11.2 Synoptic Data Handling & Graphical Skills

Question Paper

Course	DP IB Chemistry
Section	11. Measurements & Data Processes
Topic	11.2 Synoptic Data Handling & Graphical Skills
Difficulty	Hard

Time allowed: 40

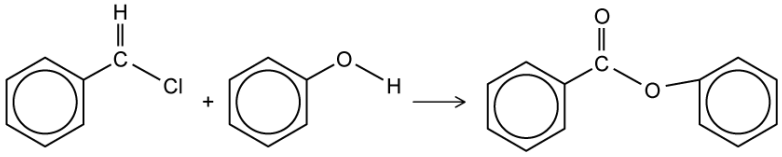
Score: /33

Percentage: /100

Question 1a

a)

A student prepared some phenyl benzoate by reacting phenol with benzoyl chloride in alkaline conditions. The equation for the reaction is:



Benzoyl chloride **Phenol** **Phenyl benzoate + Hcl**

The table shows the data recorded by the student:

Mass of phenol used	4.85 ± 0.02 g
Mass of phenyl benzoate obtained	6.34 ± 0.02 g

State the names of two functional groups found in the product.

[2]

[2 marks]

Question 1b

b)

Determine the following quantities from the data in part a):

i)

The amount, in mol, of phenol used

[2]

ii)

The theoretical yield, in g, of phenyl benzoate

[2]

iii)

The percentage yield of phenyl benzoate

[1]

[5 marks]

Question 1c

c)
State the number of significant figures associated with the mass of phenyl benzoate obtained and calculate the percentage uncertainty associated with this mass.

[2]

[2 marks]

Question 1d

d)
Another student repeated the experiment and obtained an experimental yield of 145%.
The teacher checked the student's calculations and found no errors.
Suggest an explanation for this result.

[1]

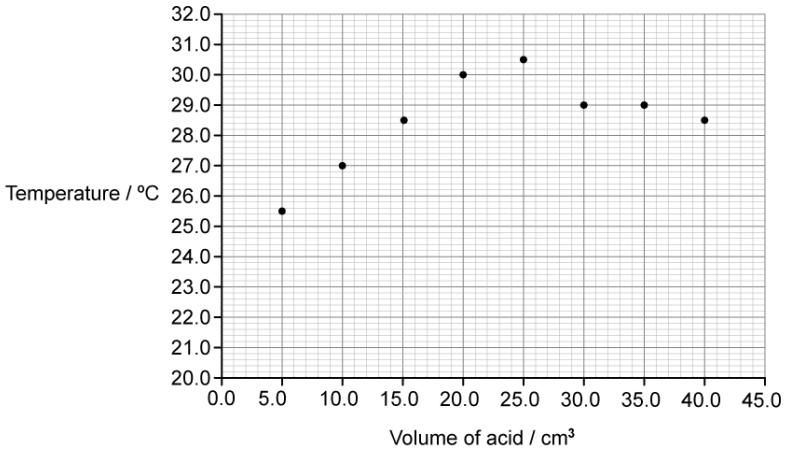
[1 mark]

Question 2a

a)

A student titrated hydrochloric acid solution against 50.0 cm^3 of 0.950 mol dm^{-3} sodium hydroxide solution to determine is concentration.

After each addition of acid the temperature was measured to the nearest 0.5 °C and recorded and plotted on a graph:



What should the labels be on each axis?

[1]

[1 mark]

Question 2b

b)

Use the graph to:

i)

Estimate the initial temperature of the solution.

[1]

ii)

Determine the maximum temperature reached in the experiment

[1]

[2 marks]

Question 2c

c)
Use the values obtained in part b) to determine the temperature change and percentage uncertainty in the calculated value.

[2]

[2 marks]

Question 2d

d)
Determine the concentration of the acid used in the experiment.

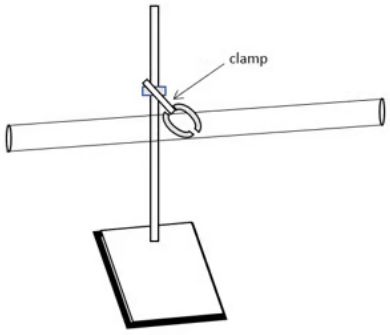
[1]

[1 mark]

Question 3a

a)

A student investigated the diffusion of ammonia and hydrogen chloride gases in a 1.00 m glass tube. She placed cotton wool plugs containing concentrated ammonia and hydrochloric acid at either end of the tube and sealed the ends with stoppers.



Where the two gases meet a white smoke ring of ammonium chloride, NH_4Cl, appears. The student recorded the time taken for the white smoke to appear and the distance travelled by each gas.

	1st trial	2nd trial	3rd trial
Total time elapsed /s	126	114	163
Distance travelled by NH_3 (g) / cm	72	68	75
Distance travelled by HCl (g) / cm	28	32	25

The rate of diffusion of a gas is proportional to the square root of the mass of its particles.

Calculate the mean rate of diffusion of ammonia and hydrogen chloride, expressing your answer to an appropriate number of significant figures.

[3]

[3 marks]

Question 3b

b)
The rate of diffusion of a gas is proportional to the square root of its mass.

$$\text{Rate} = \frac{1}{\sqrt{M_r}}$$

When two gases, A and B, are compared the relative rates of diffusion are:

$$\frac{\text{Rate}_A}{\text{Rate}_B} = \frac{\sqrt{M_{r_B}}}{\sqrt{M_{r_A}}}$$

Determine the relative rate of diffusion of the ammonia and hydrogen chloride from their molar masses and from part a). Comment on your result.

[3]

[3 marks]

Question 3c

c)
Determine the percentage error in the experiment.

[1]

[1 mark]

Question 3d

d)
The student cleans and dries the glass tube between each run of the experiment. If the glass tube is not completely dry, state what type of error can occur and what its impact on the results would be.

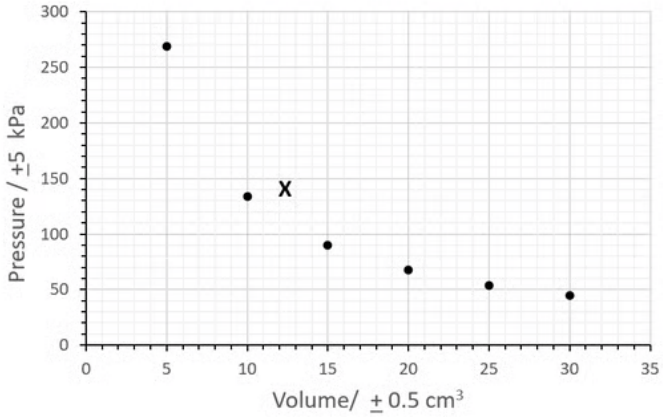
[2]

[2 marks]

Question 4a

a)

The graph below shows measurements of pressure and volume for a sample of air at constant temperature.



Draw a best fit line through the points.

[1]

[1 mark]

Question 4b

b)

Deduce the relationship between pressure and volume in the sample of air.

[1]

[1 mark]

Question 4c

c)

Given the average molar mass of air is 28.97 g mol^{-1}, find the number of moles of air used in the experiment using the values at point X.

[4]

[4 marks]

Question 4d

d)
Determine the percentage uncertainty in the measure data at point, X.

[2]

[2 marks]