RADLEY

2022 Scholarship Examination Paper

COMBINED SCIENCE

CHEMISTRY

Time allowed – 30 min

Total marks: 30

PLEASE WRITE IN BLACK INK

1. Matter around us exists in three major states: solid, liquid and gas.

a) Sketch a representation that represents the arrangement of particles in

(i) a solid

[1]

(ii) a liquid

[1]

(iii) a gas

[1]

b) Describe the major differences between arrangement and behaviour of particles in the solid state and those in the gaseous state.

[2]

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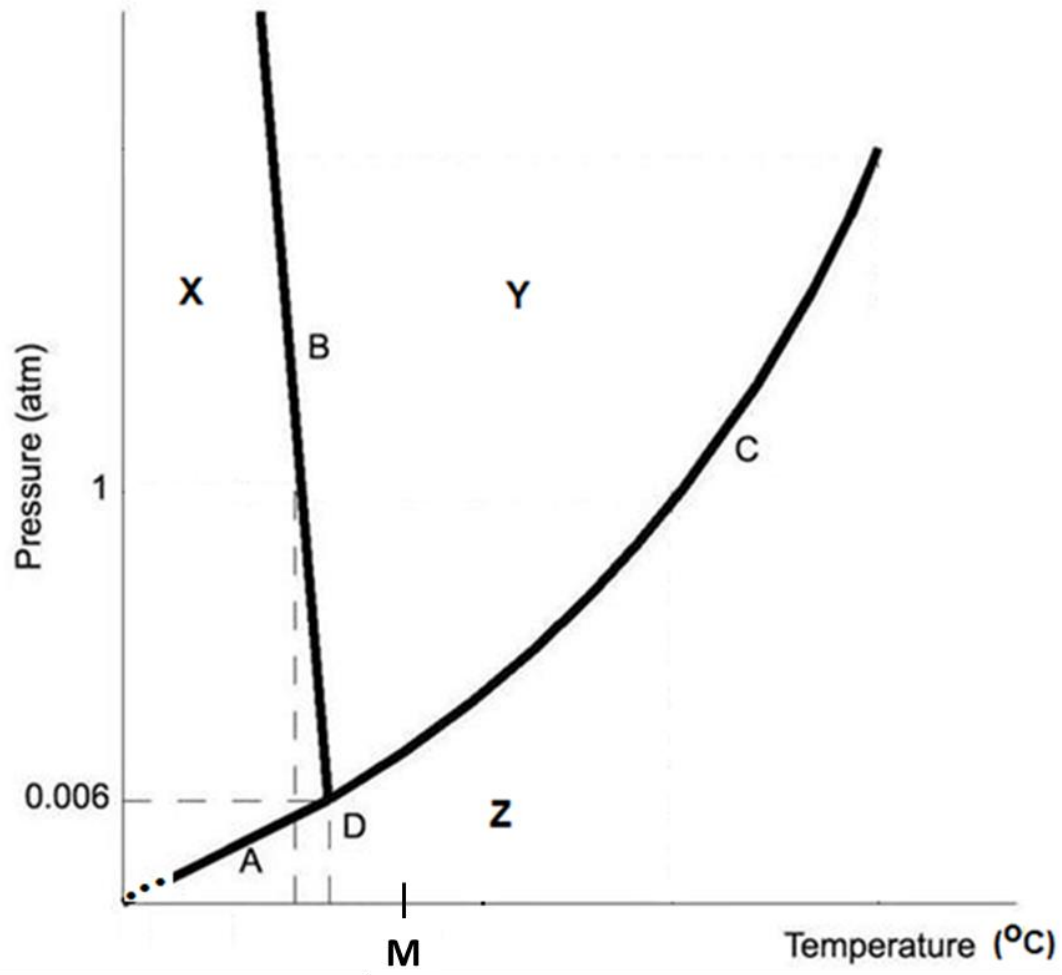
2. Given below is a phase diagram that shows you the states of matter of water at certain pressures and temperatures. Phase diagrams can be useful information for chemists. The thick lines, A, B and C, indicate a phase change: solid <--> liquid, etc.

The areas between the curves, labelled X, Y and Z, represent the state of matter of the water at a particular pressure and temperature. For example, the area labelled 'Y' is the liquid state.



a) On the graph above indicate the temperature at which water freezes under normal/ambient pressure. Write the correct number in the correct place on the x-axis.

[1]

b) On the graph above indicate the usual temperature at which water boils. Write the correct number in the correct place on the x-axis. You must use construction lines to score full marks.

[2]

c) Suggest the states of matter present in areas labelled

[1]

X: …..... and Z: …..

d) Suggest the name for the change of states of matter as the temperature increases as represented by the curves labelled:

[2]

A: …....., B: …..... and C: …..

e) The point labelled D is called the triple point. Suggest which state of matter is present at point D.

[1]

……

f) Predict how the state of matter **changes** when you increase the pressure from 0.006 atm to 2 atm at the temperature M.

[1]

……

g) Explain what happens, in terms of the particles, when the substances undergoes the change of state when the pressure is changed from 0.006 atm to 2 atm at the temperature M.

[1]

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h) Explain, in terms of particles, the **change** of state when water is warmed from a very low to a very high temperatures below a pressure of 0.006 atm.

[2]

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3. Water is arguably the single most important compound on Earth to supports life (of course, there are other important substances, too).

a) Why is water called a compound?

[1]

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b) Water can be made by direct synthesis from its elements hydrogen, H_2, and oxygen, O_2. Write a balanced chemical equation for this reaction.

[2]

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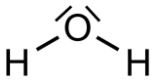
c) Water can be graphically represented as



where each line represents two electrons. This type of bonding is known as covalent bonding where the atoms share electrons with their neighbours. It is the attraction of these negatively charged electrons to the neighbouring nuclei that holds the atoms together.

(i) Predict the charge of the nucleus?

[1]

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(ii) How many electrons are shown on the diagram above.

[1]

……

(iii) How many electron pairs hold the atoms in the water molecule together?

[1]

……

d) When a puddle of water is left on the desk it will soon disappear.

(i) What do you call this process?

[1]

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(ii) Suggest a reason why water disappears without boiling it.

[1]

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4. The unit for temperature is usually quoted in degrees Celsius (°C). Scientist often use another unit which is Kelvin, K. The Kelvin is also called the absolute temperature where the lowest attainable temperature is 0 K. The temperature at absolute zero (0 K) corresponds well enough to 273 °C.

a) State the temperature at absolute zero in units of degrees Celsius, °C.

[1]

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b) State the temperature in units of Kelvin at 25 °C.

[1]

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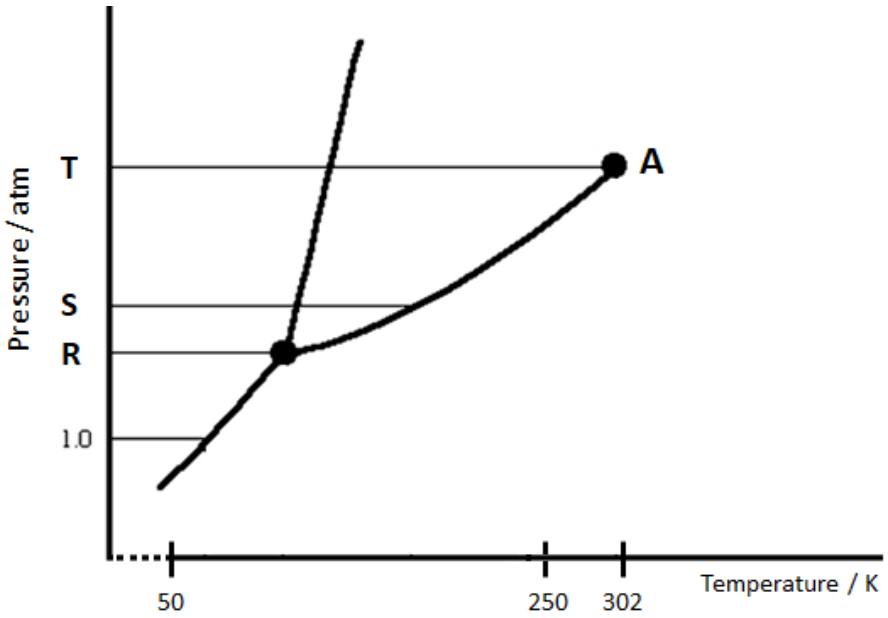
c) The phase diagram of another substance is shown below. The curves separate three areas of the three states of matter. Label these three areas in the diagram.



(i) The substance is at its triple point.

Label the triple point in the diagram above with TP and **predict** which change of conditions (temperature / pressure) will convert the substance into a solid?

[2]

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(ii) Predict the **change** of state when the substance is first pressurised from 1 atm to a pressure **S** at 250 K and then cooled to 50 K.

[1]

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(iii) One of the phase border curve ends at point A (at 302 Kelvin). Suggest the state the substance may be in at a temperature of above 302 K.

[1]

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