CHEMISTRY DEPARTMENT

ELECTION PAPER 2019: PRACTICAL EXAM

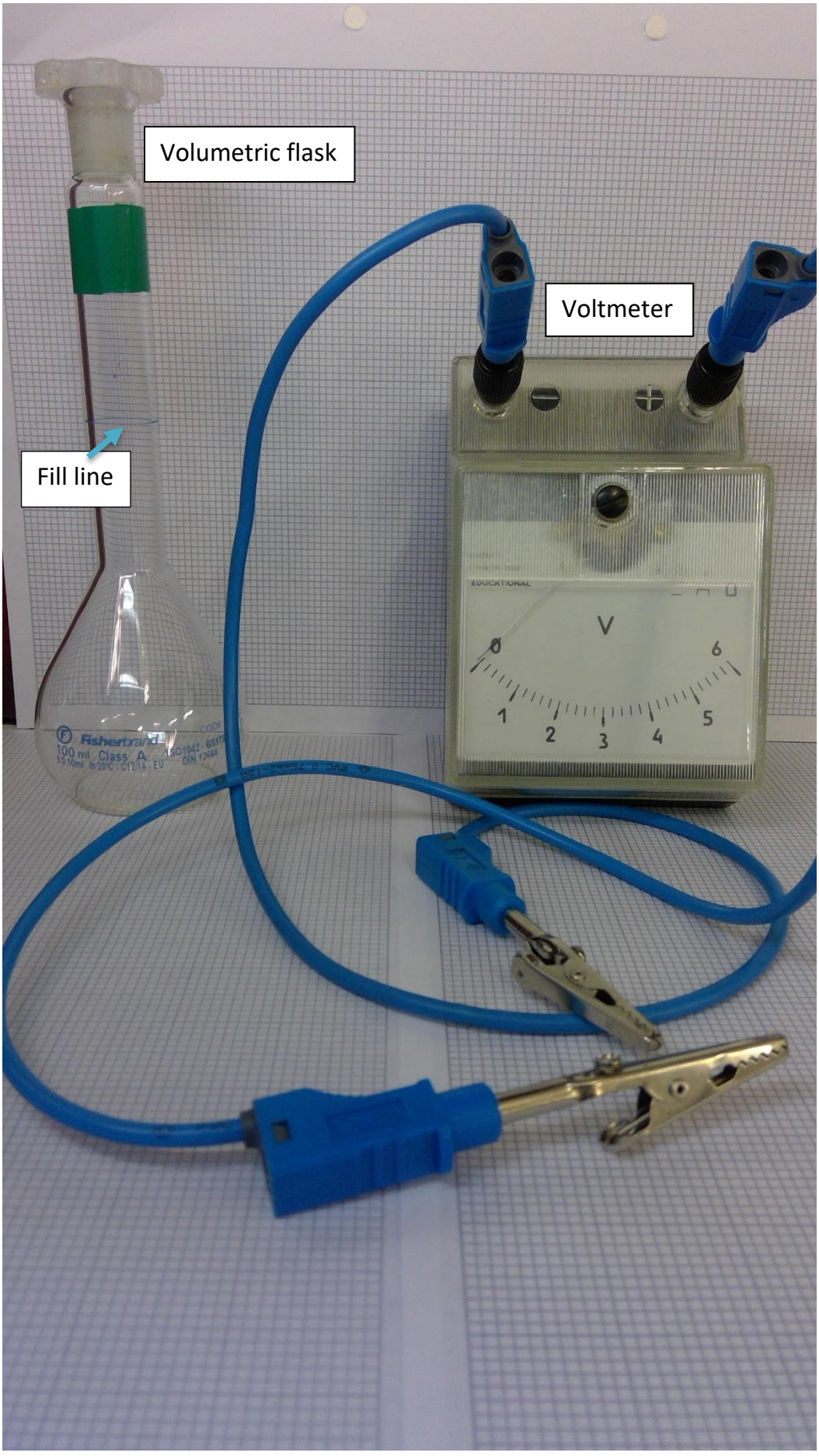
MARK SCHEME

WINCHESTER

COLLEGE

CALCULATORS MAY BE USED

NO PERIODIC TABLES TO BE VISIBLE


Volumetric flask
Voltmeter
Fill line
Fisherbrand
100 ml Class A
EDUCATIONAL
V
0
1
2
3
4
5
6

Q1 **Preparing a standard solution of sodium chloride in water:** The aim is to have a solution of precisely known concentration. The first step is to weigh out accurately some solid sodium chloride. Scales are provided in your area, but you may be sharing. Never zero (tare) the scales*.

* PRACTICAL MARKING POINTS

(a) **Weighing out the sodium chloride**: Fill out the table below as you go along. Weigh your bottle of sodium chloride. Empty the bottle into your 100 cm^3 beaker. Return the weighing bottle to the scales to measure its mass.*

Item	**Mass / g**
Filled weighing bottle	
Emptied weighing bottle	
Sodium chloride used	

[3]

Readings recorded and consistent. 2dp for the mark. 1 each.

(b) **Making the sodium chloride solution:**

(i) Add approximately 25 cm^3 of deionized water from the wash bottle to the beaker containing sodium chloride.

(ii) Stir the mixture with a glass rod until all the sodium chloride has dissolved.

(iii) Using the funnel, pour the solution into the 100 cm^3 volumetric flask.

(iv) Rinse the glass rod into the beaker, swirl the water around and then add these washings to the volumetric flask.

(v) Using deionized water, fill the flask to the line marked on the neck.

(vi) Replace the stopper and invert the flask 20 times.

(c) By taking and recording suitable measurements, determine the density of the sodium chloride solution. Outline your method. Keep the solution.

Method:

Measurements:

Volume with units (1) matching the method

Mass with units (1) matching the method

Formula or calculation (1)

Answer (around 1.02 g cm^{-3}) with units (1)

[4]

Density = ……

(d) In terms of individual particles, describe what happens when solid sodium chloride dissolves in water. You may include a diagram, but it is not essential for full marks.

……

……

……

……

……

……

……

…… [5]

In solid, regular, touching (1) ions (1) Separated on dissolving (1)

Surrounded by water (1) molecules (1)

Free to move in solution (1)

ANY 5, could be from diagrams.

Q2 You will use your sodium chloride solution in an investigation of the electrical properties of metals. You have a voltmeter and 2 wires with crocodile clips attached, and various samples of metals, plus carbon.

(a) Pour around 50 cm^3 of your sodium chloride solution into the 100 cm^3 beaker. If you have lost your solution or were unable to make it, please raise your hand and ask for a supply from the spare stock. There is no penalty for this.

Rub the piece of zinc with abrasive paper to remove some of the layer of corrosion from it, and gently rub the iron nail with the same abrasive paper.

Using the crocodile clips, attach the iron nail to the positive side of the voltmeter and the strip of zinc to the negative side. Hold both metals in the sodium chloride solution*, without getting the crocodile clips wet. Note down the reading from the voltmeter*.

Reading to 1d.p. (1) units (1)…… [2]

(b) Explain why it is necessary to remove the layer of corrosion from the zinc.

Insulator (1)

Need electrical contact (1) ALLOW: need current to flow (incorrect). [2]

(c) Now replace the zinc with the carbon rod and describe what happens to the voltmeter.

Negative deflection / goes wrong way (1)

…… [1]

(d) Switch around the wires in the voltmeter and write down the voltage shown with iron and carbon electrodes.

Reading to 1dp and unit (1) [1]

(e) Complete the table below using the measurements you have already taken and any more measurements that are necessary*. [4]

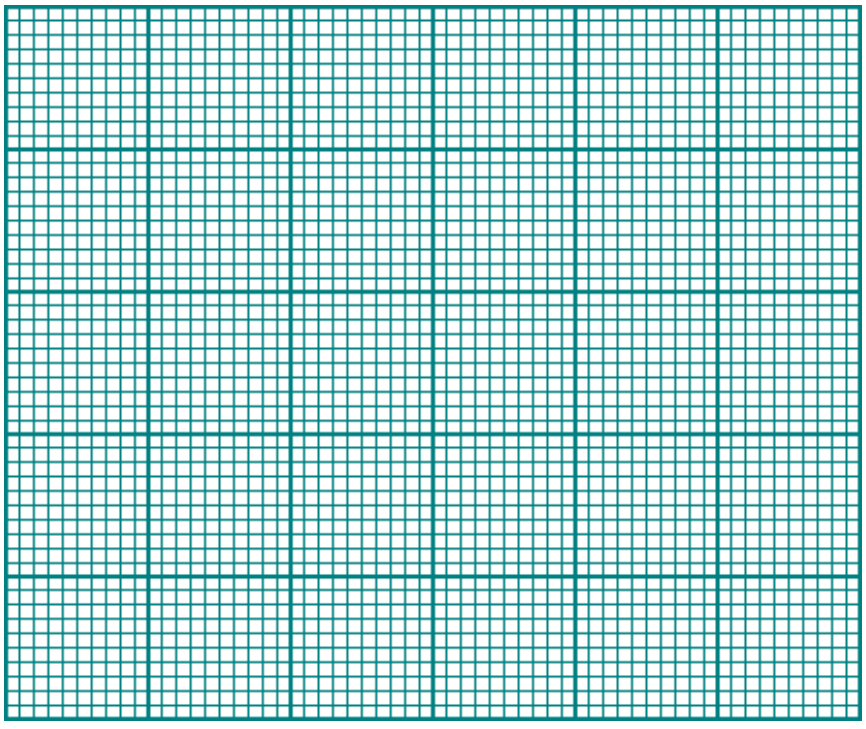
All recorded (2) all to 1dp (1) All positive (1)

Metal on negative side	**Positive side**	**Voltmeter reading / V**
zinc	iron	
aluminium	iron	
magnesium	iron	
iron	carbon	
iron	copper	

(f) Using the graph paper below, illustrate the voltages obtained or deduced when iron is on the positive side of the voltmeter and the 5 other materials are on the negative side. [7]

y-axis labelled (1) units (1) bar chart chosen (1) bars identified (1)

negative values shown (1) correct plotting (1) sensible y-scale (1)



(g) Now replace the iron with copper on the positive side and use zinc on the negative side. Note the reading on the voltmeter.

Reading to 1dp (unit not required) (1)…… [1]

(h) Compare the reading from part (g) with your readings for iron with copper and iron with zinc.

Bigger (1 if no mention of difference)

Equal to the difference (2) [2]

(i) Give the expected voltmeter reading when carbon is the positive electrode and magnesium is the negative electrode.

Difference of their reading for Mg/Fe and Fe/C (no unit required) (1) [1]

(j) You have two test tubes containing blue copper(II) sulfate solution. Place the iron nail in one of these test tubes. Continue with the examination and look back later, then note your observations.

Nail discoloured / goes brown (1) This will take time, and they may need to correct an earlier answer. [1]

Draw a conclusion about the relative reactivity of iron and copper.

Iron > copper (1) [1]

(k) Iodide can be placed in the same series of reactivity. When mixed with a compound of a metal less reactive than iodide, iodine is produced and the solution turns brown. To the second test tube containing copper(II) sulfate solution, add a few drops of potassium iodide solution. Note your observations.

Brown (1) cloudy (1)

…… [2]

(l) You have two boiling tubes, each containing a little hydrochloric acid. You have two pieces of granulated zinc, and one piece of thin copper wire. Wrap the copper wire around one of the pieces of granulated zinc. Drop one piece of zinc into each boiling tube of acid, and note carefully your observations.

Bubbles (1) on both

Quicker with copper (1)

On surface / on copper (1)

……

…… [3]

(m) The chemical formula of zinc is Zn and that of zinc chloride is $ZnCl_2$. Write down the formulae of the other substances present in the boiling tubes during the reactions.

H_2O, H_2, Cu, HCl (1 each)

…… [4]

Now go back and complete part (j).

Cleans other metals before using																						
Voltmeter read carefully, avoiding parallax																						
Electrodes submerged, but not clips																						
Flask filled carefully to line (bottom of meniscus, checking at eye level)																						
Empty bottle reweighed with lid on																						
No zeroing of scales																						
NAME																						
NUMBER																						

Appendix: Required materials

Safety glasses

Electronic scales, 2d.p.

Wash bottle

Weighing bottle with lid, containing around 2.5g (+/- 0.2) NaCl (no lumps)

100 ml volumetric flask + stopper

Glass rod

Small funnel

100 ml beaker

25 ml measuring cylinder

Boiling tube rack with

- 2 boiling tubes containing around 10 ml each of 1M HCl(aq)
- 2 test tubes containing around 5 ml each of 0.2M $CuSO_4$(aq).

1 sample bottle containing around 10 ml 0.2M KI(aq) – labelled “potassium iodide solution”

Abrasive paper

Strips (around 5-10cm) of Mg, Zn, Al, Cu (laid on paper in a printed box with name of element in it).

Fe nail

Carbon rod (4-10 cm)

DC Voltmeter (6V scale, 0.2V divisions)

2 wires with plugs for Voltmeter

2 crocodile clips, clean

2 pieces of granulated zinc, small enough to fit in a test tube, but large enough to wrap wire around.

1 thin piece of copper wire (6-8 cm)

Dropper

Spare aqueous sodium chloride, around 0.2 $moldm^{-3}$, 1 dm^3 per lab.

Question paper

Candidates should bring:

Pen

Pencil

Ruler

Calculator

ZINC

IRON

CARBON

COPPER

MAGNESIUM

ALUMINIUM