Name: …….. **Prep School: ……**

4 Questions [33 marks]

RADLEY

2017 Scholarship Examination Paper

Chemistry

Time Allowed - 30 minutes

1.

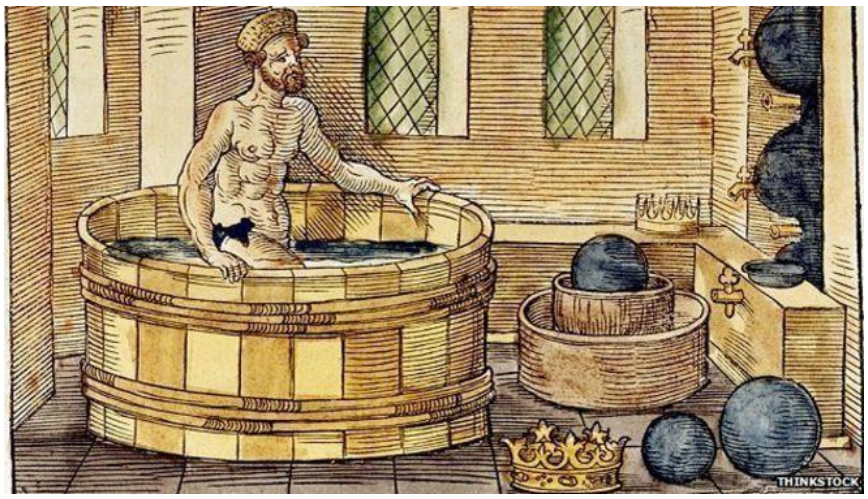


Fig. 1

Gold has always been a very valuable commodity. Archimedes, *Fig 1*, was famed for having recognised that pure gold could be discerned from fake substitutes by measuring its density. Pure gold has a density of 19.3g/cm^3. This is very unusually dense; in antiquity, no other metal came close and so forgeries using lesser metals could quickly be identified.

Today, chemists have identified several elements that are denser than gold and substantially cheaper. This opens the door to modern day forgeries.

a. Gold is a metal. Name three properties of gold that are common to most metals.

……

……

……

[3]

b. Gold is found native, in its elemental state, in nature. Does this suggest that it is at the top or bottom of the reactivity series, and why?

……

……

……

[2]



Fig. 2

Recently, fake gold bars have been found containing large slabs of the element tungsten, surrounded by thin layer of pure gold. Tungsten is cheaper than gold, and has a density of 19.6g/cm^3. One bar, *Fig. 2*, had a volume of 50cm^3 and was found to have a mass of 972.5g.

c. What is the density of the gold bar in *Fig. 2* in grams per centimetre cubed (g/cm^3).

……

[1]

Another similar bar of volume 50cm^3 was found to have a density of 19.57g/cm^3. Use the following data and equations to answer the questions below.

V_W = Volume of tungsten/cm^3 ρ_W = Density of tungsten = 19.6g/cm^3

V_{Au} = Volume of gold/cm^3 ρ_{Au} = Density of gold = 19.3g/cm^3

$$\text{Density} = \frac{\text{Total Mass}}{\text{Total Volume}} = \frac{\rho_W V_W + \rho_{Au} V_{Au}}{V_W + V_{Au}} = \frac{19.6 V_W + 19.3 V_{Au}}{50} = 19.57\,g/cm^3$$

d. Work out the volume of gold in the fake gold bar in cm^3. *Clue: it's much less than half the total.*

……

……

……

[3]

e. What proportion of the mass of the bar is gold?

……

[2]

[Total: 11]

2.

Some substances dissolve in water. The amount that can be dissolved varies with temperature. *Fig. 3* shows how sugar and salt dissolve at different temperatures.

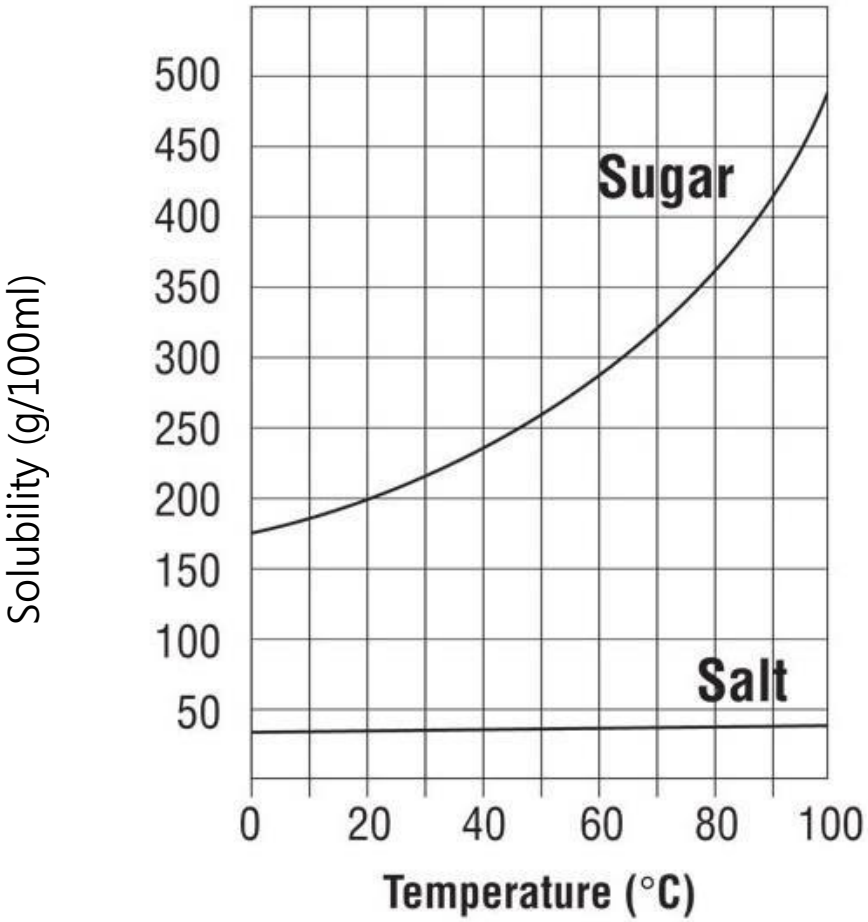


Fig.3

a. Which word below describes the water in *Fig. 3*?

Solvay Suffuse Solvent Solute Independent Variable

[1]

b. Describe how the relative solubilities of sugar and salt vary with temperature.

……

……

[2]

c. What mass of sugar dissolves in 100ml of water at 50˚C?

……

[1]

Temperature (C)	0	20	40	60	80	90
Solubility (g/100ml)	150	170	300	260	400	550

Fig.4

d. *Fig.4* describes solubility data for another substance, *X*. Plot the data on *Fig. 3* and draw a line of best fit.

[3]

e. Ring the point that seems anomalous.

[1]

f. At what temperature are sugar and substance *X* equally soluble?

……

[1]

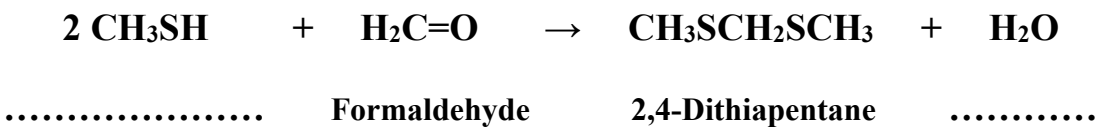
[Total: 9]

3.



Fig. 5

White truffles, *Fig. 5*, are rare and sought after culinary delicacies. They have a very powerful and interesting aroma. One compound that they contain is 2,4-dithiapentane. This can be prepared by the addition of methyl mercaptan, the main aromatic compound in both halitosis and foot odour and a secondary compound in flatulence, to formaldehyde.



a. Fill in the blanks above with the names of the compounds used in the preparation of 2,4-dithiapentane and the other product formed in the addition.

[2]

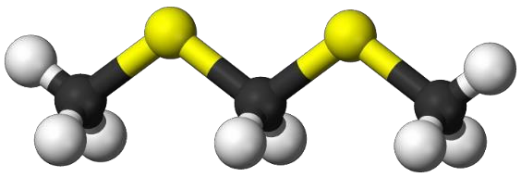


Fig. 6

b. Given the formula of 2,4-dithiapentane, $CH_3SCH_2SCH_3$, and its displayed structure, *Fig. 6,* name the colours of the following elements in the picture:

Carbon	Hydrogen	Sulphur
……	……	……

[3]

c. Given that *Fig. 6* displays the structure of 2,4-dithiapentane, $CH_3SCH_2SCH_3$, draw the structure of CH_3SH.

[2]

[Total: 7]

4.

a. What technique could be used to collect ethanol from a mixture of ethanol and water?

……

[2]

b. Pure water can be separated from a mixture of sand and water using filtration. Which word, below, describes the water collected?

Filtrate Substrate Residue Solvent Solute

[1]

c. What colour is anhydrous copper sulphate?

……

[1]

d. What does anhydrous copper sulphate test for, and what is the positive result?

……

[2]

[Total: 6]

End of Paper