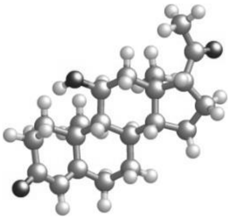

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Name: …………………… (   )

Class: ………………

Date: …… / …… / ……

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<u>Assignment on Kinetic Particle Theory</u> – Answers

Question 1:

Box A in **Figure 1** shows the arrangement of particles in a *solid*:

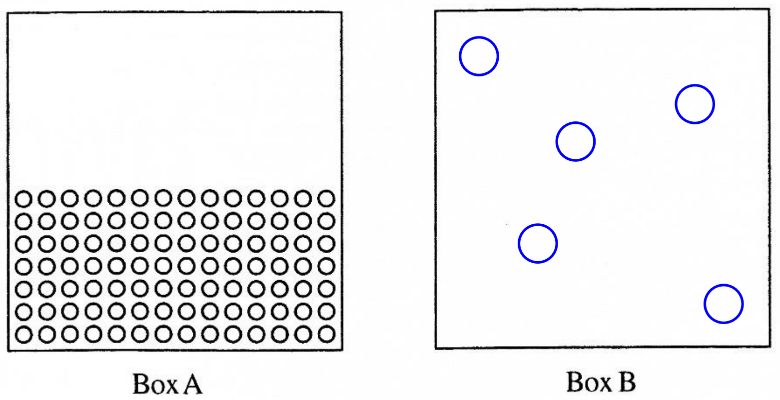

Figure 1.

a) Describe how the particles are arranged in a *solid*:

The particles are close packed **($^1/_2$ mark)** in a regular / ordered arrangement **($^1/_2$ mark)**.

The particles vibrate about fixed positions in the solid **($^1/_2$ mark)**.

The force of attraction between the particles is strong **($^1/_2$ mark)**.

(2 marks)

b) State the general properties of a *liquid*:

Liquids have a fixed volume **($^1/_2$ mark)** but no fixed shape **($^1/_2$ mark)** – a liquid will take-up the shape of its container.

Liquids cannot be compressed **($^1/_2$ mark)** and only expand slightly on heating **($^1/_2$ mark)**.

(2 marks)

c) Complete **Box B** in **Figure 1** to show how the particles are arranged in a *gas*.

(1 mark)

Question 2:

a) Carbon dioxide (CO_2) and hydrogen (H_2) are both gases at room temperature and pressure.

i) Calculate the relative molecular mass of carbon dioxide (CO_2):

Relative molecular mass of CO_2 = 12.0 + 16.0 + 16.0 = 44.0 (no units)

(1 mark)

ii) Calculate the relative molecular mass of hydrogen (H_2):

Relative molecular mass of H_2 = 1.0 + 1.0 = 2.0 (no units)

(1 mark)

b) **Figure 2** shows the start of an experiment using gas jars of hydrogen and carbon dioxide:

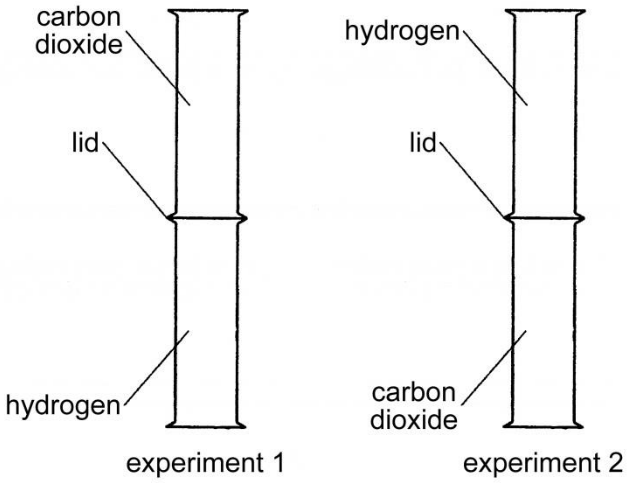

Figure 2.

The lids are removed so that the gases are allowed to mix. How will the contents of the gas jars change? Your answer should refer to:

- How the amounts of hydrogen and carbon dioxide change in the gas jars.
- The speed of movement of the gases in each experiment.
- The reasons for each change.

Both hydrogen and carbon dioxide will diffuse from a region of high concentration to a region of low concentration. Therefore, hydrogen will diffuse into the gas jar of carbon dioxide and carbon dioxide will diffuse into the gas jar of hydrogen **(1 mark)**. This occurs because particles of the two gases are in a constant state of random motion. Eventually, the amounts (concentrations) of hydrogen and carbon dioxide will reach the same constant value throughout the apparatus (the system has reached equilibrium) **(1 mark)**. The hydrogen will diffuse at a faster rate than carbon dioxide because the hydrogen has a smaller relative molecular mass than the carbon dioxide **(1 mark)**. Due to the effect of gravity, the rates at which hydrogen and carbon dioxide diffuse in **Experiment 2** will be slower that those observed in **Experiment 1**. In **Experiment 2** the high density carbon dioxide gas will tend to remain in the lower gas jar while the low density hydrogen gas will tend to remain in the upper gas jar **(1 mark)**.

(4 marks)

Question 3:

Figure 3 shows the apparatus for measuring the rates of diffusion of gases. The times taken for 100 cm^3 of some gases at room temperature and pressure to diffuse from this apparatus are shown in **Table 1**:

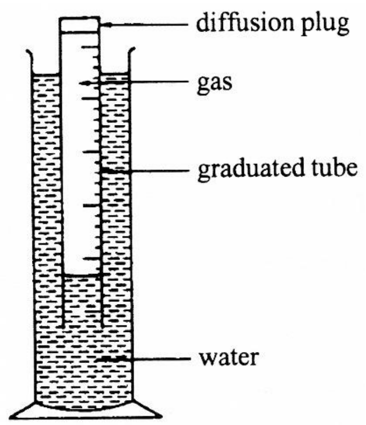

Figure 3.

Gas	Time / s
Carbon Monoxide – CO	132
Chlorine – Cl_2	211
Methane – CH_4	100
Nitrogen – N_2	?
Oxygen – O_2	141

Table 1.

a) Which gas diffuses the fastest?

CH_4 (this is called *methane*).

b) Why does this gas diffuse the fastest?

Compared to the other gases, CH_4 has the smallest relative molecular mass.

c) Suggest the time that 100 cm^3 nitrogen would take to diffuse out from the apparatus.

132 s. N_2 will take the same time to diffuse as CO as they have the same relative molecular mass.

d) Name a gas which will diffuse faster than any of the gases shown in the table.

Hydrogen (H_2) or helium (He).

e) Why is this apparatus unsuitable for finding the rate of diffusion of ammonia gas?

Ammonia gas is very soluble in water. It would dissolve in the water instead of diffusing through the porous plug.

(5 marks)

Question 4:

Figure 4 shows the heating curve for a pure substance recorded at atmospheric pressure:

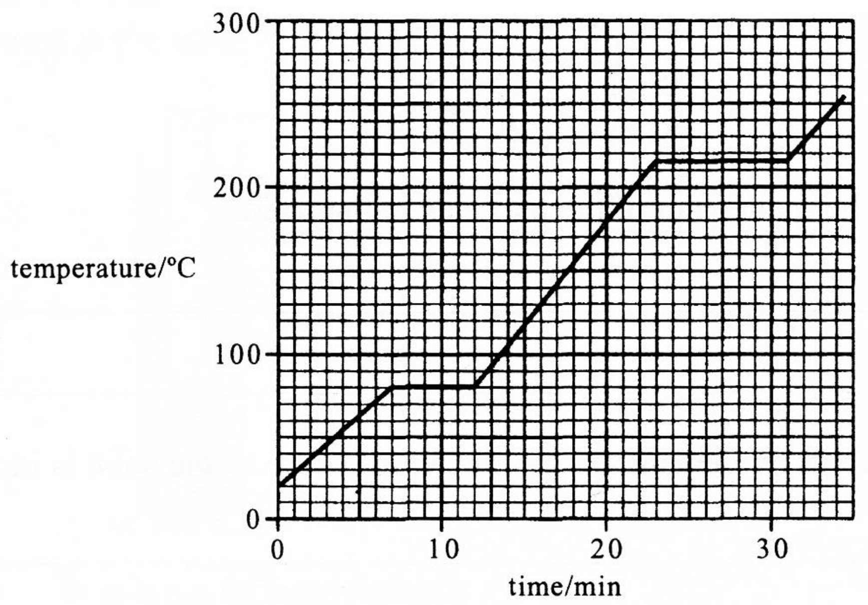

Figure 4.

a) What is the melting point of the substance?

80 °C.

b) What happens to the temperature while the substance changes state?

It remains *constant*.

c) What happens to the force of attraction between the particles while the substance changes state?

The force of attraction between the particles is weakened.

d) Explain why the substance cannot be water.

Pure water will melt at 0 °C and boil at 100 °C. This substance melts at 80 °C and boils at 215 °C.

(4 marks)

+++ End of Class Test +++

Periodic Table

The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	64 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	– Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57 *	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	– Po polonium 84	– At astatine 85	– Rn radon 86
– Fr francium 87	– Ra radium 88	– Ac actinium 89 †															

*58-71 Lanthanoid series

†90-103 Actinoid series

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	– Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	162 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	– Pa protactinium 91	238 U uranium 92	– Np neptunium 93	– Pu plutonium 94	– Am americium 95	– Cm curium 96	– Bk berkelium 97	– Cf californium 98	– Es einsteinium 99	– Fm fermium 100	– Md mendelevium 101	– No nobelium 102	– Lr lawrencium 103

Key

a X b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number