Extended Homework Task – Physics P6 & P7

Aiming for Grade 6 Name ……

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

P6 Molecules and matter

Part 2: Change of state

A 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 the graph of this data. Start your temperature scale at –250 °C.

b Identify the outlier in this experiment.

Part 1: Modelling density

a Mercury is a liquid metal and it is much denser than water. Suggest why.

..... (*1 mark*)

b Explain why metals float on mercury but do not float on water.

.....

..... (*2 marks*)

Part 2: Change of state

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

..... (*1 mark*)

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

..... (*1 mark*)

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

.....

.....

..... (*3 marks*)

7 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.

.....

.....

.....

..... (*4 marks*)

Part 3: Gas pressure

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

.....

..... (*2 marks*)

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

.....

.....

.....

..... (*4 marks*)

ii Use the data to show that pV = constant.

.....

.....

.....

..... (*2 marks*)

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

.....

.....

..... (*2 marks*)

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

.....

.....

.....

..... (*4 marks*)

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

..... (*1 mark*)

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

.....

..... (*2 marks*)

P7 Radioactivity – Aiming for Grade 6

Nuclear fusion:

The Sun shines because of 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. Complete the calculation below.

First, you calculate the number of protons (hydrogen nuclei) in the Sun that can undergo fusion.

A The mass of the Sun is 2×10^{30} kg, but only 75% of the Sun is hydrogen, so

the mass of hydrogen $= 2 \times 10^{30}$ kg $\times 0.75 =$ _____ kg

B The mass of a proton is 1.667×10^{-27} kg. So, the number of protons

$= \dfrac{\text{Your answer to A}}{\text{mass of a proton}} = \dfrac{\text{Your answer to A}}{1.667 \times 10^{-27}} =$

$=$ _____ $=$ _____ protons

C You need 4 protons to make one helium nucleus in a fusion reaction. So the number of fusion reactions that you can have with this number of protons

$= \dfrac{\text{Your answer to B}}{4} =$ _____ $\div 4 =$ _____ reactions

Next you work out the energy produced in one fusion reaction.

D The mass of 4 protons (hydrogen nuclei) is 6.693×10^{-27} kg

The mass of one helium nucleus is 6.645×10^{-27}kg

The difference in mass between the helium nucleus and the 4 protons

$= 6.693 \times 10^{-27}$ kg $- 6.645 \times 10^{-27}$ kg $=$ _____ kg.

E energy $=$ mass $\times$ (speed of light)^2. So, the energy released when this mass is converted to energy in one fusion reaction

$=$ [your answer to D] $\times$ (speed of light)$^2 =$ _____

$=$ _____ $\times (3 \times 10^8)^2 =$ _____ J.

Finally, you work out the energy released by all the hydrogen nuclei, and the lifetime of the Sun.

F Total energy released in fusion $=$ energy per reaction $\times$ number of reactions

$=$ [your answer to E] $\times$ [your answer to C] $=$ _____ J.

G The luminosity of the Sun is about 4×10^{26} W which means that it radiates 4×10^{26} joules per second. So the lifetime of the Sun

$\dfrac{\text{Your answer to F}}{4 \times 10^{26}\ \text{J/s}} =$ _____ $\div 4 \times 10^{26}\ \text{J/s} =$ _____ s.

H. Convert your answer to G to years.

Part 3: Half-life, using radioactivity and risk

Questions

Part 1: Radiation and atoms

1 **a** Compare alpha and beta radiation.

.....

.....

.....

..... (*4 marks*)

b Compare alpha and gamma radiation.

.....

.....

.....

..... (*4 marks*)

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.

..... (*3 marks*)

b the decay of thorium-231 by beta decay.

..... (*3 marks*)

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.

.....

..... (*2 marks*)

7 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.

..... (*1 mark*)

b Scientists estimate that the Sun will shine for about another 5 billion years, and know that only hydrogen in the core of the Sun (about 10% of the total hydrogen) undergoes fusion. Suggest how this would affect your calculation.

.....

.....

..... (*2 marks*)

Part 3: Half-life, using radioactivity and risk

9 **a** Use this data to plot a graph and find the half-life of a radioactive source. (*6 marks*)

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

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

.....

.....

..... (*2 marks*)

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

.....

.....

.....

.....

.....

.....

..... (6 *marks*)

11 Describe two things that doctors do to reduce the risk of radiation damage when they use radioactive material to investigate organs.

.....

..... (*2 marks*)

12 Describe two things that doctors do to reduce the risk of radiation damage when they use radioactive material to kill cancer cells.

.....

..... (*2 marks*)

13 Name one other person who is at risk from damage from radiation, and suggest one thing they can do to reduce the risk.

.....

..... (*2 marks*)

14 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.

.....

.....

..... (*3 marks*)

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

..... (*1 mark*)