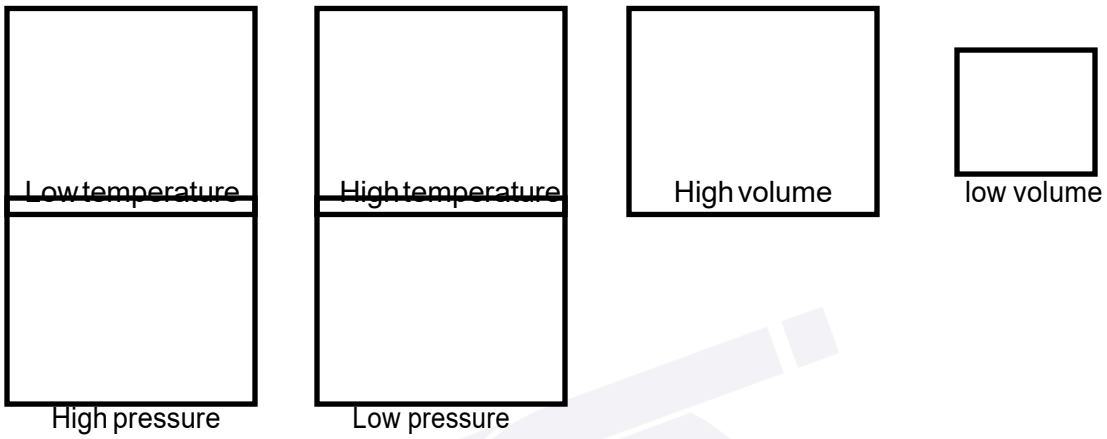
UNDERSTANDING GAS LAWS

Name_____period_____desk #_____

In the boxes below, draw a diagram of what you think ten gas particles would look like if you could zoom really close in to see them. Use ● for particles, → to show their movement. Bigger arrows mean more velocity. The box is the container.



Kinetic Molecular Theory:

Go to http://phet.colorado.edu/en/simulation/gas-properties

Select the Ideal Simulation

Click to hold the Volume constant.

1. Use the pump to put one pump of gas into the box.

a. What happens to the clump of particles?_____

(To answer the following questions, keep your eye on one particle and notice how it moves.)

b. How do the particles move? (straight line, circular, random, etc.)_____

c. Do the particles stay at a constant speed?_____

d. If not, what causes the speed to change?_____

f. Do they always move in the same direction?_____

g. If not, what causes their direction to change?_____

2. Using the Particles setting on the right side of the screen, put 100 "heavy species" in the container. Give it time for the pressure to stabilize. Observe the motion of the particles.

a. Record the pressure_____(The number will jump around- choose an average.)

b. Reset the number of "heavy species" to zero, and the "light species" to 100. Observe the motion of the particles.

c. Record the pressure_____

d. Does the mass of the particles significantly affect the pressure of the container? _____

e. Explain this using your observations._____

_____

Partial Pressures

3. Put 100 of "heavy species" and no "light species".

a. Record the pressure. _____

b. Put 50 of the "light species" and no "heavy species"

c. Record the pressure_____

d. Put 50 "light species" AND 100 "heavy species" together. Record the pressure_____

e. How does this compare to the pressures from 3a. and 3c?_____

f. What can you conclude about the relationship between the partial and total pressure?

_____

Boyle's Law:

Since Boyle's Law deals with pressure and volume, temperature must be constant.

1. On the Hold Constant box in the top right, select temperature to be constant.

2. Place 200 "heavy species" in your container.

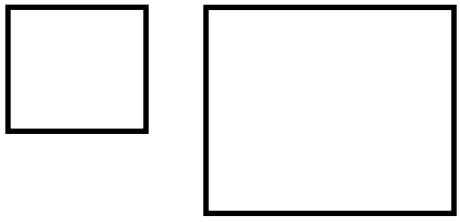
3. Use the handle on the left to change the volume of the container.

a. What happens to the pressure as the volume changes?_____

As the volume goes_____the pressure goes_____.

This is a(n)_____relationship.

4. Diagram the particles in the boxes that would Model Boyle's Law. (Include arrows.) Label the variables below each box.



5. Experiment by changing the number of species, volume and pressure. What combination do you need to blow the top off?_____

Charles' Law: (Note: For this simulation you have to put the species in the container BEFORE you set the constant parameter. .

Since Charles' Law deals with temperature and volume,_____must be constant.

1. Place 200 "heavy species" in your container

2.. On the Hold Constant box on the right, select Pressure ↕V to be constant.

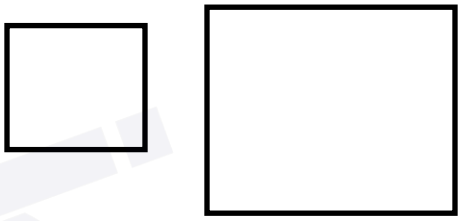
3. Use the heat/cold slider on the bucket at the bottom to heat up the container.

a. What happens to the volume as the temperature changes?_____

b. As the temperature goes_____the volume goes_____.

c. This is a(n)_____relationship.

4. Diagram the particles in the boxes that would model Charles' Law. (Include arrows.)
Label the variables below each box.



5. Experiment by changing the temperature and volume. What combination do you need to blow the top off?_____

Gay-Lussac's Law:

Since Gay-Lussac's Law deals with pressure and temperature,_____must be constant.

1. On the Hold Constant box in the top right, select the appropriate constant.

2. Place 200 "heavy species" in your container.

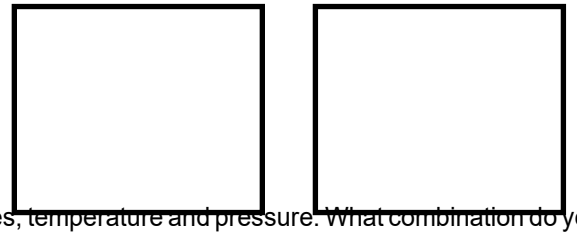
3. Use the Heat/Cold toggle in the bucket on the bottom to change the temperature of the container.

a. What happens to the pressure as the temperature changes?_____

As the temperature goes_____the pressure goes_____.

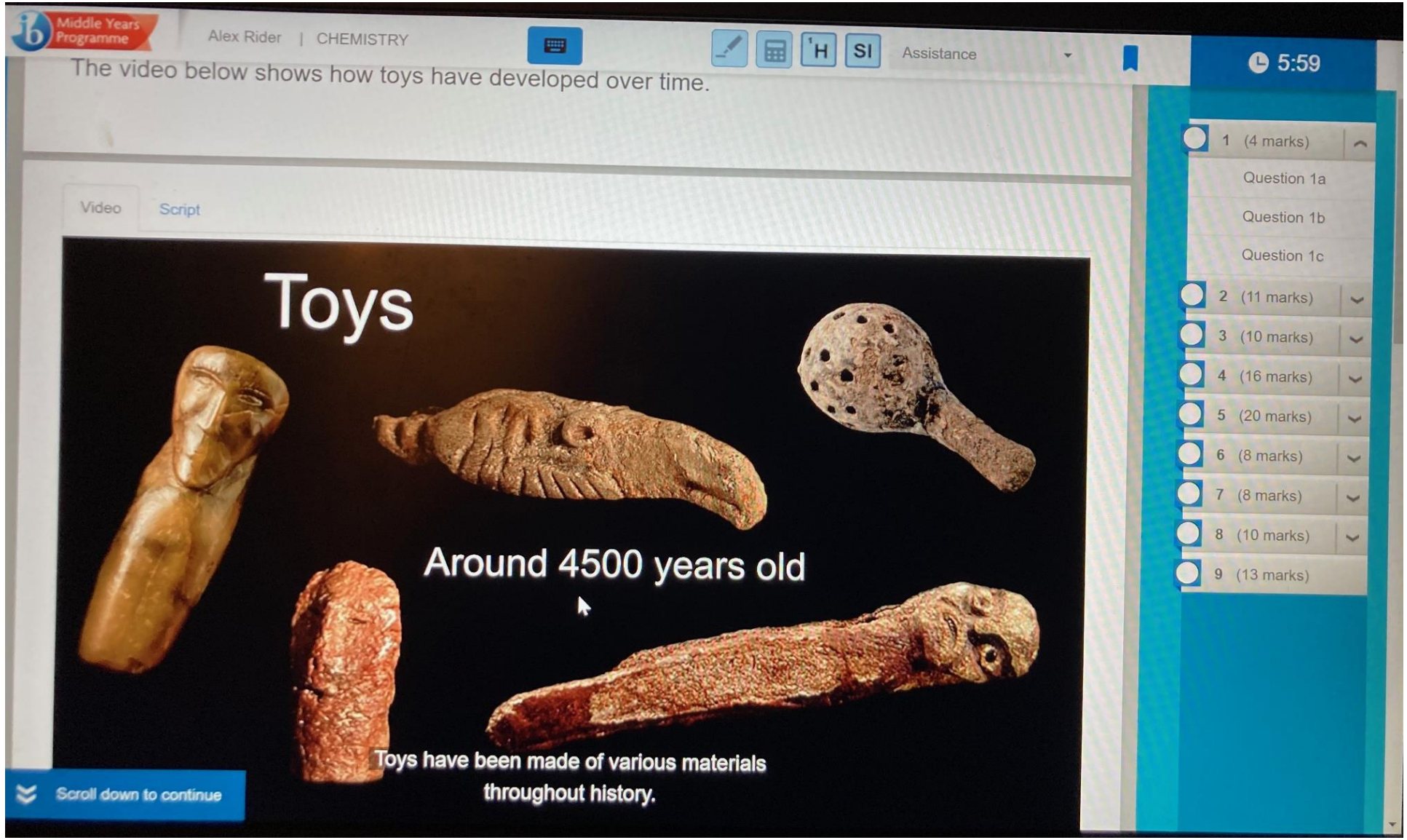
This is a(n)_____relationship.

4. Diagram the particles in the boxes that would model Gay-Lussac's Law. (Include arrows.)
Label the variables below each box.



5. Experiment by changing the number of species, temperature and pressure. What combination do you need to blow the top off?_____

Chemistry e-Assessment
November 2019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Assistance
5:59
The video below shows how toys have developed over time.
Video
Script
Toys
Around 4500 years old
Toys have been made of various materials throughout history.
Scroll down to continue
1 (4 marks)
Question 1a
Question 1b
Question 1c
2 (11 marks)
3 (10 marks)
4 (16 marks)
5 (20 marks)
6 (8 marks)
7 (8 marks)
8 (10 marks)
9 (13 marks)

Video | Script

Toys have been made of various materials throughout history.

The oldest known toy is thought to be a 4500-year-old doll found in Turkey. Toy kitchen equipment was found with the doll. The doll's head was made from terracotta, a type of clay, and had hair made of human hair.

Another toy that is thought to be about the same age is a rattle made from a different type of clay with stones inside.

As technology has developed, different materials have been used to make toys. In the 1950s, manufacturers were making toys using exciting new radioactive materials such as radium. In the 1970s, toy manufacturers used dyes and pigments that we now know are toxic.

Today, toys are made from wood, metal and various plastics. The materials and pigments that are now used have to meet strict safety standards.

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Terracotta is made from baked clay. Clay is composed of a number of minerals including kaolin. One of the main compounds found in kaolin is nacrite. The formula for nacrite is $Al_2Si_2O_5(OH)_4$.

Question 1a (1 mark)

State the number of oxygen atoms in nacrite.

B I U x_2 x^2 Ω Σ Styles

9

Question 1b (2 marks)

Two of the elements in nacrite are aluminium and silicon. **Identify** the group and period of each element.

3 Aluminium: Group ▾ Period ▾

Silicon:

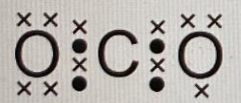
Group: Group, 1, 2, 3, 4, 5

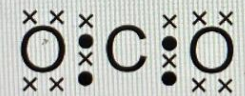
Period: Period, 1, 2, 3, 4, 5

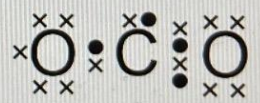
Scroll down to continue

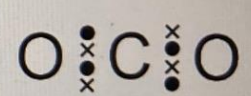
Question 1c (1 mark)

Silica is also found in clay. Silica has the chemical formula SiO_2. Silicon is in the same group as carbon and their oxides have similar formulas. Silica has a giant covalent structure but carbon dioxide has a simple molecular structure. **Select** the diagram that shows the Lewis (electron dot or dot cross) structure of carbon dioxide.

A. 

B. 

C. 

D. 

Select

- Select
- A
- B
- C
- D

Question 2 (11 marks)

The Slinky was invented in 1943 and was made of a type of high carbon steel.

High carbon steel is composed of iron with carbon and manganese. In the 1970s, plastic became more common and a large number of cheaper Slinkys were produced from this new material.

1943

2019

Scroll down to continue

positions of four different types of carbon-based steels.

Here are the compositions of four different types of carbon-based steels.

Type of carbon-based steel	% Carbon	% Manganese	% Iron	Properties
Low carbon steel	0.25	0.40	99.35	Loses its shape easily
Medium carbon steel	0.54	1.65	97.81	Ductile and long wearing
High carbon steel	0.95	0.90	98.15	Strong and holds shape memory well
Very high carbon steel	2.10	0.00	97.90	Brittle

Question 2a (1 mark)

Select the term used to describe the mixture of iron, carbon and manganese that makes up steel.

Select
Allotrope
Alloy
Compound
Ester
Select

Question 2b (2 marks)

Suggest why low carbon steel and very high carbon steel would be unsuitable to make a Slinky.

Low carbon steel:

B I U x_2 x^2 Ω Σ

Styles

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Question 2a (1 mark)

Select the term used to describe the mixture of iron, carbon and manganese that makes up steel.

Select
- Select
- Allotrope
- Alloy
- Compound
- Ester

Very high carbon steel:

Styles

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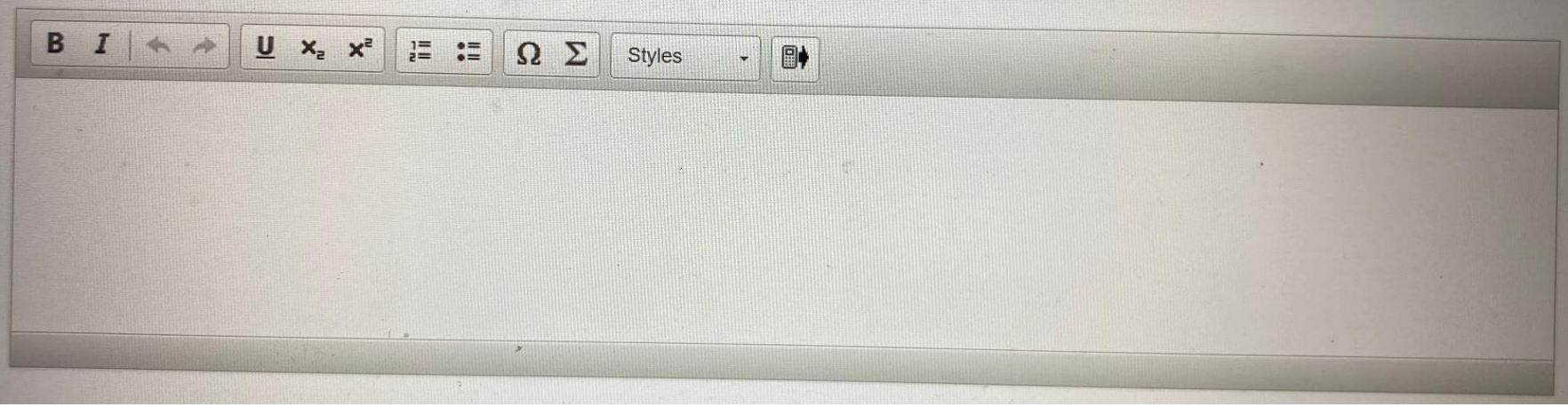
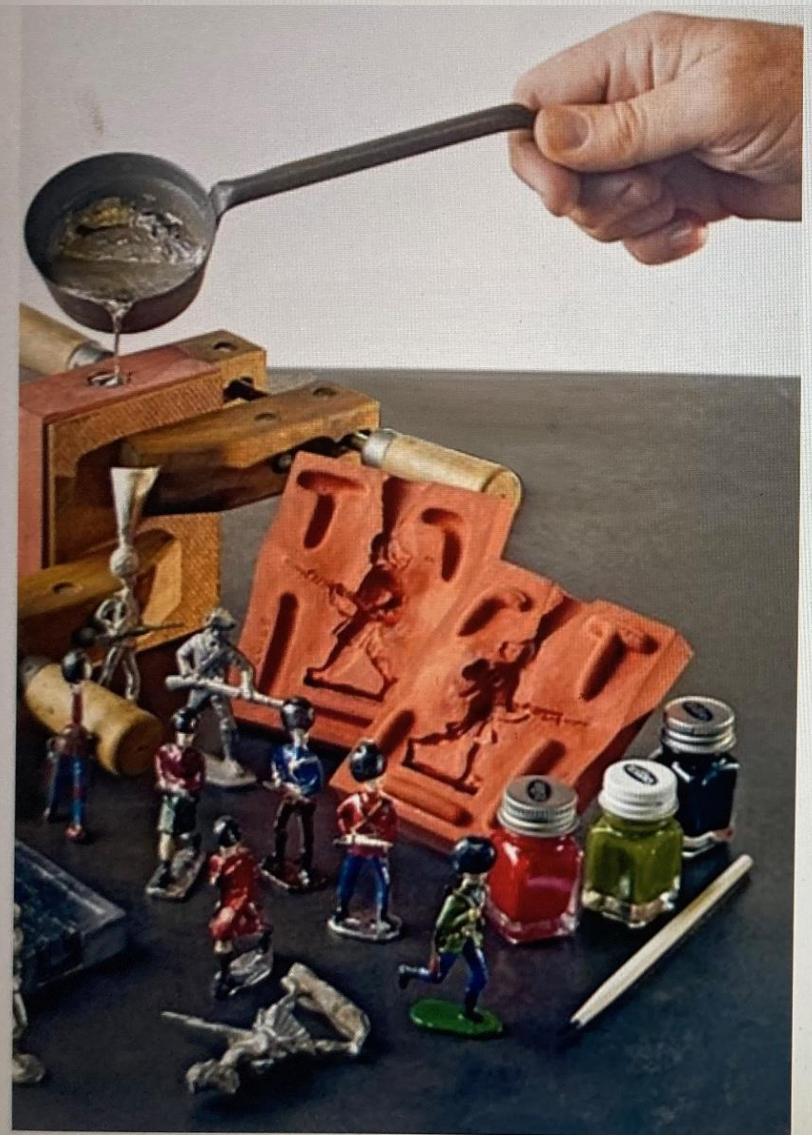
Question 2c (4 marks)

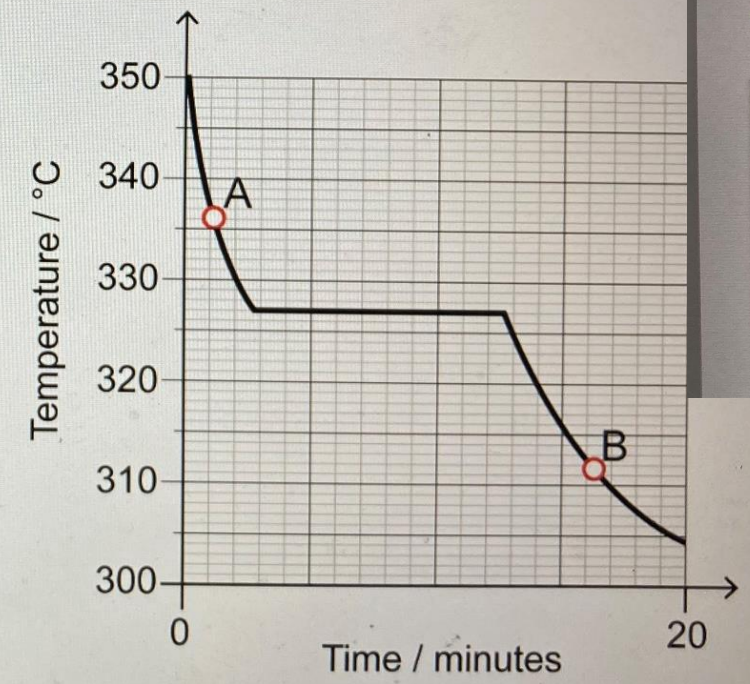
The original Slinky was made from 24.4 m of high carbon steel wire. The mass of a Slinky is 0.405 kg. **Calculate** the number of moles of iron needed to make a Slinky assuming that all the wire is made of iron. Give your answer to 2 significant figures.



The image below shows how toy figures have been made by melting lead and pouring it into clay casts. Once the molten lead has been poured into the cast it is left to cool.



A scientist heated some lead to form a liquid. The temperature of the metal was then recorded as it cooled. The graph produced from the data looked like this.



State the physical state of the lead at point B.

B I U x_2 x^2 Ω Σ Styles

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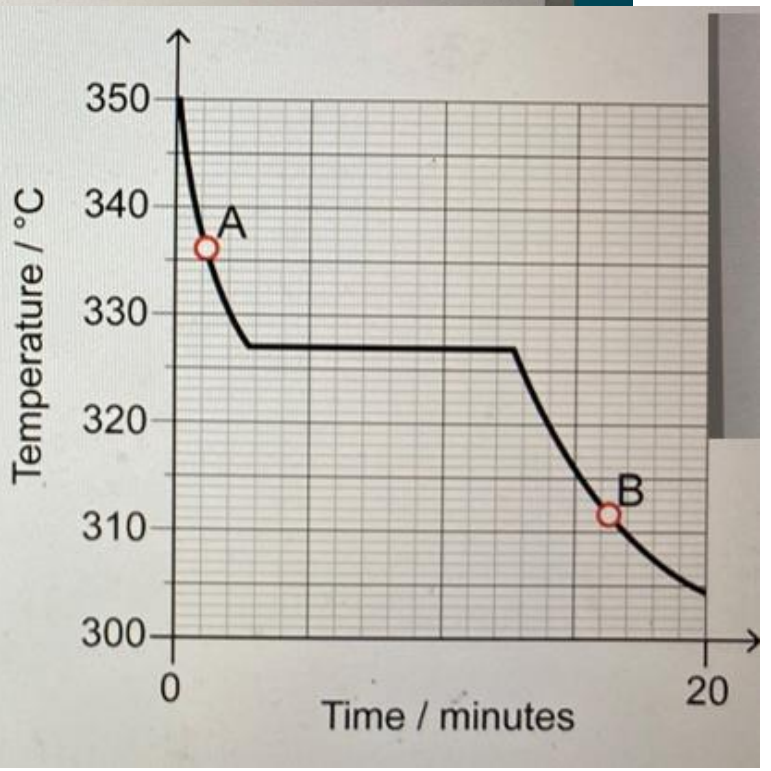
Use the tool to **draw** the arrangement of the lead particles at point A and point B. You should include at least six particles in each diagram.

Palette

Click & Click

Point A

Point B



©

Question 2f (1 mark)

Use the graph to **state** the melting point of lead.

B I U x_2 x^2 Ω Σ Styles

Question 3 (10 marks)

In the 1950-1960s, the radioactive element radium was used to coat the numbers on watches. The numbers glowed in the dark so it was possible to see the time at night. The workers that painted the dials often became ill after long exposure to the paint.

Scroll down to continue

Question 3 (10 marks)

As society became fascinated with nuclear power, children's toys were produced to encourage them to learn all about radioactive elements.
The Atomic Energy Lab in the image contained radioactive lead (Pb-210), ruthenium (Ru-106), zinc (Zn-65) and polonium (Po-210).

Scroll down to continue

Question 3 (10 marks)

Today, toys that glow in the dark do not contain radioactive materials but rely instead on the properties of strontium nitrate and zinc sulphide to emit light.

Scroll down to continue

Question 3a (2 marks)

Strontium nitrate ($Sr(NO_3)_2$) can be made by reacting strontium carbonate ($SrCO_3$) with nitric acid (HNO_3). **State** the name of the products to complete the **word** equation for this reaction.

Strontium carbonate + nitric acid → strontium nitrate + [ ] + [ ]

Question 3b (3 marks)

Write down the balanced **symbol** equation for the word equation in part (a). You do not need to include state symbols in your equation.

B I U x_2 x^2 Ω Σ Styles

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Question 3c (2 marks)

Outline why having toys with zinc sulphide would be better for your health than those containing radium.

B I U x_2 x^2 Ω Σ Styles

Question 3d (2 marks)

Determine the number of protons, neutrons and electrons in an atom of $^{210}_{84}Po$ and $^{210}_{82}Pb$.

	$^{210}_{84}Po$	$^{210}_{82}Pb$
Protons:		
Neutrons:		
Electrons:		

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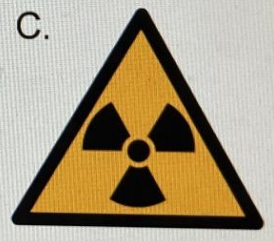
Question 3e (1 mark)

Select the hazard symbol that would be used on the Atomic Energy Lab toy if it were available today.

A.

B.

C.



D.

©

Select

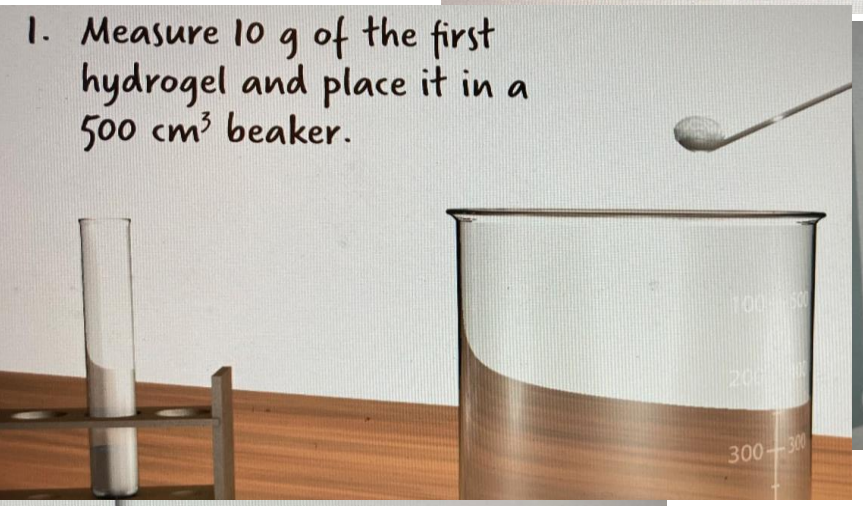
Question 4 (16 marks)

Hydrogels are synthetic molecules that can absorb large volumes of water.

Students from one MYP school carried out an experiment to compare the absorbency of different hydrogels.

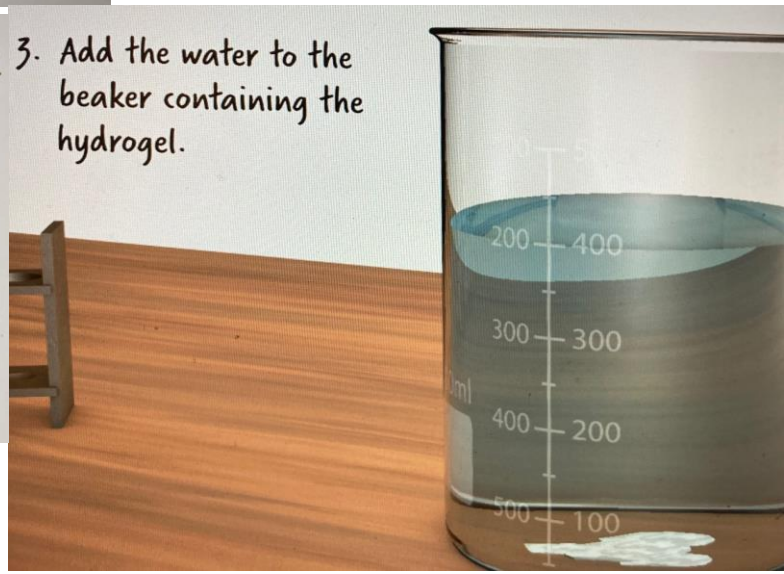
The students followed the method below:

1. Measure 10 g of the first hydrogel and place it in a 500 cm^3 beaker.

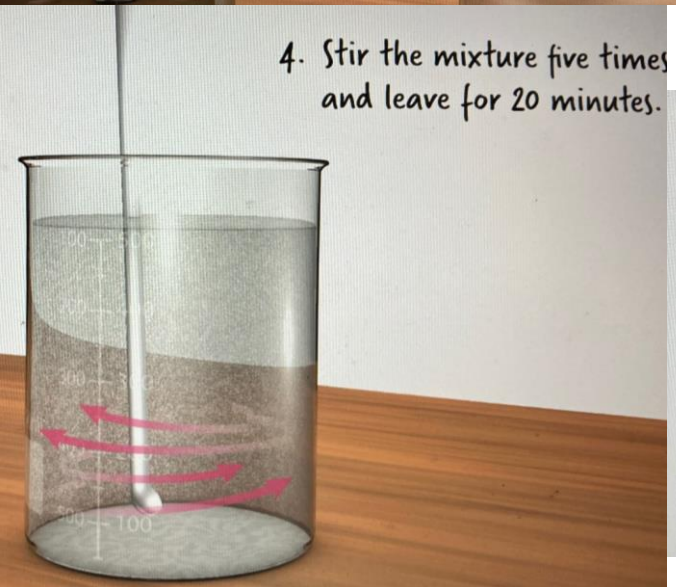


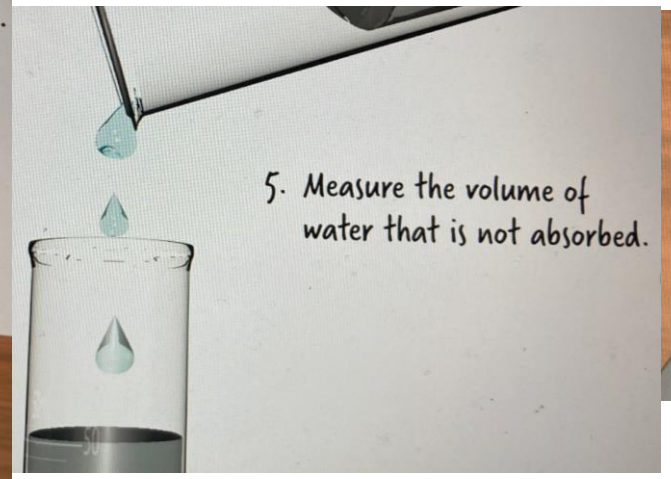
2. Measure 400 cm^3 of distilled water.

3. Add the water to the beaker containing the hydrogel.

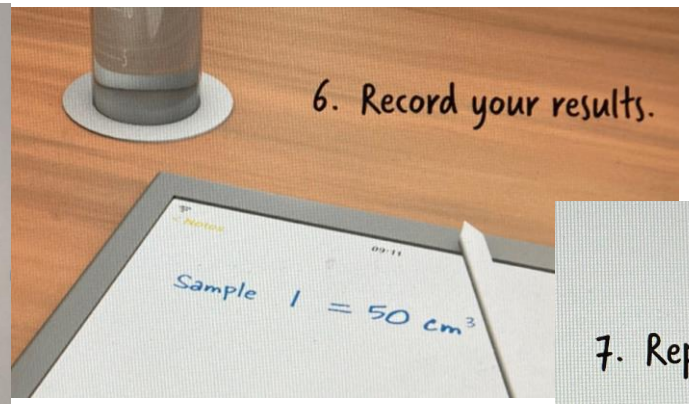


4. Stir the mixture five times and leave for 20 minutes.





5. Measure the volume of water that is not absorbed.



6. Record your results.

7. Repeat steps 2 to 6 for each hydrogel.

Question 4a (4 marks)

Identify the variables in the students' method.

Independent variable:

Dependent variable:

Scroll down to continue

Control variable 1:

Styles

Control variable 2:

Styles

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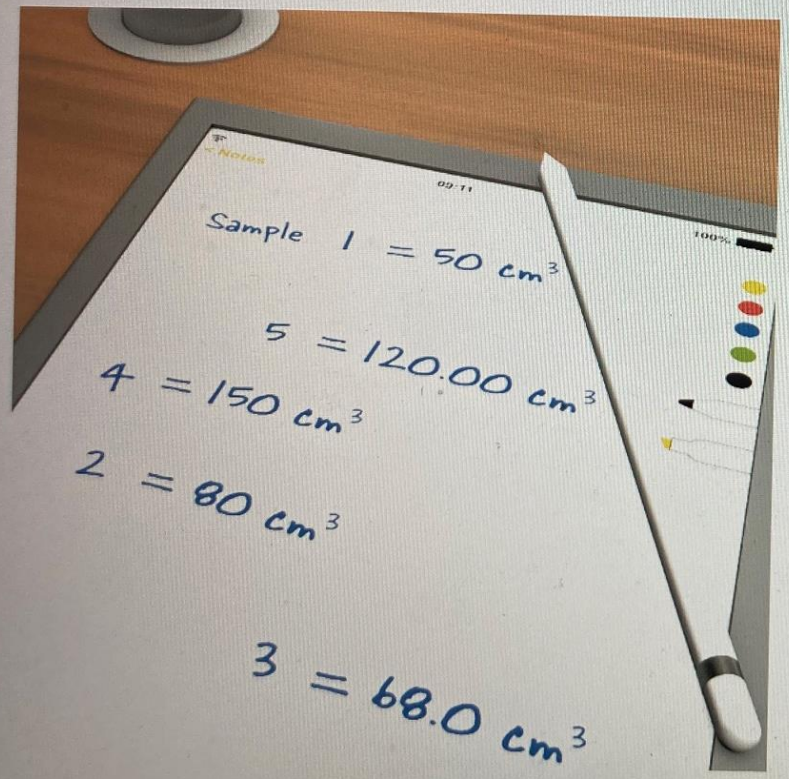
Question 4b (4 marks)

The students' raw data is shown below.



Scroll down to continue

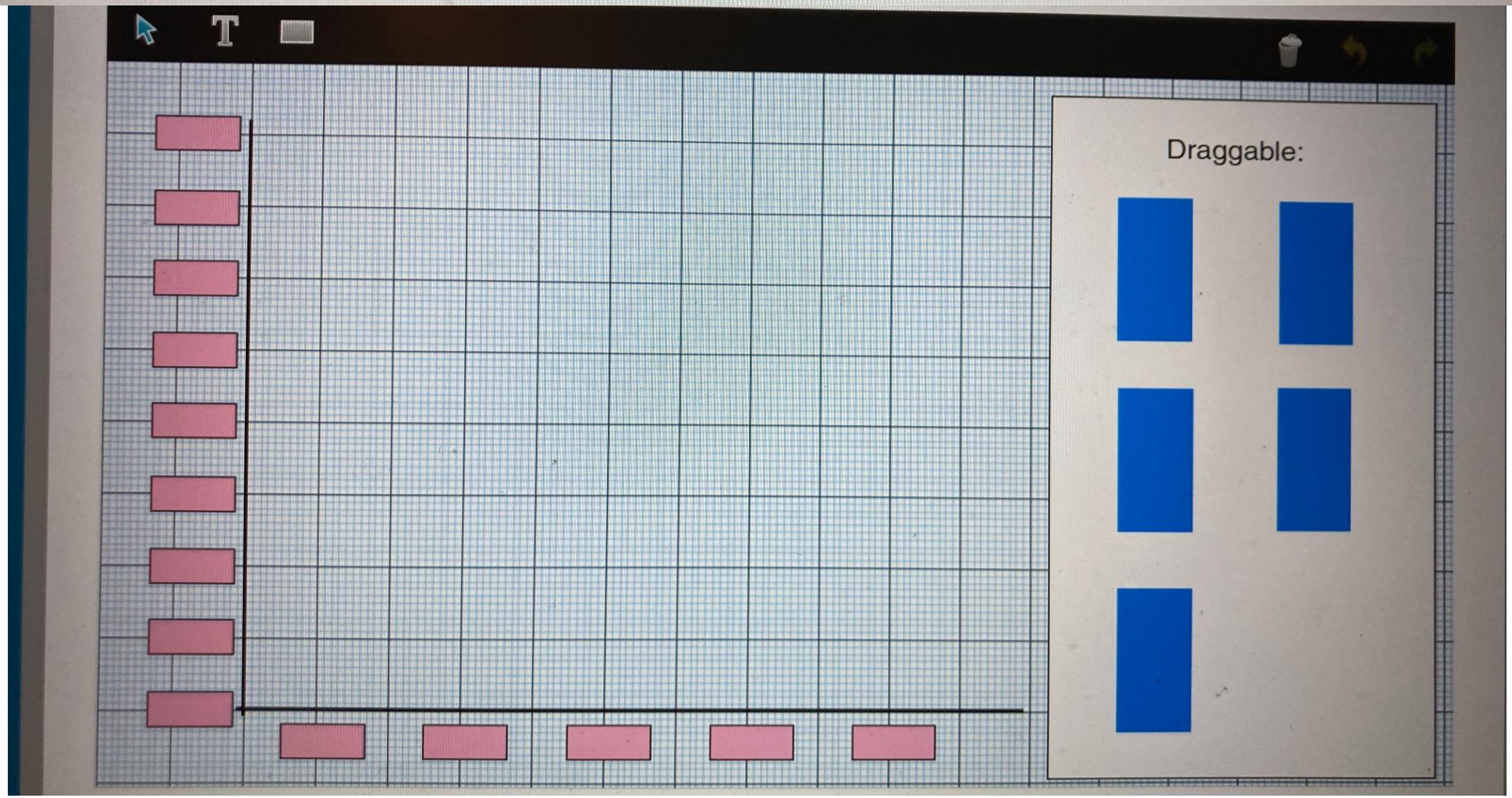
Organize and **present** the students' raw data collected during the experiment.

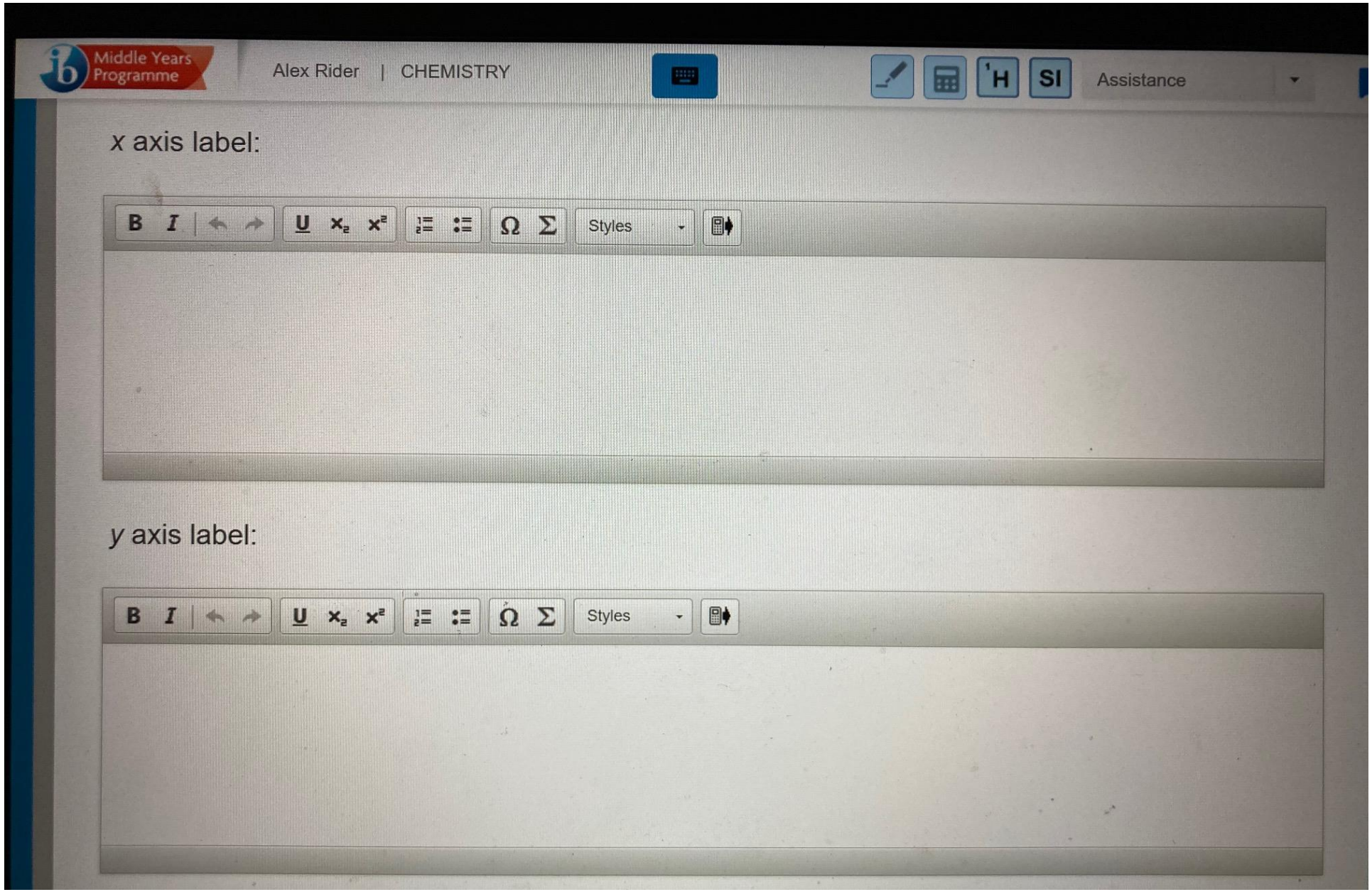
Create New Table

Reset

Plot the data from part (b) in an appropriate graph. Add a title and the labels for the axes in the boxes underneath the graph.

Title:

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x axis label:
Styles
y axis label:
Styles

Question 4d (1 mark)

The students' research question was:

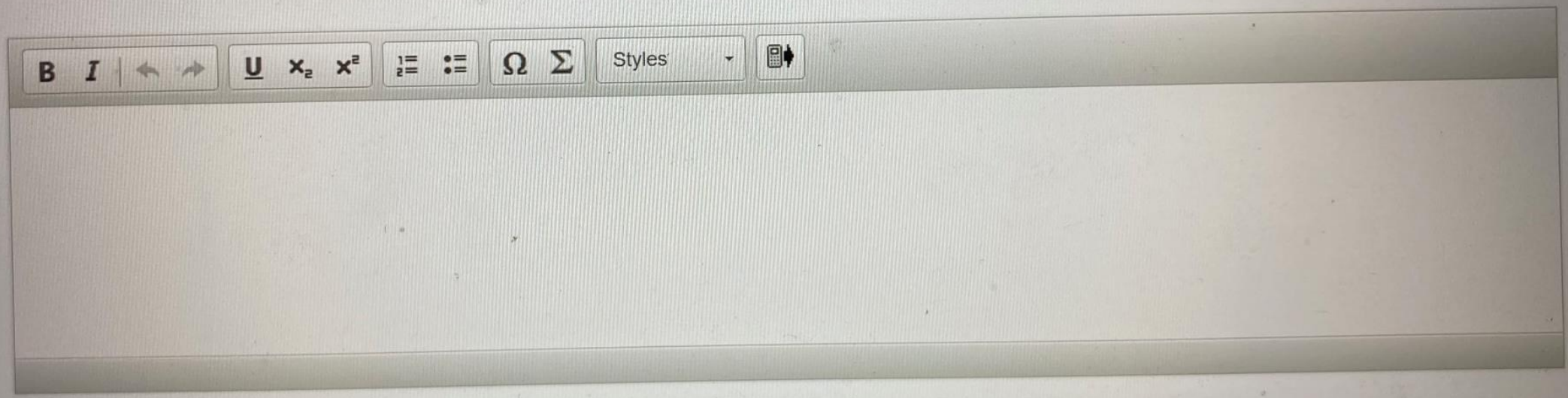
> Do different hydrogels absorb different volumes of water?

State whether the students' data can answer this research question and **justify** your response.

B I U x_2 x^2 Ω Σ Styles

Question 4e (3 marks)

Using the data in part (b), **explain** which hydrogel you could use to absorb 340 cm^3 of water.
You should use calculations to support your answer.



Question 5 (20 marks)

The main absorbent material in disposable nappies is hydrogel.

According to a study carried out by the Environment Agency in the UK, 2–3 % of all household waste is estimated to be disposable nappies. This is approximately 3×10^9 nappies, equivalent to approximately 5×10^8 kg of waste (nappy + body waste) each year.

The alternative is reusable nappies. Reusable nappies reduce the demands on landfill but they affect the environment in other ways due to the water and energy used in washing and drying them.

Scroll down to continue

The tables below give some information comparing the production and use of disposable and reusable nappies. This information is based on nappies being used for 2.5 years. Disposable nappies are made from plastic backing, hydrogels and an absorbent material called fluff pulp. Reusable nappies are made from cotton and are used with a wool or plastic outer layer.

Use the information provided in both tabs below.

Production

Factor	Disposable nappies 	Reusable cotton nappies 
What the nappy is made of	Plastic backing, hydrogels, paper	Cotton nappy with wool or plastic outer (**Note:** the outer has not been included in the figures below)
Making the nappies: Mass of plastics used (including hydrogel) / kg	15	0
Are pesticides used?	No	Yes
Mass of fluff pulp used / kg	108	0
Mass of cotton used / kg	0	2.3
Energy used / kWh	338	57
Water used that will be polluted afterwards / dm^3	10500	1100
Total raw materials used / kg	123	2.3

Usage

Factor	Disposable nappies 	Reusable cotton nappies 
Using the nappies: How many times is the same nappy used?	1	167 (as 6 nappies used in total)
Energy used in laundry / kWh	none	141 per nappy
Mass of detergents used / kg	0	32
Water used that will be polluted afterwards / dm^3	1500	6200
Disposing of the nappies: Mass of waste / kg	221	30
Where solid body waste (faeces) ends up	In landfill sites	In the waste water supply with other toilet waste

Question 5a (5 marks)

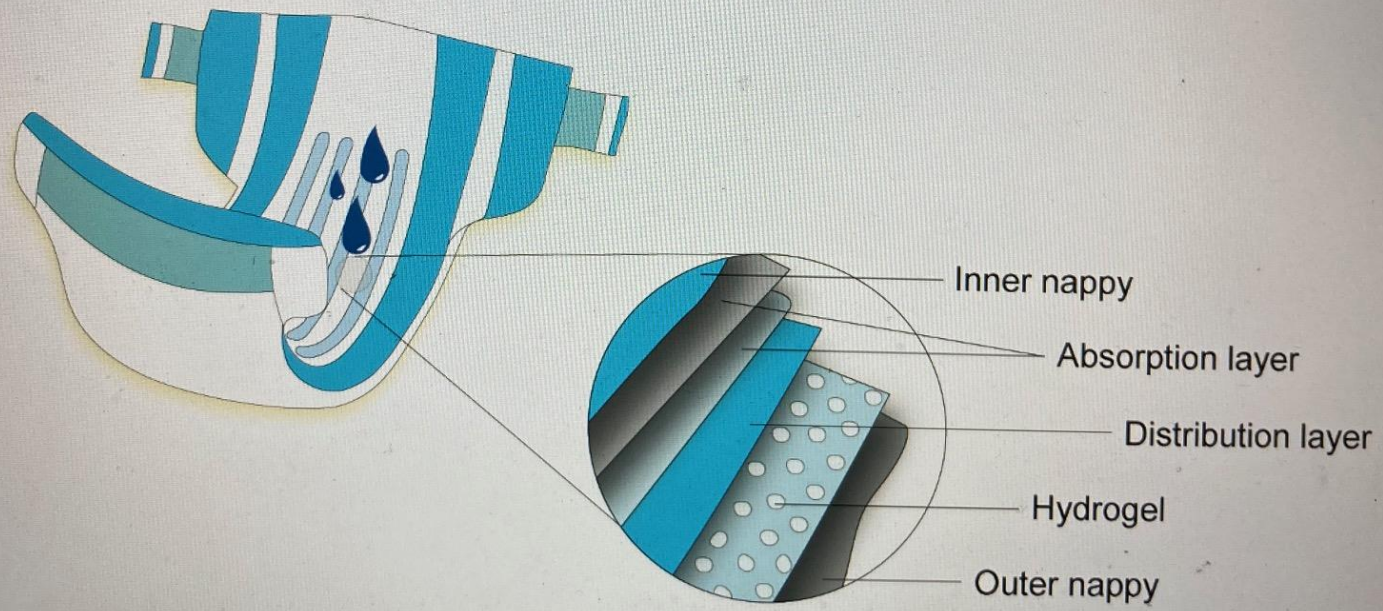
Using the data provided in the tables **discuss** which type of nappy causes less harm to the environment. In your answer you should include:

- environmental impacts
- advantages and disadvantages for a baby's carer
- your opinion about which type of nappy has a lower impact on the environment.

Scroll down to continue

Question 5b (15 marks)

A student wants to investigate five different brands of nappies to determine which one absorbs the most liquid. Disposable nappies will contain a mixture of hydrogel and fluff pulp as absorbents.



Scroll down to continue

that the student could follow to identify the brand that absorbs the most liquid.

Design a method that the student could follow to identify the brand that absorbs the most liquid.
In your answer you should include:

- the independent, dependent and two control variables
- a list of equipment you will need
- how you will collect sufficient data
- details of the method you will use.

Scroll down to continue

Question 6 (8 marks)

Question 6a (3 marks)

The table below shows some data about the composition of different nappy brands.

Nappy composition	Pugs	Hamps	Little Angels	Little Ones	Cuties
Fluff pulp / g	6.97	0.71	2.35	5.36	1.28
Hydrogel / g	1.88	3.97	3.56	2.76	5.43
Total mass of fluff pulp + hydrogel / g	8.85	4.68	5.91	8.12	6.71
Water absorbed by fluff pulp / g	188.2	19.2	63.4	144.7	34.56
Water absorbed by hydrogel / g	56.4	119.1	106.8	82.8	162.9
Nappy's total absorption / g	244.6	138.3	170.2	227.5	197.5

One of the students came up with the following research statement:

> The more hydrogel in nappies, the more absorbent they are.

Using the data in the table, **discuss** the validity of the research statement.

Scroll down to continue

Question 6b (3 marks)

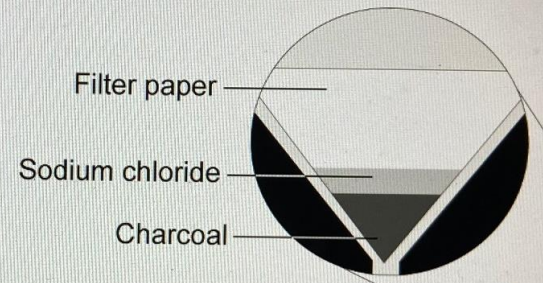
Formulate a hypothesis that would be supported by the data in the table.

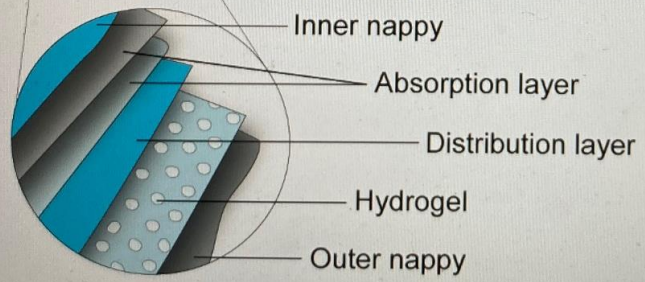
If:

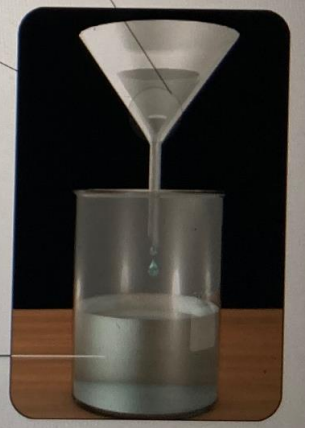
then:

because:

Liquid added to 10 g of hydrogel	Mass of liquid absorbed / g
Distilled water	300
Tap water	100
Urine	80







Assistance

Question 6c (2 marks)

The table below shows data about the mass of different liquids that can be absorbed by hydrogel. A solution of sodium chloride can be used to model urine.

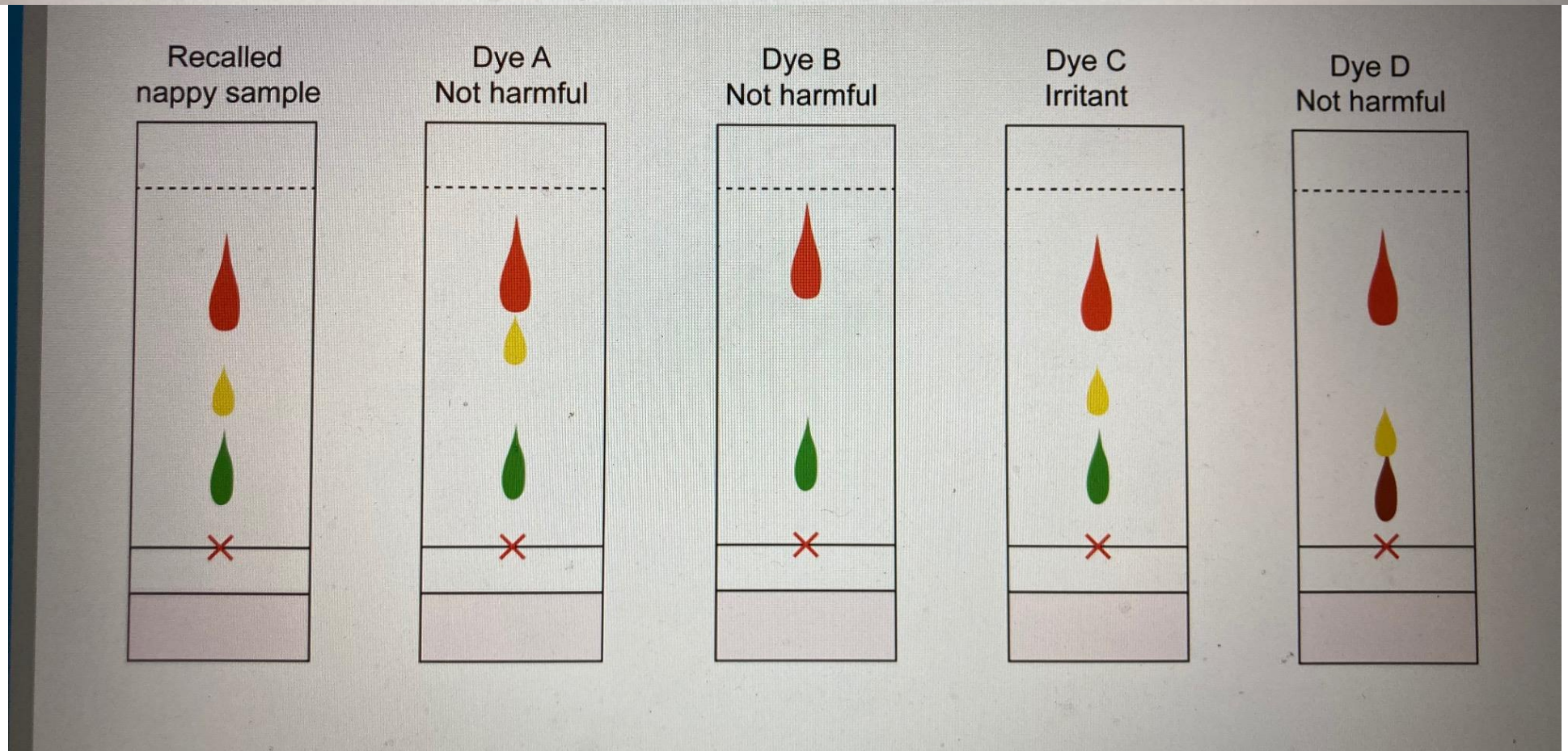
The data in the table shows that hydrogel does not absorb urine very well. Use the two diagrams to **suggest** the function of fluff pulp in nappies.

B I U x_2 x^2 Ω Σ Styles

Question 7 (8 marks)

Nappy producers use dyes to make some nappies look appealing. A new brand of nappy has been released but is suspected to have caused skin irritation due to the dyes used. The dyes are being tested using chromatography.

A sample of three nappies were analysed using chromatography. The results are shown below with the potential hazards of four dyes.



Question 7a (2 marks)

Identify the dye that the nappy sample contains. **Justify** your answer.

B I U x_2 x^2 Ω Σ
Styles

Question 7b (3 marks)

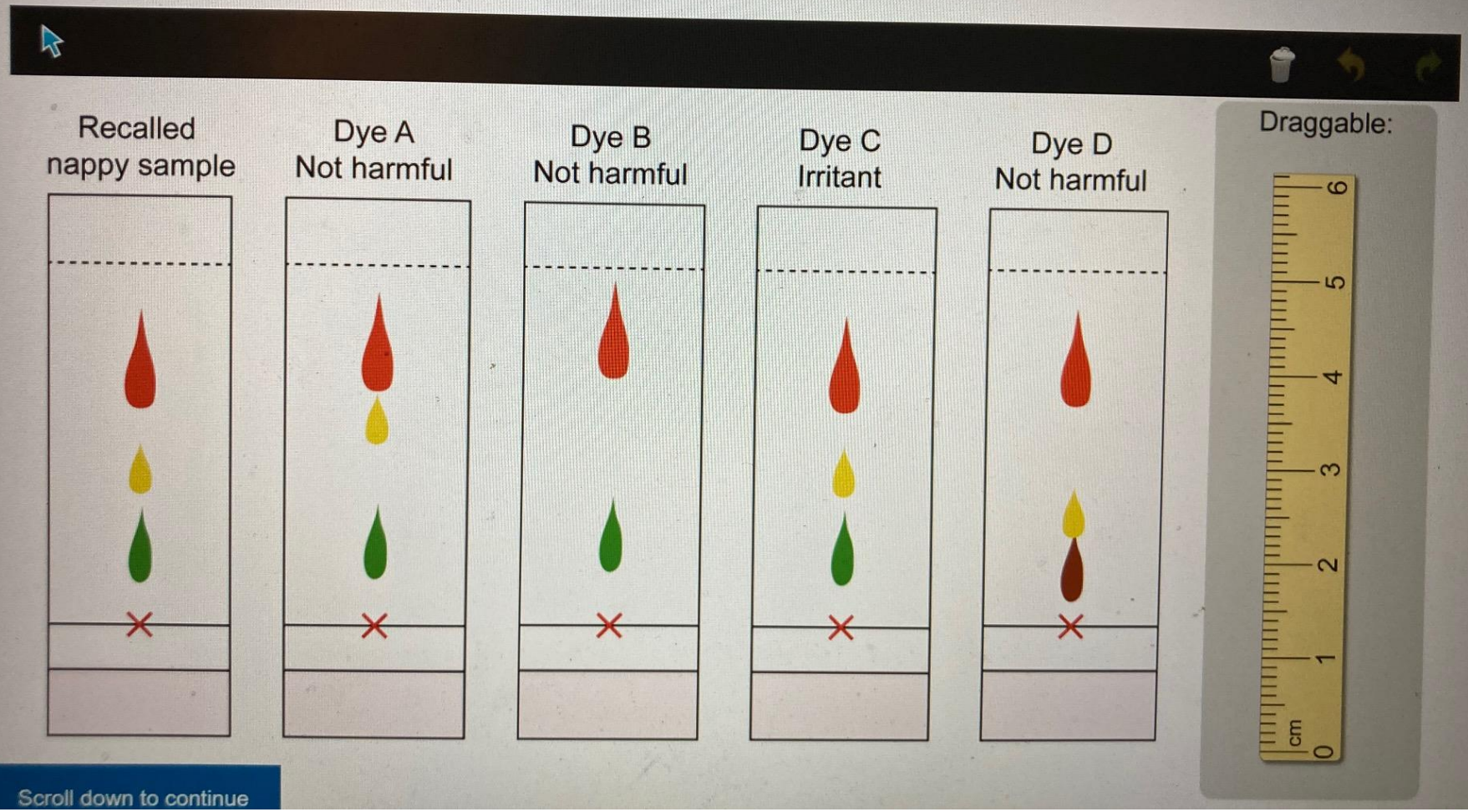
For each of the other dyes, **explain** why they are not contained in the nappy sample.

B I U x_2 x^2 Ω Σ
Styles

Scroll down to continue

Question 7c (3 marks)

In chromatography, the Rf value compares the distance moved by each spot with the distance moved by the solvent front. **Calculate** the Rf value of the spot responsible for the irritation.



Scroll down to continue

Question 8 (10 marks)

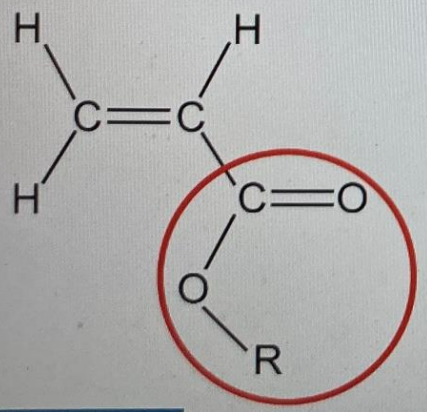
Plastic is a synthetic material made from a variety of organic polymers. Polymers are made up from a large number of monomers that are chemically bonded together.

Question 8a (3 marks)

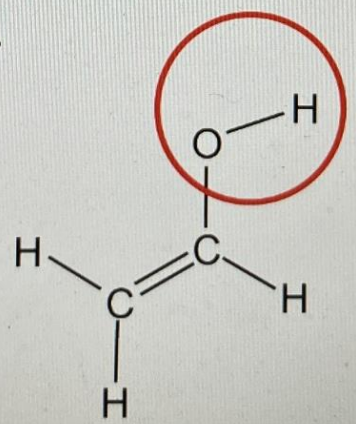
Below are different monomers used to make different types of plastic.

Select the class name of the group that is circled in the monomers below:

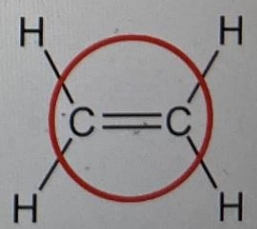
A.



B.



C.



Select
Alkane
Alcohol
Ester
Carboxylic acid
Alkene

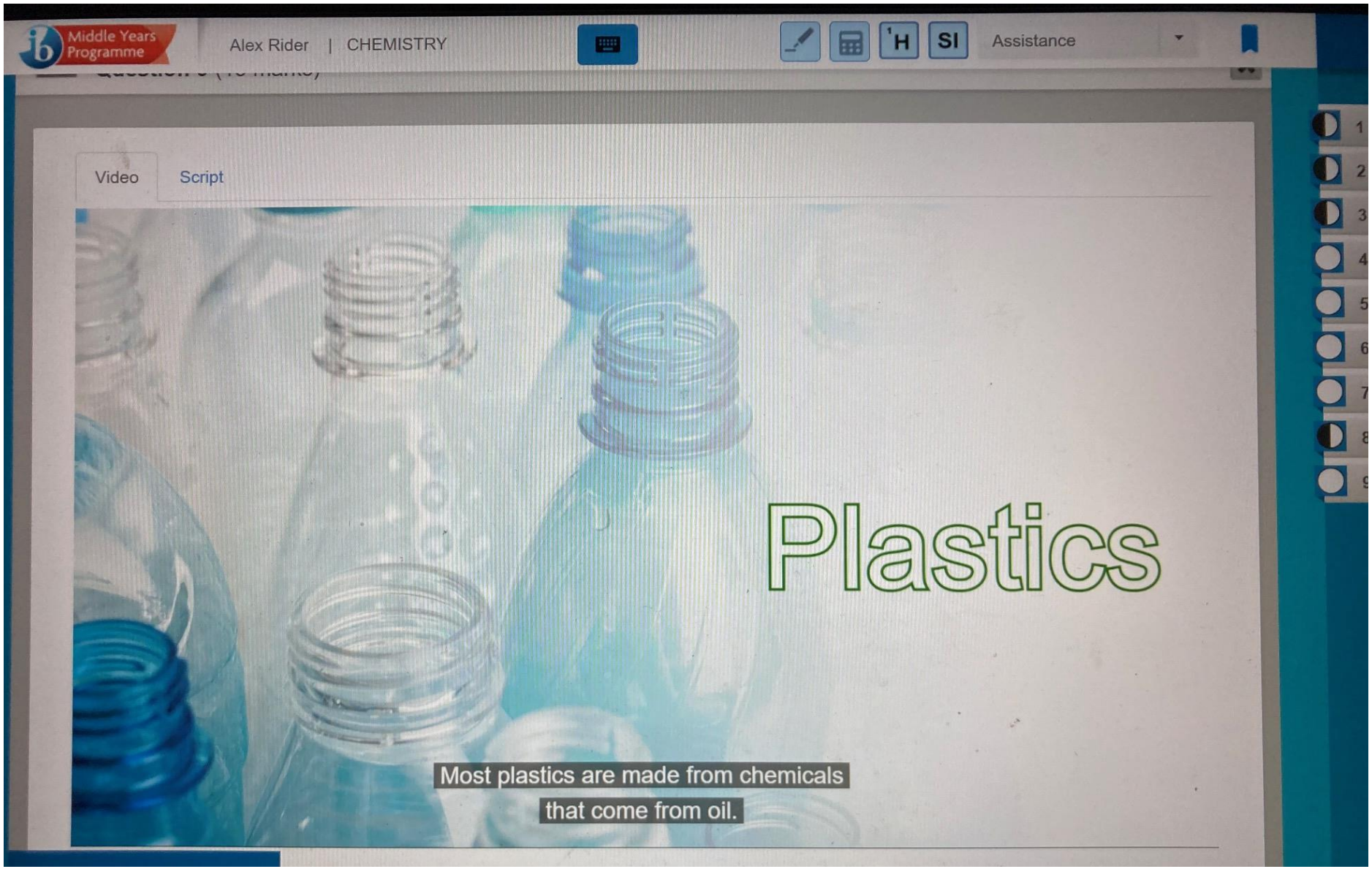
Select

Q. 8b (7 marks)
Michelle, Yuri and Paul are excited to open their own new coffee shop. They are deciding which type of cups to buy. They want their cups to be environmentally friendly, practical to use and inexpensive to maximise profit.

	PET – 500 cm^3 coffee cups	PLA – 500 cm^3 coffee cups
Will it biodegrade	No	Yes, in managed composting facilities
Made from	Oil	Annually renewable plants
Should single use bottles be refilled	No, not recommended	Yes
Can be recycled	Yes, where facilities exist	No, they biodegrade and return to nature
Releases harmful toxins when incinerated	Yes	No
Greenhouse gases savings during production	0 %	60 % less than PET
Oil saved	–	1 dm^3 for every 24 cups produced compared to PET
Production capacity / k tonnes y^{-1} (2015–2016)	990	220
Cost / € kg^{-1}	0.9	2
Temperature at which it starts to melt / °C	260	160
Specific heat capacity / Jkg^{-1} °C $^{-1}$	1000	1800

Using the table above, **explain** the advantages and disadvantages of using PLA compared to PET for the take-away cups in the coffee shop. In your answer you should:

- outline the physical properties required in a coffee cup
- describe the advantages and disadvantages that PLA has compared to PET
- justify whether PLA would make a suitable replacement for PET.


Middle Years Programme
Alex Rider | CHEMISTRY
Assistance
Video
Script
Plastics
Most plastics are made from chemicals
that come from oil.

Video Script

Most plastics are made from chemicals that come from oil. Scientists are finding innovative solutions to produce plastics that are more sustainable to limit their impact on the environment. One solution is to produce plastics using algae.

Oil-based plastics are made from fossil fuels and have unlimited uses. During their production they release greenhouse gases. Oil-based plastics are long lasting and certain products can be reused many times. Scientists have estimated that it could take up to 450 years after disposal for these plastics to degrade.

Oil-based plastics can be recycled or otherwise they can end up in waterways that lead into oceans. Once in the oceans, plastics form large islands of waste that pose threats to wildlife. Fish, turtles and birds can eat the plastic or get entangled in it.

If the plastic is recycled, it is broken down and made into new plastic. Alternatively, it can be reused and made into household items that can be sold to generate income in less economically developed countries. In some areas of the world, this refashioning of plastics into new products can be the only source of income.

As a sustainable alternative, plastics can be made using algae. Large volumes of water are needed to grow the algae. Sea water or freshwater can be used. When it is growing, algae takes in dissolved carbon dioxide from the water. At present, these new plastics are creating jobs in various regions of the world.

Currently, algae-based plastics have limited uses such as wrappers and bags. These type of plastics need to be stored carefully as they are sensitive to the environment and may break down before use. Algae-based plastics biodegrade quickly and do not leave behind any pollutants that are harmful to the environment. Because the products biodegrade in a very short time, they can only be used once so high production rates are needed to meet demand.

Using your experience from your wider MYP studies and the information above, **discuss** and **evaluate** the impact of algae-based biodegradable plastics as a replacement for oil-based plastics. In your answer you should consider:

- the sustainability of **production** of algae-based and oil-based plastics
- the environmental impacts of the **production** and **end of use** of algae-based and oil-based plastics
- the social impacts of the **production, use** and **end of use** of algae-based and oil-based plastics
- your opinion about replacing oil-based with algae-based plastics.

Scroll down to continue

MPESA FOUNDATION ACADEMY

MYP 5 Weekly Revision Work — Week 5 task

Task: Criterion D (Applying Science)

Chemistry department

Name:…….. Class:……..

Total marks: 26 marks — Time: 30 – 35 minutes

Question 6 (12 marks)

Applying science

The global context is **orientation in space and time** with a focus on **natural and human landscapes and resources.** This task (questions 6 and 7) addresses the key concept of **systems** and assesses **criterion D** (Reflecting on the impacts of science).

Complex systems are used in crude oil processing.

Question 7 (14 marks)

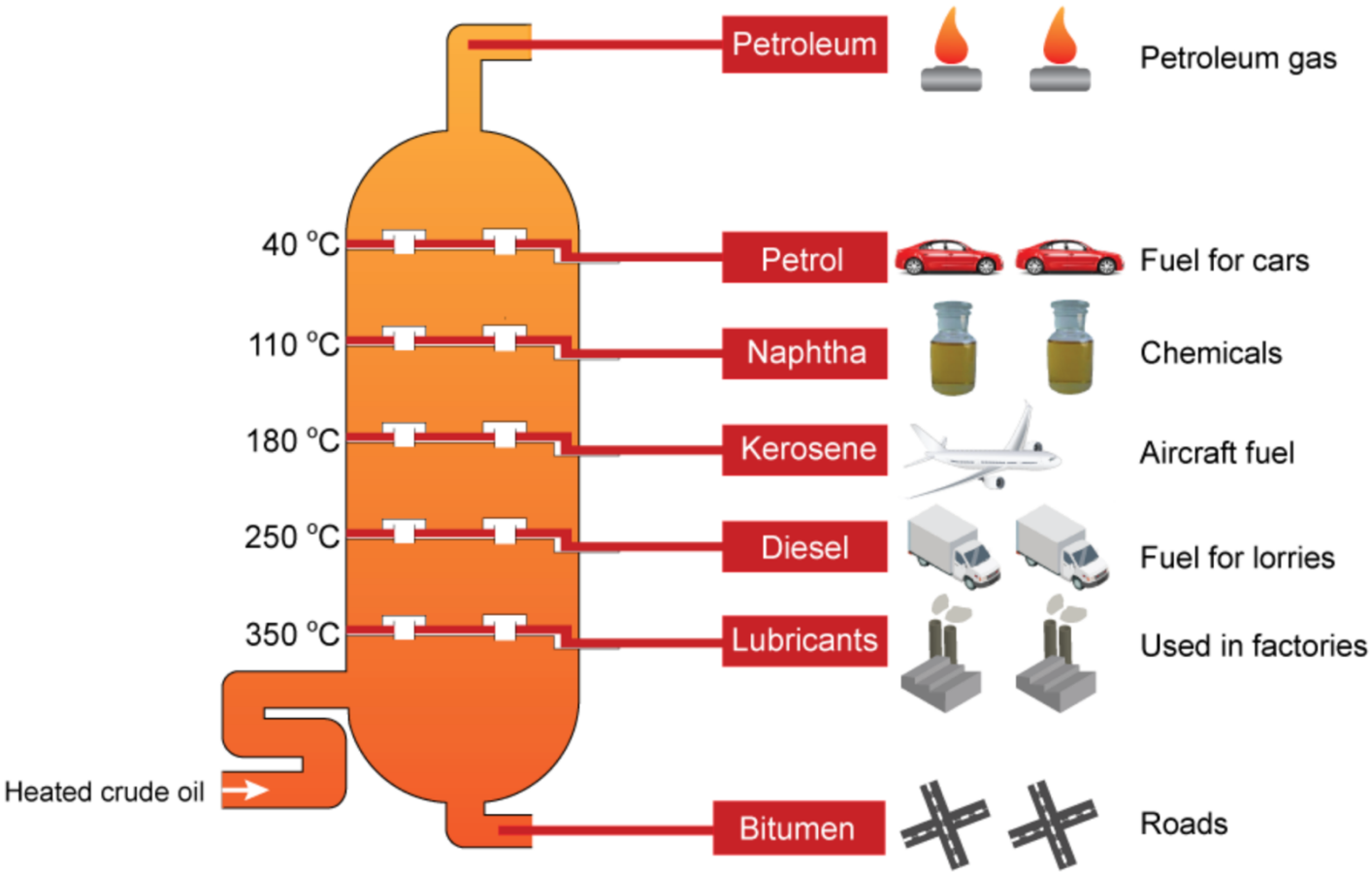
The natural landscape determines the type of system used to transport crude oil.

INSTRUCTIONS:

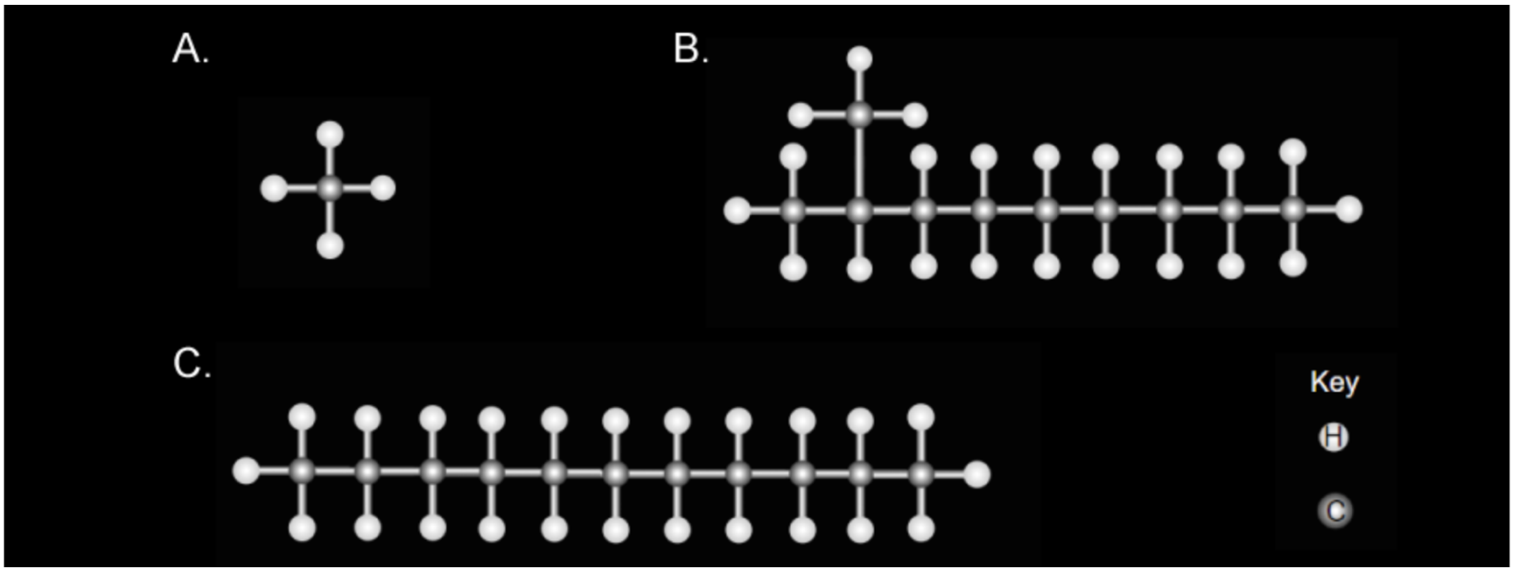
- Write your answers on the spaces left after each question.
- The work must be handed over for marking and feedback

Question 6 (12 marks)

Crude oil is a mixture of different sized hydrocarbons and other chemicals and is a source of various fuels. Crude oil can be separated into useful products by fractional distillation. The diagram below shows the process of fractional distillation.



Select the hydrocarbon that would be distilled with petroleum gases.



Question 6b (3 marks)

Outline the process of fractional distillation.

_____

_____

_____

_____

_____

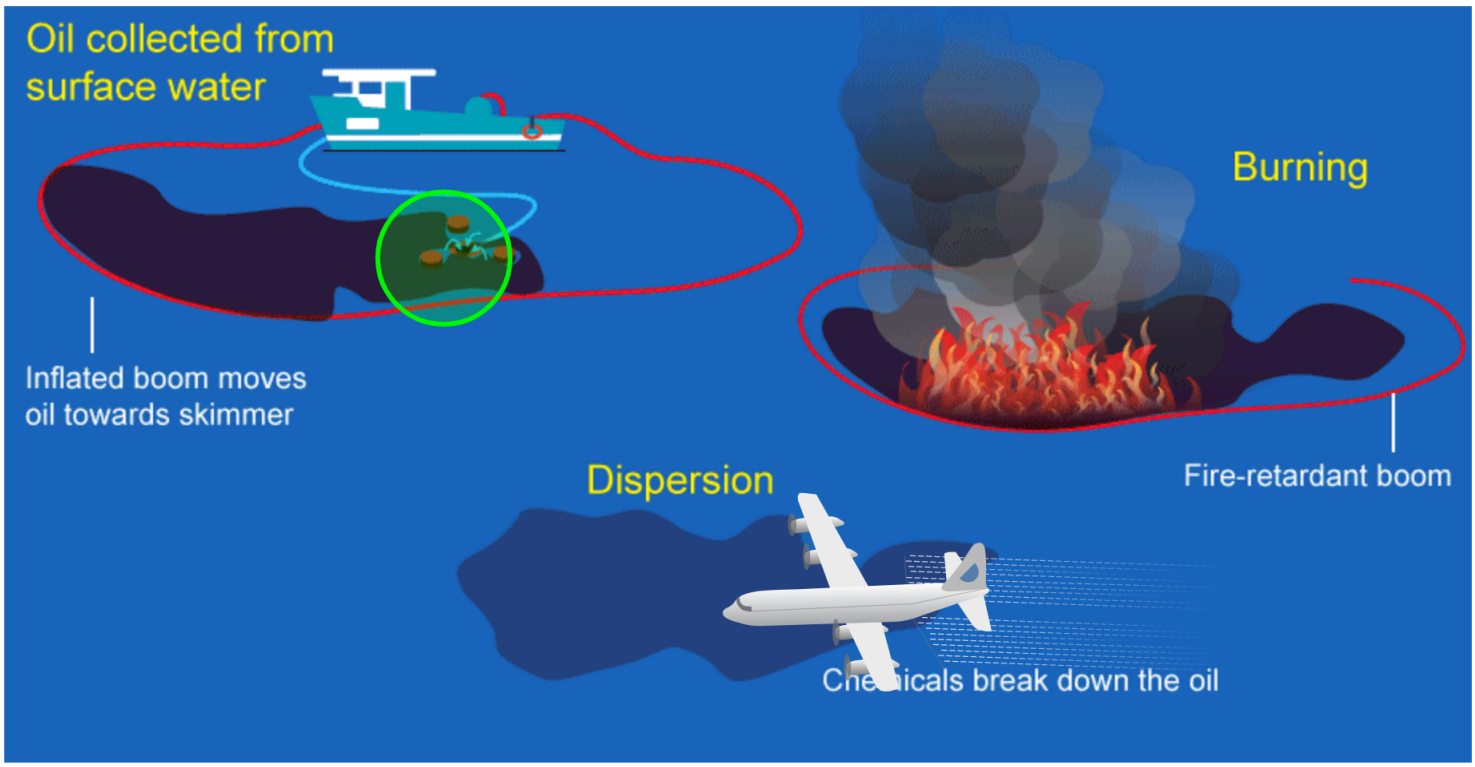
_____

_____

Question 6c (8 marks)

Accidental oil spills in seas, lakes and rivers can have consequences for birds, fish and other wildlife. Some methods used to clean up oil spills are shown below.

This media is interactive



Discuss and **evaluate** the three methods for cleaning oil spills and identify one method as being the best for the environment.

Question 7 (14 marks)

Video and map | Script

Crude oil and oil products must be transported from the oil field to refineries and on to other industrial facilities.

There are several options currently in use for transportation of crude oil over long distances.

Pipelines, rail, road and sea are some of the options.

The pipes can be above ground or buried at depths of up to 2 metres.

Once construction is complete, routine maintenance will involve checking for blockages, cracks and other damage from corrosion.

Rail transport is economical over long distances. Rail transport uses containers known as tank cars or tank wagons that are specially designed to avoid damage if there is an accident.

Road tankers are also specially designed to avoid damage in accidents. Road tankers can travel on existing road systems.

Crude oil has been transported at sea by tankers since 1892. Transportation at sea is useful when transportation over land is not possible.

Discuss and **evaluate** the most appropriate method of transporting crude oil from the oil field to various locations within the country and exporting excess oil. In your answer you should compare a pipeline with two alternative methods of transport and include:

- advantages and disadvantages of a pipeline
- advantages and disadvantages of your alternative methods
- environmental considerations
- social considerations
- a concluding appraisal linking all the issues you have discussed.

Lithium, sodium and potassium are metals in group 1 of the periodic table. They are good conductors of heat and electricity. The freshly-cut metals are shiny.

(a) (i) Give another physical property of all three of these metals.

(ii) Explain, in terms of electrons in their atoms, why lithium, sodium and potassium are in group 1 of the periodic table.

(b) A small piece of potassium is added to water. (i) Describe what you would see in this reaction.

(ii) Which of these is the balanced equation for this reaction? Put a cross (x) in the box next to your answer.

A. $2K + 2H_2O \rightarrow K_2O + 2H_2$
B. $2K + H_2O \rightarrow K_2O + H_2$
C. $4K + 3H_2O \rightarrow 4KOH + H_2$
D. $2K + 2H_2O \rightarrow 2KOH + H_2$

(c) There is an increase in reactivity of these group 1 metals from lithium to potassium. Explain this increase in reactivity.

2 (a) The table shows the names and formulae of three ions.

name of ion	formula of ion
calcium	Ca^{2+}
nitrate	NO_3^-
phosphate	PO_4^{3-}

What is the formula of calcium nitrate? Put a cross (x) in the box next to your answer.
( ) A. Ca_2NO_3
( ) B. $CaNO_3$
( ) C. Ca_3NO_2
( ) D. $Ca(NO_3)_2$

(b) Complete the sentence by putting a cross (x) in the box next to your answer. The number of oxygen atoms in the formula $Ca_3(PO_4)_2$ is:
( ) A. 2
( ) B. 4
( ) C. 8
( ) D. 12

(c) The table gives some information about the elements sodium and sulfur.

	sodium	sulfur
metal or non-metal	metal	non-metal
atomic symbol	Na	S
number of electrons in one atom	11	16

Sodium sulfide is an ionic compound. Describe, in terms of electron transfer, how sodium atoms react with sulfur atoms to form sodium sulfide. Your description should include the charges on the ions formed.

(d) Explain the difference in the ability of solid sodium chloride and molten sodium chloride to conduct electricity in terms of their structures.

3. Explain why an element's charge is related to the group on the periodic table to which it belongs.

4. Directions: Complete the table comparing ionic compounds and covalent compounds.

Characteristic	Ionic compounds	Covalent compounds
How the compound is formed		
Smallest particle		
Usual state at room temperature		

5. Draw a Bohr model for the following:

Argon (18)

Magnesium (12)

6. Complete the table below.

Symbol	Atomic Number	Mass Number	Number of Protons	Number of Electrons	Number of Neutrons
^{23}					
		39		19	
			38	38	50
	20	40			
Ions					
$^{+2}$					
$^{-1}$					
Isotopes					
		110	47		
^{36}S					
^{26}M					

7. How many grams are in 4.63×10^{24} molecules of CCl_4?

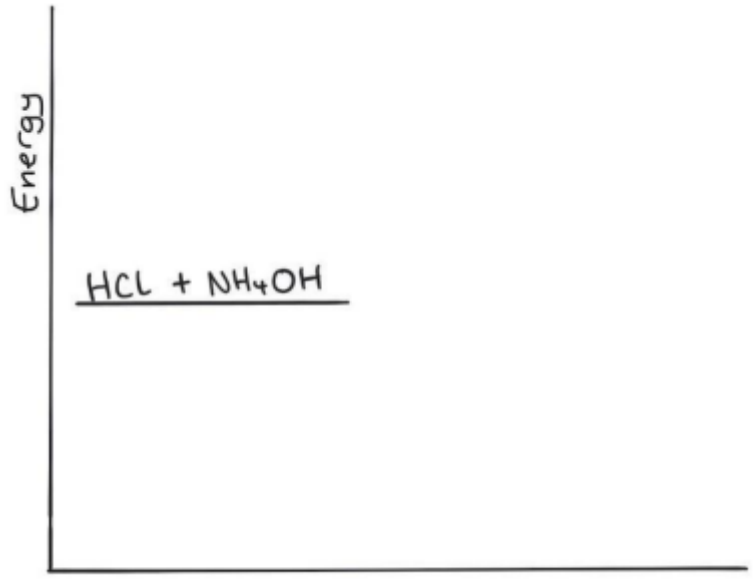
8. Use the table to answer this question

Reaction	Starting temperature °C	Final temperature °C
A	20	31
B	22	18
C	21	25

a. Decide whether each reaction is endothermic or exothermic, explain how you could tell.

b. Which reaction has the largest energy change?.

9. When hydrochloric acid reacts with ammonium hydroxide in a beaker, the temperature goes up.
$HCl + NH_4OH \rightarrow NH_4Cl + H_2O$
$\Delta H = -53.4 kJ/mol$
Complete the energy profile diagram and state whether the reaction is endothermic or exothermic, explain your answer.



10. There are many metallic elements in the periodic table. (a) Which row of the table correctly shows two metals that are in group 1 and two metals that are transition metals? Put a cross (x) in the box next to your answer.

	group 1	transition metals
☒ A	lithium and zinc	calcium and copper
☒ B	potassium and caesium	copper and iron
☒ C	sodium and potassium	copper and magnesium
☒ D	sodium and magnesium	manganese and nickel

(b) (i) Describe the structure of metals in terms of the particles present in their structures.

(ii) Explain how metals conduct electricity.

(c) (i) Describe what you would see when a small piece of sodium is added to water.

(ii) Write the balanced equation for the reaction of sodium with water to form sodium hydroxide and hydrogen.

11. Describe how the salinity level of the lake has changed over the past 100 years. To what extent might the lake have changed naturally over time?

12. What impact has human development and intervention had on the ecosystem of the lake?

Worksheet: Calculating Empirical & Molecular Formulas

1. The empirical formula for the compound having the formula $H_2C_2O_4$ is

   [A] C_2H_2 [B] CO_2H [C] COH [D] $C_2O_4H_2$ [E] COH_2

2. Calculate the empirical formula of a compound that is 85.6% C and 14.4% H (by mass).

   [A] CH_2 [B] CH [C] C_3H_5 [D] C_2H_4 [E] C_2H

3. A compound is analyzed and found to contain 12.1% carbon, 16.2% oxygen, and 71.7% chlorine (by mass). Calculate the empirical formula of this compound.

   [A] $COCl_2$ [B] CO_2Cl_2 [C] CO_2Cl [D] $COCl_4$ [E] COCl

4. A compound contains 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen (by mass). Calculate the empirical formula.

   [A] C_2H_2O [B] CH_2O [C] CH_4O [D] C_2HO_2 [E] $C_3H_6O_3$

5. A compound contains 25.94% N and 74.06% O (by mass). What is the empirical formula?

6. Calculate the empirical formula of a compound containing 18.29% H and 81.71% C (by mass).

7. Determine the empirical formula of a compound containing 54.2% F and 45.8% S (by mass).

8. A compound has 40.68% carbon, 5.12% hydrogen, and 54.20% oxygen (by mass). Calculate its empirical formula.

9. Calculate the empirical formula of a compound that is 50.04% C, 5.59% H, and 44.37% O (by mass).

10. A 7.33-g sample of lanthanum, La, combines with oxygen to give 10.29 g of the oxide. Calculate the empirical formula of this oxide.

11. Calculate the molecular formula of a compound with the empirical formula CH_2O and a molar mass of 150 g/mol.

    [A] $C_3H_6O_3$ [B] $C_5H_{10}O_5$ [C] $C_2H_4O_2$ [D] $C_4H_8O_4$ [E] $C_6H_{12}O_6$

Worksheet: Calculating Empirical & Molecular Formulas

12. Acetylene gas is 92.3% carbon and 7.7% hydrogen (by mass), and its molar mass is 26 g/mol. What is its molecular formula?

    [A] C_2H_2 [B] CH_4 [C] CH [D] C_4H_4 [E] none of these

13. The empirical formula of a compound is known to be CH_2, and its molar mass is 56 g/mol. What is the molecular formula?

14. The empirical formula of a compound is CH_2O, and its mass is 120 amu/molecule. Calculate its molecular formula.

    [A] $C_3H_6O_3$ [B] $C_2H_4O_2$ [C] $C_4H_8O_4$ [D] CH_2O [E] none of these

15. A compound contains 12.8% C, 2.1% H, and 85.1% Br (by mass). Calculate the empirical formula and the molecular formula of this compound given that the molar mass is 188 g/mol.

16. A compound contains 10.13% C and 89.87% Cl (by mass). Determine both the empirical formula and the molecular formula of the compound given that the molar mass is 237 g/mol.

17. A certain compound has an empirical formula of NH_2O. Its molar mass is between 55 and 65 g/mol. Its molecular formula is

    [A] $N_2H_4O_2$ [B] $N_2H_2O_2$ [C] not calculable [D] NH_2O

18. A compound has a molar mass of 86 g/mol and has the percent composition (by mass) of 55.8% C, 37.2% O, and 7.0% H. Determine the empirical formula and the molecular formula.

19. A compound has a molar mass of 100 g/mol and the percent composition (by mass) of 65.45% C, 5.45% H, and 29.09% O. Determine the empirical formula and the molecular formula.

    [A] CHO and $C_6H_6O_6$ [B] CH_4O and $C_3H_{12}O_3$ [C] C_3HO and $C_6H_2O_2$

    [D] CH_2O and $C_4H_8O_4$ [E] C_3H_3O and $C_6H_6O_2$

20. The empirical formula for acetic acid is CH_2O. Its molar mass is 60 g/mol. The molecular formula is

    [A] C_2H_6O [B] CH_2O [C] $C_2H_4O_2$ [D] C_2HO_2 [E] none of these

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7. Determine the empirical formula of a compound containing 54.2% F and 45.8% S (by mass).

   SF_2

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    La_2O_7

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C_2H_3O

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[D] CH_2O and $C_4H_8O_4$ [E] C_3H_3O and $C_6H_6O_2$

#20 $(C\times1)+(H\times2)+(O\times1)=12+2+16=30$

$60/30=2$ → $C_2H_4O_2$

Worksheet: Calculating Empirical & Molecular Formulas

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[A] C_2H_6O [B] CH_2O [C] $C_2H_4O_2$ [D] C_2HO_2 [E] none of these

(2) $85.6\,g\,C\times\frac{1\,mol}{12\,g}=7.13\,mol$ /// $14.4\,g\,H\times\frac{1\,mol}{1.01\,g}=14.26\,mol$

$\frac{14.26}{7.13}=\frac{H}{C}=\frac{2}{1}\rightarrow C_1H_2\rightarrow CH_2$

(3) $12.1\,g\,C\times\frac{1\,mol}{12.0\,g}=1.01\,mol$ $16.2\,g\,O\times\frac{1\,mol\,O}{16.0\,g\,O}=1.01\,mol\,O$

$71.7\,g\,Cl\times\frac{1\,mol}{35.45\,g}=2.02\,mol$ $C_{1.01}O_{1.01}Cl_{2.02}$

$C_1O_1Cl_2$ $COCl_2$

(4) $40.0\,g\,C\times\frac{1\,mol}{12\,g}=3.33\,mol$ /// $6.7\,g\,H\times\frac{1\,mol}{1.01\,g}=6.63\,mol$

$53.3\,g\,O\times\frac{1\,mol}{16\,g}=3.33\,mol$ $\frac{H}{C}=\frac{H}{O}=\frac{6.63}{3.33}\approx\frac{2}{1}$

$C_1H_2O_1$ CH_2O

(5) $25.9\,g\times\frac{1\,mol}{14\,g}=1.85\,mol\,N$ /// $74.06\,g\times\frac{1\,mol}{16\,g}=4.63\,mol\,O$

$\frac{O}{N}=\frac{4.63}{1.85}=\frac{2.5}{1}=\frac{5}{2}$ N_2O_5

(6) $18.29\,g\,H\times\frac{1\,mol\,H}{1.01\,g\,H}=18.1\,mol\,H$ $81.71\,g\,C\times\frac{1\,mol}{12.0\,g}=6.81\,mol$

$\frac{H}{C}=\frac{18.1}{6.81}=2.66=2\frac{2}{3}=\frac{8}{3}$ C_3H_8

(7) $54.2\text{g F} \times \frac{1\text{ mol F}}{19.0\text{ g F}} = 2.85\text{ mol F}$ /// $45.8\text{g S} \times \frac{1\text{ mol S}}{32.1\text{g S}} = 1.43\text{ mols}$

$\frac{2.85}{1.43} = \frac{F}{S} = \frac{2}{1} \rightarrow S_1F_2 \rightarrow SF_2$

---

(8) $40.68\text{g C} \times \frac{1\text{ mol}}{12\text{ g}} = 3.39\text{ mol C}$ /// $54.20\text{g O} \times \frac{1\text{ mol}}{16\text{g}} = 3.39\text{ mol}$

$5.12\text{g H} \times \frac{1\text{ mol H}}{1.01\text{ g H}} = 5.07\text{ mol H}$ ///

$\frac{C}{O} = \frac{3.39}{3.39} = \frac{1}{1}$ $\frac{5.07}{3.39} = \frac{H}{C} = \frac{1.5}{1} = \frac{3}{2}$

$C_2H_3O_2$

1 : 1.5 ratio

1 : 1 ratio

---

(9) $50.04\text{g C} \times \frac{1\text{ mol}}{12\text{g}} = 4.17\text{ mol}$ /// $5.59\text{g H} \times \frac{1\text{ mol H}}{1.01\text{g H}} = 5.53\text{ mol H}$

$44.37\text{g O} \times \frac{1\text{ mol O}}{16\text{ g O}} = 2.77\text{ mol O}$

$\frac{5.53}{2.77} = \frac{H}{O} = \frac{2}{1}$ /// $\frac{5.53}{4.17} = 1.33 = \frac{4}{3} = \frac{H}{C}$

$\frac{4.17}{2.77} = \frac{1.5}{1} = \frac{3}{2} = \frac{C}{O}$

$C_3H_4O_2$

3 : 4 ratio

2 : 1 ratio

---

(10) The compound is lanthanum oxide. "The oxide" refers to lanthanum oxide.

Total mass = mass of the oxide = 10.29g

− mass of lanthanum alone = 7.33g

mass of oxygen alone = 2.96g

$7.33\text{g} \times \frac{1\text{ mol}}{138.9\text{ g}} = 0.0528\text{ mol La}$

$2.96\text{g} \times \frac{1\text{ mol}}{16\text{ g}} = 0.185\text{ mol O}$

$\frac{0.185\text{ mol O}}{0.0528\text{ mol La}} = \frac{3.5}{1} = \frac{7}{2} = La_2O_7$

(11) $CH_2O = 12+2+16 = 30$ $\frac{150}{30} = 5$ $CH_2O \times 5 = C_5H_{10}O_5$

(12) $92.3g \times \frac{1mol}{12g} = 7.69 mol$ $7.7g\,H \times \frac{1mol}{1.01g} = 7.62 mol$

$\frac{C}{H} = \frac{7.69}{7.62} = 1.0 = \frac{1}{1}$ CH C_2H_2

(13) $CH_2 = 12+2 = 14$ $56/14 = 4$ C_4H_8

(14) $CH_2O = 12+2+16 = 30$ $\frac{120}{30} = 4$ $C_4H_8O_4$

---

(15) $12.8g\,C \times \frac{1mol}{12g} = 1.07 mol$ $2.1g\,H \times \frac{1mol}{1.01g} = 2.08 mol\,H$

$85.1g\,Br \times \frac{1\ mol}{79.9\ g} = 1.07\ mol$ $\frac{H}{Br} = \frac{2.08}{1.07} = 1.95 = \frac{2}{1}$

$\frac{H}{O} = \frac{1.07}{1.07} = \frac{1}{1}$

CH_2Br

---

(16) $10.13g\,C \times \frac{1\ mol}{12g} = 0.844\ mol$ $89.87g\,Cl \times \frac{1mol}{35.45g} = 2.54\ mol\,Cl$

$\frac{Cl}{C} = \frac{2.54}{0.844} = \frac{3}{1}$ CCl_3 = empirical formula

mass $= 12+(35.5\times3) = 118.35$

$\frac{237}{118.35} = 2$ C_2Cl_6

---

(17) $NH_2O = 14+2+16 = 32$

~~$32\times1=32$~~

$32\times2=64$ ← this is in between 55 and 65!

~~$32\times3=96$~~

$NH_2O \times 2 = N_2H_4O_2$

(18) $55.8\,g\,C \times \frac{1\,mol}{12\,g} = 4.65\,mol$ $\quad 7.0\,g\,H \times \frac{1\,mol}{1.01\,g} = 6.93\,mol$

$37.2\,g\,O \times \frac{1\,mol}{16\,g} = 2.325\,mol$

$C_{4.65}H_{6.93}O_{2.325}$ $\quad \frac{H}{O} = \frac{6.93}{2.325} = \frac{3}{1}$

$\frac{C}{O} = \frac{4.65}{2.325} = \frac{2}{1}$

$C_2H_3O_1$

$\frac{H}{C} = \frac{6.93}{4.65} = \frac{1.5}{1} = \frac{3}{2}$

C_2H_3O = e.f.

$C \times 2 = 24$
$H \times 3 = 3$
$+ O \times 1 = 16$
43

$\frac{86}{43} = 2$

$C_4H_6O_2$ = m.f.

(19) $65.45\,g\,C \times \frac{1\,mol}{12\,g} = 5.45\,mol$

$5.45\,g\,H \times \frac{1\,mol}{1.01\,g} = 5.40\,mol$

$29.10\,g\,O \times \frac{1\,mol}{16\,g} = 1.82\,mol$

$C_{5.45}H_{5.40}O_{1.82}$

$\frac{C}{H} = \frac{5.45}{5.40} = \frac{1}{1}$

$\frac{C}{O} = \frac{5.45}{1.82} = \frac{3}{1}$

$C_3H_3O_1$ $\quad C_3H_3O$

$C_6H_6O_2$ $\quad \frac{100}{55} = 1.82 =$ maybe 2, I guess

Hmmm....
I think that "100" was supposed to be "110"
Typo???

$C \times 3 = 36$
$H \times 3 = 3$
$+ O \times 1 = 16$
$55\,g/mol$

(20) See work on top of #20 question

Chapter 20 Worksheet: Redox

I. Determine what is oxidized and what is reduced in each reaction. Identify the oxidizing agent and the reducing agent, also.

1. $2Sr + O_2 \longrightarrow 2SrO$

2. $2Li + S \longrightarrow Li_2S$

3. $2Cs + Br_2 \longrightarrow 2CsBr$

4. $3Mg + N_2 \longrightarrow Mg_3N_2$

5. $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$

6. $Cl_2 + 2NaBr \longrightarrow 2NaCl + Br_2$

7. $Si + 2F_2 \longrightarrow SiF_4$

8. $2Ca + O_2 \longrightarrow 2CaO$

9. $Mg + 2HCl \longrightarrow MgCl_2 + H_2$

10. $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

---

11. Give the oxidation number of each kind of atom or ion.

    a. sulfate b. Sn c. S^{2-} d. Fe^{3+} e. Sn^{4+} f. nitrate g. ammonium

12. Calculate the oxidation number of chromium in each of the following.

    a. Cr_2O_3 b. $Na_2Cr_2O_7$ c. $CrSO_4$ d. chromate e. dichromate

13. Use the changes in oxidation numbers to determine which elements are oxidized and which are reduced in these reactions. (Note: it is not necessary to use balanced equations)

    a. $C + H_2SO_4 \longrightarrow CO_2 + SO_2 + H_2O$

    b. $HNO_3 + HI \longrightarrow NO + I_2 + H_2O$

    c. $KMnO_4 + HCl \longrightarrow MnCl_2 + Cl_2 + H_2O + KCl$

    d. $Sb + HNO_3 \longrightarrow Sb_2O_3 + NO + H_2O$

14. For each reaction in problem 13, identify the oxidizing agent and reducing agent.

15. Write half-reactions for the oxidation and reduction process for each of the following.

a. $Fe^{2+} + MnO_4^- \longrightarrow Fe^{3+} + Mn^{2+}$

b. $Sn^{2+} + IO_3^- \longrightarrow Sn^{4+} + I^-$

c. $S^{2-} + NO_3^- \longrightarrow S + NO$

d. $NH_3 + NO_2 \longrightarrow N_2 + H_2O$

16. Complet and balance each reaction using the half-reaction method.

a. $Fe^{2+} + MnO_4^- \longrightarrow Fe^{3+} + Mn^{2+}$

b. $Sn^{2+} + IO_3^- \longrightarrow Sn^{4+} + I^-$

c. $S^{2-} + NO_3^- \longrightarrow S + NO$

d. $NH_3 + NO_2 \longrightarrow N_2 + H_2O$

e. $Mn^{2+} + BiO_3^- \longrightarrow Bi^{2+} + MnO_4^-$

f. $I_2 + Na_2S_2O_3 \longrightarrow Na_2S_2O_4 + NaI$

Chapter 20 Worksheet: Redox **ANSWERS**

I. Determine what is oxidized and what is reduced in each reaction. Identify the oxidizing agent and the reducing agent, also.

1. $2Sr + O_2 \longrightarrow 2SrO$ Sr^0 to Sr^{2+}; oxidized/reducing agent O^0 to O^{2-}; reduced/ox. ag.

2. $2Li + S \longrightarrow Li_2S$ Li^0 to Li^{1+}; oxidized/red. ag. S^0 to S^{2-}; reduced/ox. ag.

3. $2Cs + Br_2 \longrightarrow 2CsBr$ Cs^0 to Cs^{1+}; oxidized/red. ag. Br^0 to Br^{1-}; reduced/ox. ag.

4. $3Mg + N_2 \longrightarrow Mg_3N_2$ Mg^0 to Mg^{2+}; oxidized/red. ag. N^0 to N^{3-}; reduced/ox. ag.

5. $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$ Fe^0 to Fe^{3+}; oxidized/red. ag. O^0 to O^{1-}; reduced/ox. ag.

6. $Cl_2 + 2NaBr \longrightarrow 2NaCl + Br_2$ Cl^0 to Cl^{1-}; reduced/ox. ag. Br^{1-} to Br^0; oxidized/red. ag.

7. $Si + 2F_2 \longrightarrow SiF_4$ Si^0 to Si^{4+}; oxidized/red. ag F^0 to F^{1-}; reduced/ox. ag.

9. $Mg + 2HCl \longrightarrow MgCl_2 + H_2$ Mg^0 to Mg^{2+}; oxidized/red. ag. H^{1+} to H^0; reduced/o.a.

10. $2Na + 2H_2O \longrightarrow 2NaOH + H_2$ Na^0 to Na^{1+}; oxidized/r.a. H^{1+} to H^0; reduced/o.a.

---

11. Give the oxidation number of each kind of atom or ion.

a. sulfate	b. Sn	c. S^{2-}	d. Fe^{3+}	e. Sn^{4+}	f. nitrate	g. ammonium
2-	**0**	**2-**	**3+**	**4+**	**1-**	**1+**

12. Calculate the oxidation number of chromium in each of the following.

a. Cr_2O_3	b. $Na_2Cr_2O_7$	c. $CrSO_4$	d. chromate	e. dichromate
3+	**6+**	**2+**	**7+**	**6+**

13. Use the changes in oxidation numbers to determine which elements are oxidized and which are reduced in these reactions. (Note: it is not necessary to use balanced equations)

a. $C + H_2SO_4 \longrightarrow CO_2 + SO_2 + H_2O$ C^0 to C^{4+}; oxidized S^{6+} to S^{4+}; reduced

b. $HNO_3 + HI \longrightarrow NO + I_2 + H_2O$ N^{5+} to N^{2+}; reduced I^{1-} to I^0; oxidized

c. $KMnO_4 + HCl \longrightarrow MnCl_2 + Cl_2 + H_2O + KCl$ Mn^{7+} to Mn^{2+}; reduced; Cl^{1-} to Cl^0; oxidized

d. $Sb + HNO_3 \longrightarrow Sb_2O_3 + NO + H_2O$ Sb^0 to Sb^{3+}; oxidized N^{5+} to N^{2+}; red.

14. For each reaction in problem 13, identify the oxidizing agent and reducing agent.

a. oxidizing agent: sulfur reducing agent: carbon
b. oxidizing agent: nitrogen reducing agent: iodine
c. oxidizing agent: manganese reducing agent: chlorine
d. oxidizing agent: nitrogen reducing agent: antimony

15. Write half-reactions for the oxidation and reduction process for each of the following.

a. $Fe^{2+} + MnO_4^- \longrightarrow Fe^{3+} + Mn^{2+}$

$Fe^{2+} \longrightarrow Fe^{3+}$; oxidation $Mn^{7+} \longrightarrow Mn^{2+}$; reduction

b. $Sn^{2+} + IO_3^- \longrightarrow Sn^{4+} + I^-$

$Sn^{2+} \longrightarrow Sn^{4+}$; oxidation $I^{5+} \longrightarrow I^{1-}$; reduction

c. $S^{2-} + NO_3^- \longrightarrow S + NO$

$S^{2-} \longrightarrow S$; oxidation $N^{5+} \longrightarrow N^{2+}$; reduction

d. $NH_3 + NO_2 \longrightarrow N_2 + H_2O$

$N^{3-} \longrightarrow N^0$; oxidation $N^{4+} \longrightarrow N^0$; reduction

16. Complete and balance each reaction using the half-reaction method.

a. $Fe^{2+} + MnO_4^- \longrightarrow Fe^{3+} + Mn^{2+}$

$[Fe^{2+} \longrightarrow Fe^{3+} + 1e^-] \times 5$

$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

$\Big\}\ 5Fe^{2+}_{(aq)} + MnO_4^-{}_{(aq)} + 8H^+_{(aq)} \longrightarrow 5Fe^{3+}_{(aq)} + Mn^{2+}_{(aq)} + 4H_2O_{(l)}$

b. $Sn^{2+} + IO_3^- \longrightarrow Sn^{4+} + I^-$

$6H^+_{(aq)} + 3Sn^{2+}_{(aq)} + IO_3^-{}_{(aq)} \longrightarrow 3Sn^{4+}_{(aq)} + I^-_{(aq)} + 3H_2O_{(l)}$

c. $S^{2-} + NO_3^- \longrightarrow S + NO$

$8H^+_{(aq)} + 3S^{2-}_{(aq)} + 2NO_3^-{}_{(aq)} \longrightarrow 3S_{(s)} + 2NO_{(g)} + 4H_2O_{(l)}$

d. $NH_3 + NO_2 \longrightarrow N_2 + H_2O$

$8NH_{3(g)} + 6NO_{2(g)} \longrightarrow 7N_{2(g)} + 12H_2O_{(l)}$

e. $Mn^{2+} + BiO_3^- \longrightarrow Bi^{2+} + MnO_4^-$

$3Mn^{2+}_{(aq)} + 5BiO_3^-{}_{(aq)} + 6H^+_{(aq)} \longrightarrow 5Bi^{2+}_{(aq)} + 3MnO_4^-{}_{(aq)} + 3H_2O_{(l)}$

f. $I_2 + Na_2S_2O_3 \longrightarrow Na_2S_2O_4 + NaI$

$Na_2S_2O_{3(aq)} + H_2O_{(l)} + I_{2(s)} + 2Na^+_{(aq)} \longrightarrow Na_2S_2O_{4(aq)} + 2H^+_{(aq)} + 2NaI_{(aq)}$

14.E: Oxidation-Reduction Reaction (Exercises)

Exercises (Oxidation-Reduction Reactions)

1. Is this reaction a redox reaction? Explain your answer. $2K(s) + Br_2(\ell) \rightarrow 2KBr(s)$
2. Is this reaction a redox reaction? Explain your answer. $2NaCl(aq) + Pb(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + PbCl_2(s)$
3. Which substance loses electrons and which substance gains electrons in this reaction? $2Mg(s) + O_2(g) \rightarrow 2MgO$
4. Which substance loses electrons and which substance gains electrons in this reaction? $16Fe(s) + 3S_8(s) \rightarrow 8Fe_2S_3(s)$
5. Which substance is oxidized and which substance is reduced in this reaction? $2Li(s) + O_2(g) \rightarrow Li_2O_2(s)$
6. Which substance is oxidized and which substance is reduced in this reaction? $2Fe(s) + 3I_2(s) \rightarrow 2FeI_3(s)$
7. What are two different definitions of oxidation?
8. What are two different definitions of reduction?
9. Assign oxidation numbers to the atoms in each substance.
   a. P_4
   b. SO_3
   c. SO_3^{2-}
   d. $Ca_3(PO_3)_2$
10. Assign oxidation numbers to the atoms in each substance.
    a. PCl_5
    b. $(NH_4)_2Se$
    c. Ag
    d. Li_2O_2
11. Assign oxidation numbers to the atoms in each substance.
    a. NO
    b. NO_2
    c. $CrCl_2$
    d. $CrCl_3$
12. Assign oxidation numbers to the atoms in each substance.
    a. NaH
    b. N_2O_3
    c. NO_2^-
    d. $CuNO_3$
13. Assign oxidation numbers to the atoms in each substance.
    a. CH_2O
    b. NH_3
    c. Rb_2SO_4
    d. $Zn(C_2H_3O_2)_2$
14. Assign oxidation numbers to the atoms in each substance.

a. C_6H_6
b. $B(OH)_3$
c. Li_2S
d. Au

15. Identify what is being oxidized and reduced in this redox reaction by assigning oxidation numbers to the atoms. $2NO + Cl_2 \rightarrow 2NOCl$

16. Identify what is being oxidized and reduced in this redox reaction by assigning oxidation numbers to the atoms. $Sr + SO_3 \rightarrow SrSO_3$

17. Identify what is being oxidized and reduced in this redox reaction by assigning oxidation numbers to the atoms. $2KrF_2 + 2H_2O \rightarrow 2Kr + 4HF + O_2$

18. Identify what is being oxidized and reduced in this redox reaction by assigning oxidation numbers to the atoms. $SO_3 + SCl_2 \rightarrow SOCl_2 + SO_2$

19. Identify what is being oxidized and reduced in this redox reaction by assigning oxidation numbers to the atoms. $2Rb + MgCl_2 \rightarrow 2RbCl + Mg$

20. Identify what is being oxidized and reduced in this redox reaction by assigning oxidation numbers to the atoms. $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$

Answers

1. yes because oxidation numbers are changing

3. lose: Mg; gain: O

5. oxidized: Li; reduced: O

7. increase in oxidation number; loss of electrons

9.

a. P: 0
b. S: +6; O: −2
c. S: +4; O: −2
d. Ca: +2; P: +3; O: −2

11.

a. N: +2; O: −2
b. N: +4; O: −2
c. Cr: +2; Cl: −1
d. Cr: +3; Cl: −1

13.

a. C: 0; H: +1; O: −2
b. N: −3; H: +1
c. Rb: +1; S: +6; O: −2
d. Zn: +2; C: 0; H: +1; O: −2

15. oxidized: N; reduced: Cl

17. oxidized: O; reduced: Kr

19.oxidized: Rb; reduced: Mg

Worksheet #2 **Redox Half Reactions and Reactions**

1. State the Oxidation Number of each of the elements that is underlined.

a) $\underline{N}H_3$ _____ b) $H_2\underline{S}O_4$ _____

c) $Zn\underline{S}O_3$ _____ d) $\underline{Al}(OH)_3$ _____

e) $\underline{Na}$ _____ f) $\underline{Cl}_2$ _____

g) $Ag\underline{N}O_3$ _____ h) $\underline{Cl}O_4^-$ _____

i) $\underline{S}O_2$ _____ j) $K_2\underline{Cr}_2O_4$ _____

k) $Ca(\underline{Cl}O_3)_2$ _____ l) $K_2\underline{Cr}_2O_7$ _____

m) $H\underline{P}O_3^{2-}$ _____ n) $H\underline{Cl}O$ _____

o) $\underline{Mn}O_2$ _____ p) $K\underline{Cl}O_3$ _____

q) $\underline{Pb}O_2$ _____ r) $\underline{Pb}SO_4$ _____

s) $K_2\underline{S}O_4$ _____ t) $\underline{N}H_4^+$ _____

u) $Na_2\underline{O}_2$ _____ v) $\underline{Fe}O$ _____

w) $\underline{Fe}_2O_3$ _____ x) $Si\underline{O}_4^{4-}$ _____

y) $Na\underline{I}O_3$ _____ z) $\underline{Cl}O_3^-$ _____

aa) $\underline{N}O_3^-$ _____ bb) $\underline{Cr}(OH)_4$ _____

cc) $Ca\underline{H}_2$ _____ dd) $\underline{Pt}(H_2O)_5(OH)^{2+}$ _____

ee) $Fe(H_2O)_6^{3+}$ _____ ff) CH_3COOH _____

2. What is the oxidation number of carbon in each of the following substances?

a) CO _____ b) C _____