Extended Homework Task – Physics P6 & P7

Aiming for Grade 8 Name ……

Please hand in a completed printed version at the end of the topic

P6 Molecules and matter

A scientist investigates the change in mass of different liquids. She puts 100 cm^3 of a liquid in a dish in a fume cupboard and leaves it for 10 minutes. Here is a table showing the data she collects. Complete the final column of the table.

Liquid	Mass of dish (g)	Mass of dish + liquid at start of 10 minutes (g)	Mass of dish + liquid at end of 10 minutes (g)	Change in mass of liquid (g)
water	100.0	110.0	109.6	
acetone	100.0	115.7	114.0	
methanol	100.0	114.0	113.2	

B Plot an appropriate graph of the data.

Part 3: Gas pressure

Here is some data from an experiment to measure the pressure of a gas as the volume decreases. Two of the measurements are missing.

Volume (cm^3)	Pressure (kPa)
160	25
80	50
40	
20	200
10	

a Suggest how you can obtain data like this.
b Complete the table with the missing readings.
c Plot a graph of pressure against volume.
d Describe the pattern in your results.

C Here is some data from an experiment to measure the pressure of a gas as the temperature increases.

Temperature (°C)	Pressure (kPa)
–150	36.0
–100	46.4
–50	56.7
0	62.1
50	77.5
100	88.0

a Plot a graph of this data.
b Identify the outlier in this experiment.

Questions

Change of state

4 Explain why you chose to plot the type of graph that you did for this data.

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(*1 mark*)

5 **a** Put the liquids in order from the liquid with the lowest specific latent heat to the liquid with the highest specific latent heat.

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(*1 mark*)

b Use the definition of specific latent heat to explain the order in part **a**. State any assumptions that you made.

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(*2 marks*)

6 **a** The specific latent heat of acetone is 518 kJ/kg. Calculate the change in thermal energy of acetone in this experiment. Make sure that you use standard units in your calculation.

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(*4 marks*)

b Use your answer to part **a** to calculate the specific latent heat of water and methanol. State any assumptions that you make.

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(*5 marks*)

7 Here is some information about refrigerators.

> *Liquids are used in the back of a refrigerator to keep it cool. The liquid is pumped around pipes inside and outside the refrigerator. The liquid evaporates when it is inside the pipes inside the refrigerator, and is changed back to a liquid by a compressor. Running the compressor is expensive.*

Suggest and explain whether the liquid should have a low or a high specific latent heat of vaporisation.

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(*6 marks*)

Part 3: Gas pressure

8 Explain how a gas exerts a pressure on a surface.

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..... (*2 marks*)

9 a i Describe and explain the relationship between the pressure and volume of a gas.

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..... (*4 marks*)

ii Use the data to show that pV = constant.

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iii Use your calculations in part **ii** to find the pressure when the volume is 450 cm^3.

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b i Describe and explain the relationship between the pressure and temperature of a gas.

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ii Extrapolate the line on the graph to find the temperature when the pressure is zero.

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iii Suggest and explain what happens to the gas molecules as you approach this temperature. (Note: you cannot actually do this.

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P7 Radioactivity – Aiming for Grade 8

Nuclear fusion:

You are going to estimate how long the Sun will shine based on the fact that that the Sun's energy source is nuclear fusion. Here are some facts about the Sun.

- The mass of the Sun is 2×10^{30} kg
- Only 75% of the Sun is hydrogen
- The mass of a proton is 1.667×10^{-27} kg
- Number of protons needed for a fusion reaction = 4
- The mass of 4 protons is 6.693×10^{-27} kg
- The mass on one helium nucleus is 6.645×10^{-27} kg
- Energy = mass difference × (speed of light)^2
- The luminosity of the Sun is about 4×10^{26} W which means that it radiates 4×10^{26} J/s

You could do the calculation in 3 parts:

A Calculate the number of fusion reactions given the mass of the Sun and the proton, and the number of protons needed for each reaction.

B Calculate the energy produced in each fusion reaction using $E = mc^2$.

C Calculate the energy released in total, then use the energy radiated by the Sun each second to find the time. Convert this to billions of years.

Part 3: Half-life, using radioactivity and risk

Questions

Part 1: Radiation and atoms

1 a Compare alpha and beta radiation.

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b Compare alpha and gamma radiation.

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2 The atomic number of thorium is 90. Use the periodic table to write a balanced decay equation for each of the following:

a the decay of thorium-229 by alpha decay.

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b the decay of thorium-231 by beta decay.

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3 Describe and explain the difference between the decay equations in question 2 and the decay equation for an isotope that decays by emitting gamma radiation.

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4 Explain how a nucleus can emit an electron when it only contains protons and neutrons.

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Part 2: Modelling the atom and fission, and calculating with fusion

5 One of the most important experiments was the Geiger and Marsden experiment.

a Describe what Geiger and Marsden did in this experiment.

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b Describe the observations that they made.

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..... (*2 marks*)

c Explain why these observations changed ideas about the atom.

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6 Describe the evidence that led to the change from Rutherford's model to Bohr's model.

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8 Describe and explain one other idea in science that has changed over time. Include the evidence that led to the change in your answer

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9 Suggest two differences between the way that Geiger and Marsden worked and the way that scientists work to investigate sub-atomic particles today.

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10 Only elements where $90 \leq Z \leq 100$, and isotopes with $2 \times Z - N = 43 \pm 2$ undergo fission when they absorb a neutron, where Z is the atomic number and *N* is the number of neutrons.

a Write down what this means in words, and in terms of protons and neutrons. Use your periodic table to look up the elements mentioned.

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b Use this information to suggest improvements to your model.

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c Suggest how you could extend your model to explain where the energy comes from in a fission reaction.

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11 Explain the difference between a nuclear reaction, a chain reaction, and a chemical reaction.

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12 Suggest how your teacher could model a chain reaction with some tall matches and a tray of sand. Include a risk assessment for your teacher in your answer.

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14 The Sun is halfway through its lifecycle, and was formed about 5 billion years ago.

a Suggest how much longer it will shine for, based on your calculation.

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(*1 mark*)

b Scientists estimate that the Sun will shine for about another 5 billion years. Suggest what fraction of the protons in the Sun are actually involved in fusion reactions.

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(*1 mark*)

15 It is not possible for the Sun to use coal as a fuel.

a Give one reason why.

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(*1 mark*)

b Burning one kilogram of coal produces 5×10^6 joules. Use this information to calculate how long the Sun would last if it was made entirely of coal and produced the energy per second that it produces.

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(*4 marks*)

c Comment on your answer to part **b** in the light of the age of the Sun.

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(*1 mark*)

Part 3: Half-life, using radioactivity and risk

17 **a** Use this data to plot a graph and find the half-life of a radioactive source.

Time (hours)	Count rate (counts/min)
0	510
0.5	414
1.0	337
1.5	276
2.0	227
2.5	188

(*6 marks*)

b Use the half-life to calculate the activity after 6 half-lives.

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(*2 marks*)

18 Compare the use of radioisotopes for investigation and for the control or destruction of unwanted tissue.

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19 Discuss two of the main ways of reducing risk when you are using radioactive materials with patients in a hospital.

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20 A doctor has a choice of various isotopes to use in an investigation into the working of a patient's kidneys. Here is a lists of the possible isotopes she can use.

Name	Type of emitter	Half life
technetium-95m	gamma	61 days
technetium-96	gamma	4.3 days
technetium-98	beta, gamma	4 200 000 years
technetium-99	beta	210 000 years
technetium-99m	gamma	6 hours

Write down and explain which isotope the doctor should use.

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21 Describe one thing that you can do to reduce the risk of a build-up of radioactive gas in your house.

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