Montsaye ACADEMY
Excellence Resilience Aspiration

KS4 Year 11 Higher Trilogy Homework Booklet

Term 3

Homework 1	**Q1 and Q2** exam question -- prepare answer at home, **complete in class, marked by teacher**
Homework 2	**Q3 and Q4** exam question - complete at home bring to class to be self/peer marked
Homework 3	**Q5 and Q6 -** exam question – complete at home bring to class to be self/peer marked
Homework 4	**Q7 and Q8 -** exam question - complete at home bring to class to be self/peer marked
Homework 5	**Q9 and Q10 -** exam question - complete at home bring to class to be self/peer marked
Homework 6	**Q11 and Q12 -** exam question – prepare answer at home, complete in class, marked by teacher

Homework 1 - Q1. A single-celled organism has a large surface area to volume ratio.

(a) How does oxygen enter a single-celled organism?

Tick (✓) **one** box.

Active transport ☐

Diffusion ☐

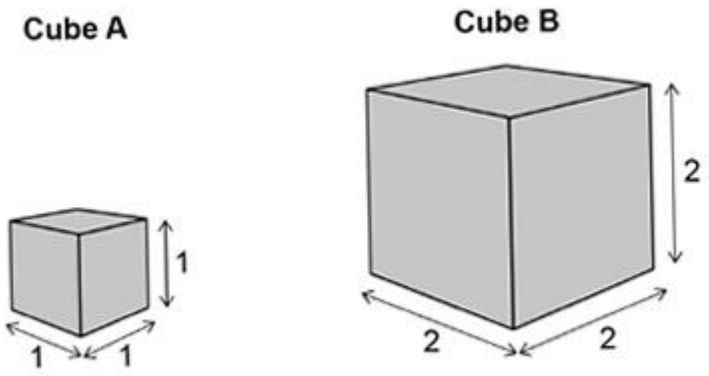
Osmosis ☐

(1)

Figure 1 shows two cubes.

The surface area to volume ratio for cube **A** is 6:1

Figure 1



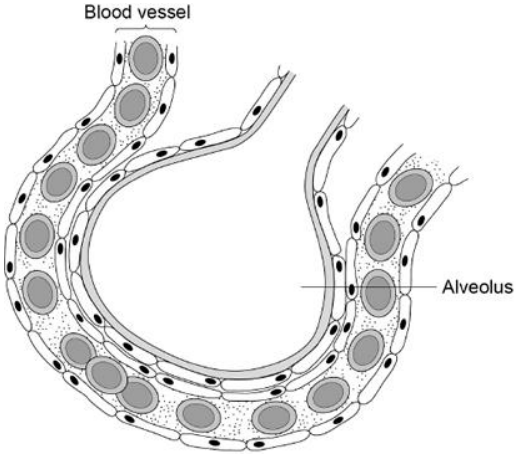
(b) Calculate the surface area to volume ratio of cube **B**.

(4)

Multicellular organisms have exchange surfaces to absorb substances.

Figure 2 shows part of the exchange surface in the lungs.

Figure 2



(c) Oxygen passes from the alveolus into the blood.

Name the part of the blood that carries the most oxygen.

(1)

(d) Name the gas that passes out of the blood into the alveolus.

(1)

(e) Alveoli provide a large surface area for gas exchange.

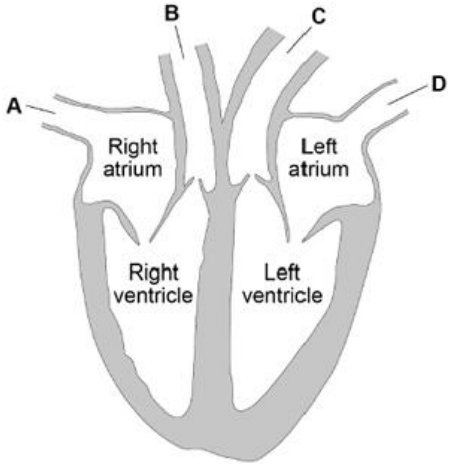
Give **two** other ways the lungs are adapted for efficient gas exchange.

(2)

(Total 9 marks)

Homework 1 - Q2.

The diagram shows a human heart.



(a) Which blood vessel carries deoxygenated blood away from the heart to the lungs?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(b) The natural resting heart rate is controlled by a group of cells that act as a pacemaker.

Where in the heart are 'pacemaker cells' found?

Tick (✓) **one** box.

- Left atrium ☐
- Left ventricle ☐
- Right atrium ☐
- Right ventricle ☐

(1)

Some people may be treated with a drug to slow their heart rate.

(c) Digitalis is a drug that slows the heart rate.

Where does the drug digitalis originate from?

Tick (✓) **one** box.

- Bacteria ☐
- Foxgloves ☐
- Mould ☐
- Willow ☐

(1)

Beta blockers are another type of drug that slows the heart rate.

The table shows information for people who do not take beta blockers and for people who do take beta blockers.

- Stroke volume is the volume of blood pumped out of the heart each time it beats.
- Cardiac output is the total volume of blood pumped out of the heart each minute.

	No beta blockers taken		**Taking beta blockers**	
	At rest	**During exercise**	**At rest**	**During exercise**
Heart rate in beats per minute	68	150	52	88
Stroke volume in cm^3	80	120	**X**	98
Cardiac output in cm^3 per minute	5440	18 000	2800	8624

(d) Calculate stroke volume **X** in the table above.

Use the equation:

cardiac output = stroke volume × heart rate

Give your answer to 2 significant figures.

(3)

(e) Some people who take beta blockers get out of breath when they exercise.

Explain why beta blockers can have this effect during exercise.

You should refer to information given in the table in part (d).

(6)

(Total 12 marks)

Homework 2 . Q3 . This question is about Group 1 elements.

(a) Sodium reacts with chlorine to produce sodium chloride. Balance the equation for the reaction.

$$\_\_\_\_\_\ Na + Cl_2 \rightarrow \_\_\_\_\_\ NaCl$$

(1)

(b) 4.6 g of sodium reacts with chlorine to produce 11.7 g of sodium chloride.

What mass of chlorine reacted?

(1)

(c) A teacher puts hot sodium into a gas jar of chlorine.

The changes seen before, during and after this reaction were observed.

Complete the sentences. Choose the answers from the box.

colourless	**green**	**lilac**	**silver**	**white**
		yellow		

Sodium is a _____ solid.

Chlorine is a _____ gas.

The hot sodium burns with a _____ flame.

The product sodium chloride is a _____ solid.

(4)

(d) Sodium chloride (NaCl) is an ionic compound.

Write the formulae of the ions in sodium chloride.

(2)

(e) Complete the sentence.

Choose the answer from the box.

an atom	**an electron**	**a neutron**	**a proton**

Potassium is more reactive than sodium.

This is because potassium loses _____ more easily than sodium.

(1)

(f) How does the size of a potassium atom compare with the size of a sodium atom?

Give a reason for your answer.

(2)

(Total 11 marks)

Homework 2. Q4.

Magnesium and hydrochloric acid react to produce magnesium chloride and hydrogen.

(a) Give the test for hydrogen gas.

Give the result of the test if hydrogen gas is present.

(2)

(b) During the reaction between magnesium and hydrochloric acid, hydrogen ions form hydrogen molecules.

The half equation for this process is:

$$2\ H^+ + 2e^- \longrightarrow H_2$$

What type of reaction does this half equation show?

Give the reason for your answer.

(2)

(c) 0.72 g of magnesium reacted completely with dilute hydrochloric acid.

The equation for the reaction is:

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

Calculate the mass of magnesium chloride produced.

Relative atomic masses (A_r): Mg = 24 Cl = 35.5

(4)

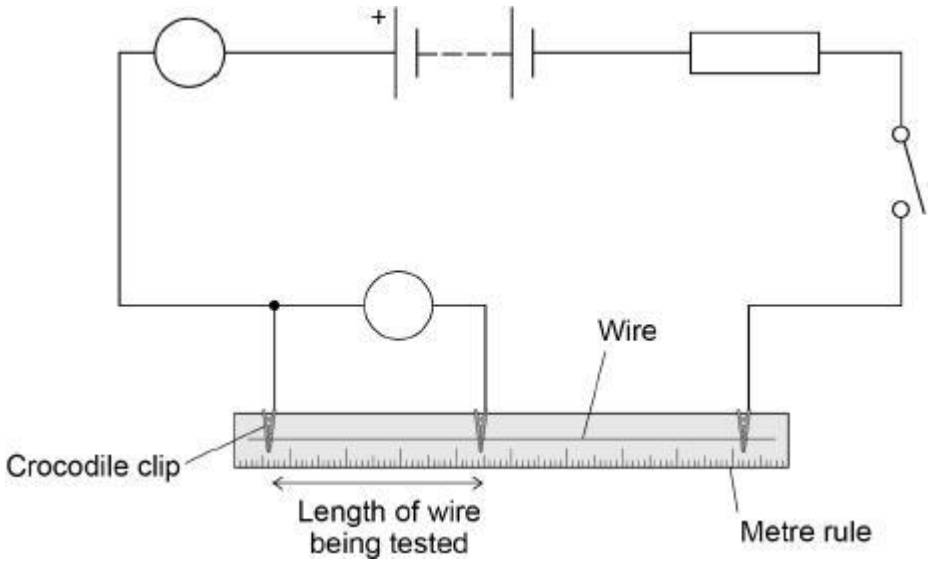
(Total 8 marks)

Homework 3 Q5.

A student investigated how the resistance of a wire varies with the length of the wire.

Figure 1 shows the circuit used.

Figure 1



(a) The symbols for the voltmeter and ammeter in **Figure 1** are **not** complete.

Complete the symbols for the voltmeter and ammeter in **Figure 1**.

(1)

(b) Which variable is the independent variable?

Tick (✓) **one** box.

The current in the wire ☐

The length of the wire being tested ☐

The resistance of the wire ☐

The thickness of the wire ☐

(1)

(c) Which variable is the dependent variable?

Tick (✓) **one** box.

The current in the wire ☐

The length of the wire being tested ☐

The resistance of the wire ☐

The thickness of the wire ☐

(1)

(d) The student took repeat readings of potential difference for a 30 cm length of the wire.

The readings were:

0.16 V 0.17 V 0.15 V

Calculate the mean potential difference.

(2)

The length of the wire was increased to 60 cm

The current in the wire was 0.50 A

The mean potential difference across the wire was 0.32 V

(e) Calculate the resistance of the 60 cm length of wire.

Use the equation:

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

(2)

(f) Calculate the power dissipated in the 60 cm length of wire.

Use the equation:

power = potential difference × current

(2)

(g) Calculate the charge flow when there is a current of 0.50 A in the wire for 17 s

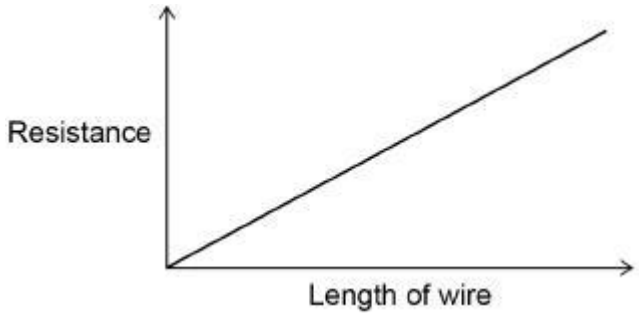
Use the equation:

charge flow = current × time

(2)

(h) **Figure 2** is a sketch graph of the results.

Figure 2



The student repeated the investigation using a thicker wire made from the same metal. For the same length, the thicker wire has a lower resistance.

Draw a line on **Figure 2** to show how the resistance of the thicker wire varies with length.

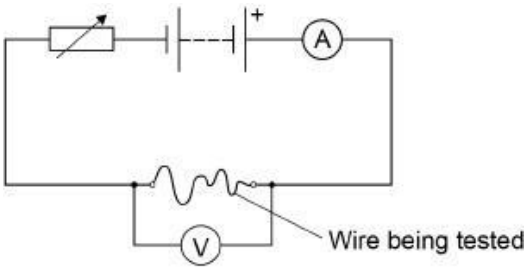
(1)

(Total 12 marks)

Homework 3 - Q6.

A student investigated how the resistance of a piece of wire varies with its length.

(a) The diagram below shows the circuit used.



Explain why the student needed to adjust the variable resistor each time she changed the length of the wire.

(3)

(b) The student recorded three measurements of the potential difference across a 0.10 m length of wire.

The table below shows the results.

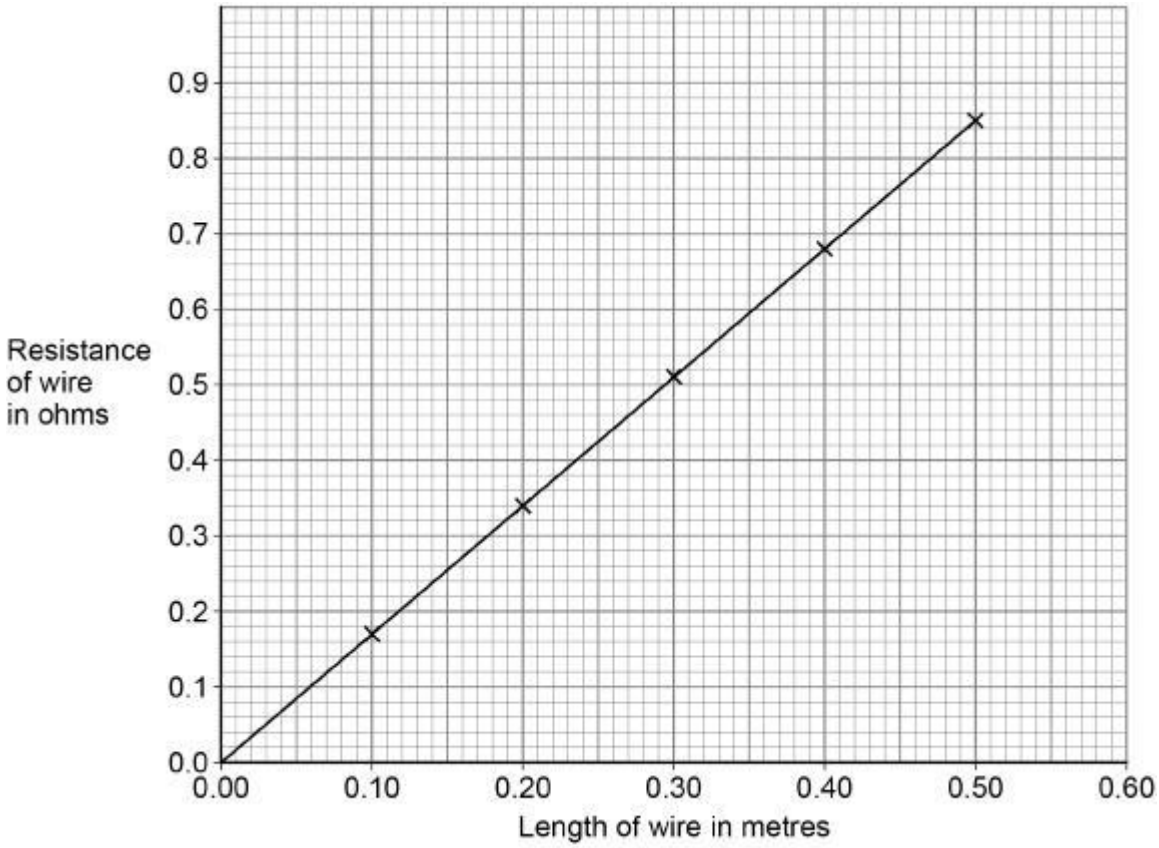
Length in m	**Potential difference in V**			
	1	2	3	Mean
0.10	**X**	0.18	0.15	0.17

Calculate **X** in table above.

(2)

(c) **Figure 1** shows the results for five different lengths of the wire.

Figure 1



Describe the relationship between the length of the wire and the resistance of the wire.

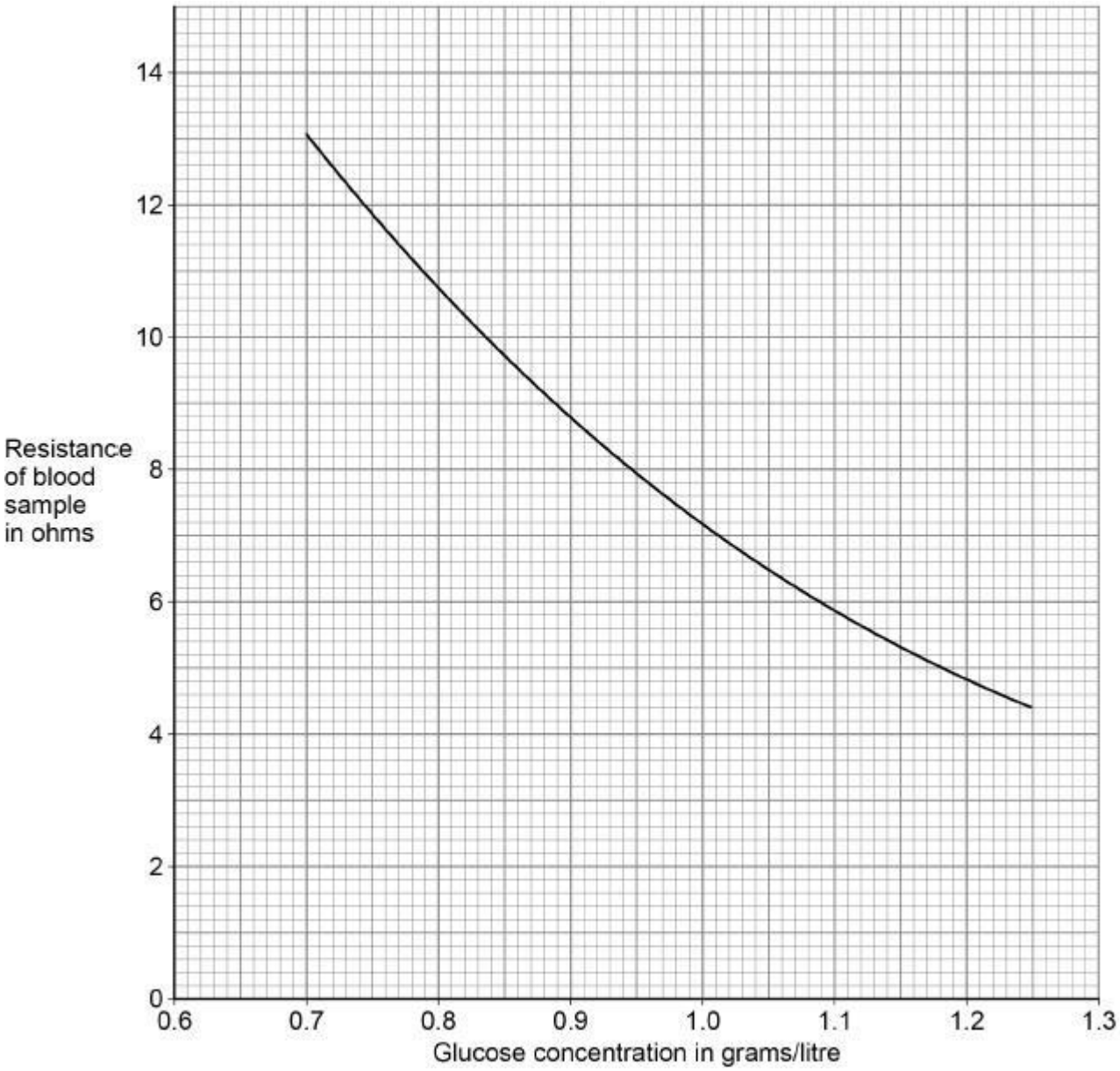
(2)

A glucometer uses the resistance of a blood sample to calculate the glucose concentration in a person's blood.

A blood sample is put into a small tube, which is put inside the glucometer. The blood then acts like a resistance wire.

Figure 2 shows the relationship between the resistance of a blood sample and the glucose concentration.

Figure 2



(d) The glucometer applies a potential difference of 0.90 volts across a blood sample.

The glucose concentration of the blood sample is 0.98 grams/litre.

Determine the current in the blood sample.

(4)

(e) A new tube is used each time a blood sample is tested.

Explain why valid results are only obtained if each tube is identical.

(2)

(Total 13 marks)

Homework 4 Q7.

Bacteria and viruses can cause communicable diseases.

(a) Bacterial cells are different from animal cells.

Which structure is found in bacterial cells and **not** in animal cells?

Tick (✓) **one** box.

- Cell membrane ☐
- Mitochondrion ☐
- Nucleus ☐
- Plasmid ☐

(1)

(b) Which scientific process uses part of bacterial cells?

Tick (✓) **one** box.

- Breeding programmes ☐
- Genetic engineering ☐
- Selective breeding ☐
- Stem cell treatment ☐

(1)

(c) The table below lists four communicable diseases.

Which diseases are caused by a bacterium and which are caused by a virus?

Put **one** tick in each row.

One row has been completed for you.

Disease	Caused by a bacterium	Caused by a virus
Measles		✓
Gonorrhoea		
AIDS		
Salmonella		

(2)

(d) A virus causes measles.

Give **three** symptoms of measles.

(3)

(e) Bacteria can be killed with antibiotics.

Give **one** problem linked to the overuse of antibiotics.

(1)

(f) A fungus causes an infection called athlete's foot.

- The fungus infects the skin.
- The fungus grows in moist, warm conditions.

Describe how athlete's foot can be transmitted from one person to another person.

(2)

(g) Bacteria and viruses can enter the body through the nose and mouth.

Describe how mucus and cilia in the trachea prevent most of these pathogens from reaching the lungs.

Mucus _____

Cilia _____

(2)

(Total 12 marks)

Homework 4. Q8.

Lipids are an essential part of our diet.

(a) Describe how a student could test a food for lipids and the positive result for the test.

(2)

A high concentration of cholesterol in the blood has been linked with coronary heart disease (CHD).

(b) Name the type of drug used to reduce the concentration of cholesterol in the blood.

(1)

(c) A new CHD drug has been trialled to reduce the concentration of cholesterol in the blood.

Patients were given the new CHD drug or a placebo.

One possible side effect of the new CHD drug is an increased risk of diabetes.

The table below shows some of the results.

	Group 1: New CHD drug	**Group 2: Placebo**
Number of patients	12 562	12 541
Number of patients developing diabetes during the trial	636	606

Calculate the difference between the percentage of patients developing diabetes in group 1 compared to group 2.

Give your answer to 3 significant figures.

(4)

(d) The new CHD drug causes liver cells to remove more cholesterol from the blood.

Explain how the drug could reduce the risk of CHD.

(4)

(e) Give **three** factors doctors should consider when they plan to use a new drug with a patient.

Do **not** refer to cost in your answer.

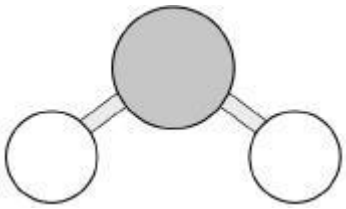
(3)

(Total 14 marks)

Homework 5 Q9.

This question is about substances with covalent bonding.

(a) The diagram below shows a ball and stick model of a water molecule (H_2O).



Suggest **one** limitation of using a ball and stick model for a water molecule.

(1)

(b) Ice has a low melting point.

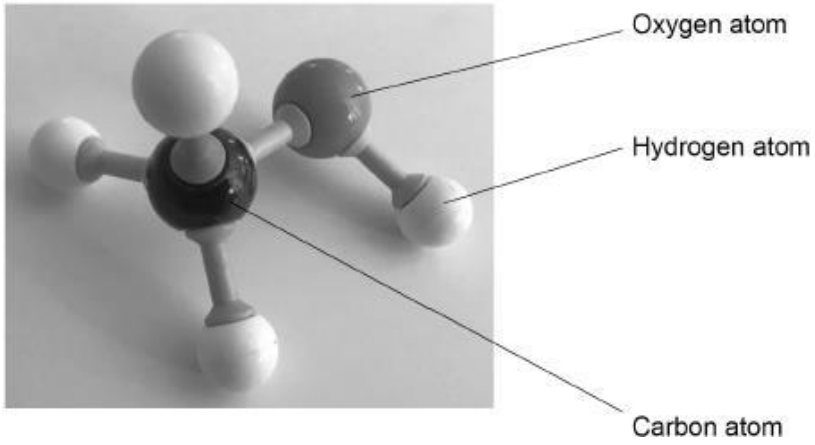
Water molecules in ice are held together by intermolecular forces.

Complete the sentence.

Ice has a low melting point because the intermolecular forces are _____.

(1)

(c) The image below shows the structure of a molecule.



What is the molecular formula of the molecule in the above image?

(1)

Diamond has a giant covalent structure.

(d) What is the number of bonds formed by each carbon atom in diamond?

Tick (✓) **one** box.

2 ☐ 3 ☐ 4 ☐ 8 ☐

(1)

(e) Give **two** physical properties of diamond.

(2)

(f) Name **two** other substances with giant covalent structures.

(2)

(Total 8 marks)

Homework 5 - Q10.

This question is about bonds.

(a) Compare the bonding in hydrogen gas (H_2) with the bonding in copper metal.

(4)

(b) Hydrogen reacts with oxygen to produce water.

The equation for the reaction is:

$$2\ H_2 + O_2 \longrightarrow 2\ H_2O$$

The energy released in forming new bonds is 486 kJ/mol greater than the energy needed to break the existing bonds.

The table below shows some bond energy values.

Bond	Bond energy in kJ/mol
H–H	**Y**
O=O	498
O–H	464

Y is the bond energy of a H–H bond.

Calculate **Y**.

(5)

(Total 9 marks)

Homework 6. Q11.

Between 1951 and 1992 the USA tested nuclear weapons in a desert.

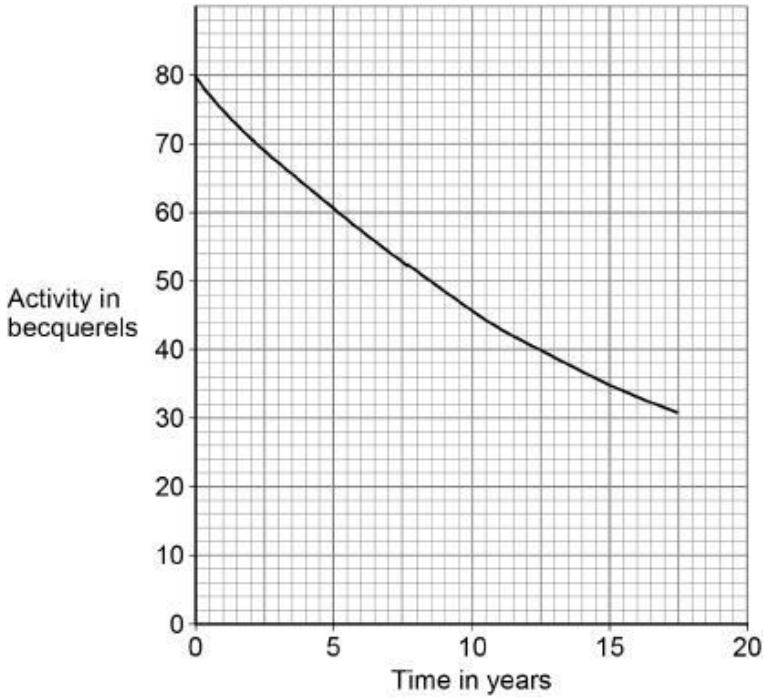
(a) Complete the sentence. Choose the answer from the box.

contamination	**irradiation**	**ionisation**	**decay**

Radioactive dust from the nuclear weapons testing settled on the desert. This is called radioactive _____.

The desert now contains radioactive tritium.

The graph below shows how the activity of the tritium in a sample taken from the desert changed with time.



(1)

(b) The sample was collected from the desert in 1992.

Determine the activity of the tritium in the sample in 2007.

(2)

(c) How much time did it take for the activity of the tritium in the sample to decrease from 80 Bq to 40 Bq?

(1)

(d) What is the half-life of tritium?

(1)

(e) The sample started with 45 billion atoms of tritium.

After 4 years the sample had 36 billion atoms of tritium.

Calculate the percentage of the tritium in the sample that remained after 4 years.

(2)

(f) A scientist determined the activity of a sample of tritium every minute for 3 minutes.

The table below shows the results.

Time in minutes	**Activity in Bq**
0	149
1	151
2	148
3	152

Why do the activity readings in table vary?

Tick (✓) **one** box.

Radioactive decay is a random process.	☐
Temperature changes affect the radioactive decay.	☐
The number of radioactive nuclei keeps increasing and decreasing.	☐

(1)

(g) What safety precaution should scientists take when working with radioactive materials in a laboratory?

Tick (✓) **one** box.

Tie long hair back before handling the materials.	☐
Use long tongs to handle the materials.	☐
Wear safety goggles when handling the materials.	☐

(1)

(h) Studies show that children born near the area of the desert containing tritium were more likely to develop cancer.

It is important that the results from these studies are checked by other scientists.

What is this process called?

Tick (✓) **one** box.

Experiment review	☐
Peer review	☐
Results review	☐
Test review	☐

(1)

(Total 10 marks)

Homework 6 - Q12.

Lanthanum-140 is a radioactive isotope.

(a) A nucleus of lanthanum-140 emits gamma radiation.

What happens to the mass number and the charge of the nucleus when gamma radiation is emitted?

Tick (✓) **one** box.

Mass number	**Charge**	
Decreases	Decreases	☐
Decreases	Stays the same	☐
Stays the same	Decreases	☐
Stays the same	Stays the same	☐

(1)

(b) Why is it difficult to detect gamma radiation?

(1)

(c) Activity is the rate at which a radioactive source decays.

A teacher measured the count-rate from a sample of lanthanum-140 using a Geiger-Muller (G-M) tube.

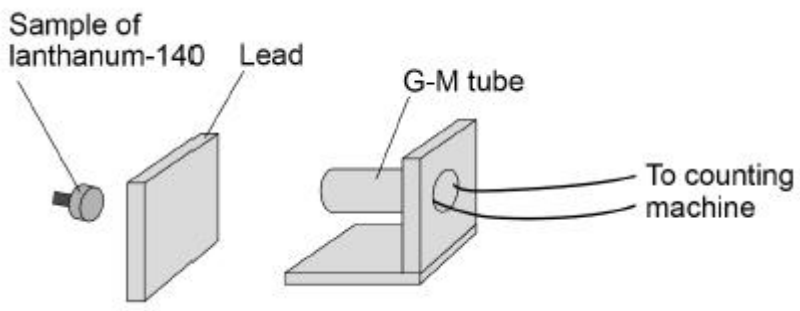
Explain why the count rate was less than the activity of the sample of lanthanum-140

(2)

The teacher investigated how the thickness of lead affected the amount of gamma radiation that could pass through it.

Figure 1 shows the apparatus.

Figure 1



(d) Explain why the teacher stood as far away from the apparatus as possible.

(2)

The table shows the results.

Thickness of lead in cm	Count rate in counts per second
0.5	110
1.0	60
1.5	33
2.0	18
2.5	10

(e) The teacher concluded that the count rate was **not** inversely proportional to the thickness of lead.

Explain why the teacher was correct.

Use the data in the table above.

(3)

(f) Lanthanum-140 can also emit beta radiation and change into cerium.

Complete the equation showing the decay of lanthanum (La) 140 into cerium (Ce).

$$^{140}_{57}\text{La} \longrightarrow {}^{\ \ }_{\ \ }\text{e} + {}^{\ \ }_{\ \ }\text{Ce}$$

(2)

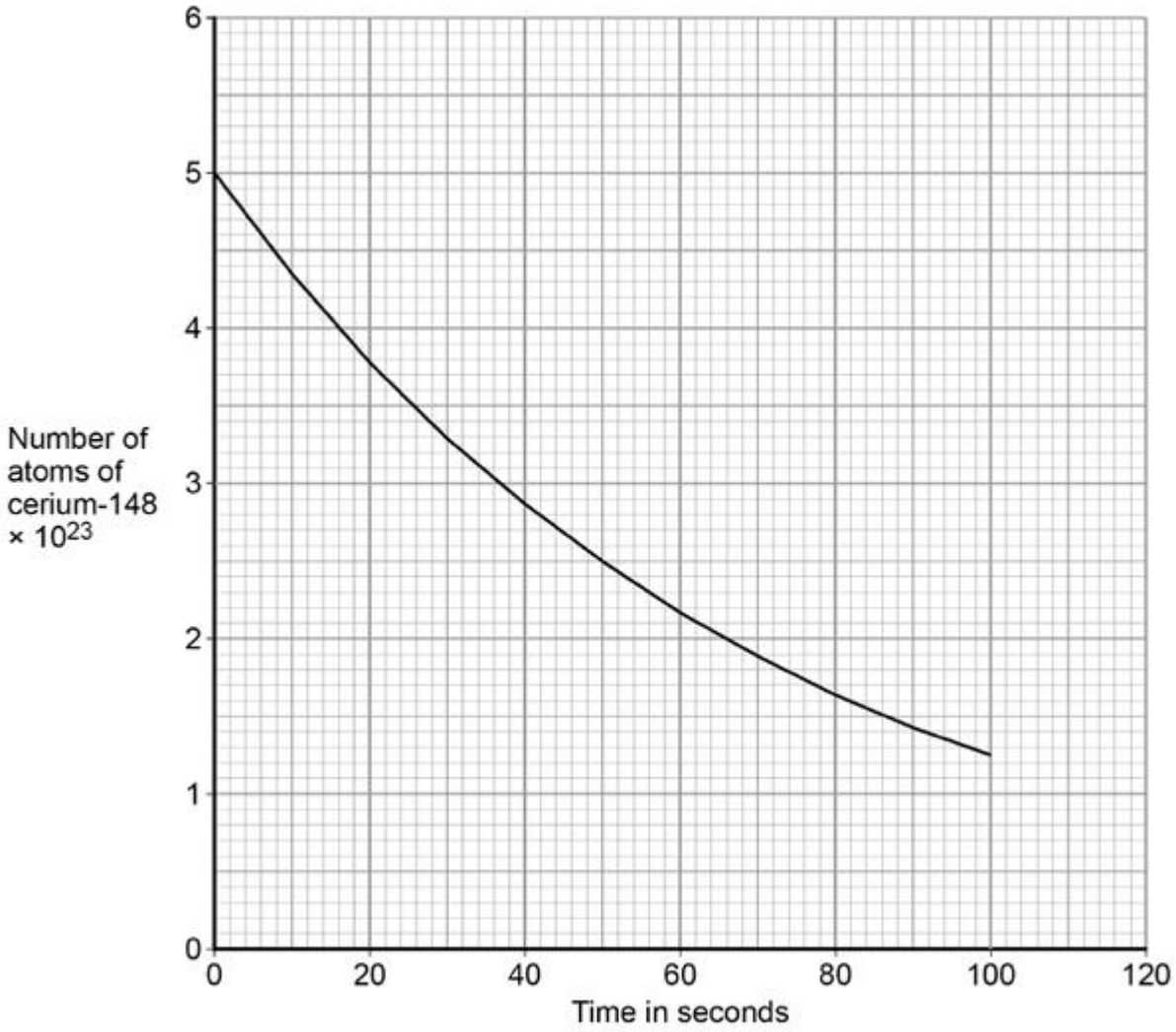
There are other isotopes of cerium which are radioactive.

Different isotopes of cerium have different half-lives.

The half-life of an isotope can be found by studying how the number of atoms changes over time.

Figure 2 shows how the number of atoms of cerium-148 in a 120 g sample changes over time.

Figure 2



(g) Determine the ratio of the number of cerium atoms in the sample when it was 100 seconds old compared with when the sample was 350 seconds old.

Use data from **Figure 2**.

(4)

(h) Determine the activity of the sample of cerium when the sample was 20 seconds old.

Use **Figure 2**.

(3)

(Total 18 marks)