{1 \text{ mol}}{22.42 \text{ L}} \times \frac{2.016 \text{ g}}{\text{mol H}_2} = 359.6 \text{ g}$$

answer: 3.6 × 10<sup>2</sup> g

- b. What will be the balloon volume, in liter, if it rises 32 km high where the atmospheric pressure is 89 torr and the temperature is -47 °C (note: 1 m<sup>3</sup> = 1000 L). (3 marks)

$$PV = nRT$$

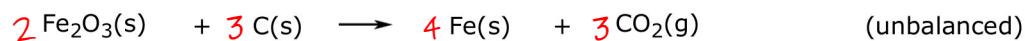
$$V = \frac{nRT}{P} = \frac{(178 \text{ mol})(8.314 \frac{\text{L} \cdot \text{kPa}}{\text{K} \cdot \text{mol}})(273.15 - 47) \text{ K}}{89 \text{ Torr} \times \frac{101.3 \text{ kPa}}{760 \text{ Torr}}}$$

11.86 kPa

answer: 2.8 × 10<sup>4</sup> L

### Question 8

Iron metal is produced from the reaction of iron(III) oxide with carbon according to the reaction:



- a. What is the maximum mass of iron produced from the reaction of 555 kg  $\text{Fe}_2\text{O}_3$  with 55 kg carbon assuming a %yield = 100%. (4 marks)

$$2 \text{Fe}_2\text{O}_3 + 3 \text{C} \rightarrow 4 \text{Fe} + 3 \text{CO}_2$$

kg →	555	55	341	→	$3.4 \times 10^2 \text{ kg Fe}$
g/mol →	÷ 159.7	÷ 12.01	↑		$\times 55.85 \text{ g/mol}$
kmol →	3.475	4.580	↑		
			↳ $\times \frac{4}{3} = 6.106 \text{ kmol} \leftarrow \text{L.R.}$		
			↳ $\times \frac{4}{2} = 6.950 \text{ mol}$		

answer: 340 kg

- b. Calculate the mass of the starting material that would remain unreacted (excess reactant). (2 marks)

$$\text{Fe}_2\text{O}_3 \text{ consumed} = 6.106 \text{ kmol} \times \frac{2 \text{Fe}_2\text{O}_3}{4 \text{Fe}} = 3.053 \text{ kmol}$$

$$\text{Remaining} = (3.475 - 3.053) \text{ kmol} \times 159.7 \text{ g/mol} = 67 \text{ kg excess}$$

Answer: \_\_\_\_\_

### BONUS

This bonus question will add 2 marks to your test up to a maximum of 40 marks. The grade will ONLY be awarded for a complete work shown and a correct answer (no partial mark).

Hemoglobin, a protein present in the blood to transport oxygen, is 0.347% Fe by mass. If a hemoglobin molecule contains 4 iron atoms, calculate the molar mass of hemoglobin.

$$\frac{4 \text{Fe}}{\text{HM}} = 0.347 \%$$

$$\frac{4 (55.85 \text{ g/mol})}{0.347/100} = \text{HM} = 6.44 \times 10^4 \frac{\text{g}}{\text{mol}}$$

answer: \_\_\_\_\_