

# Assessment formats: do they make a difference?

Eleni Danili and Norman Reid

## Appendix 1

### Test 1: Atomic Structure-Classification of Matter

**Section 1.** Each question has only ONE correct answer. Tick the answer that you think is correct.

1. What would be the volume in litres of 240g of oil if the density of the oil were 0.8 g/mL?

- 300L
- 0.3L
- 192L
- 0.19L

Discrimination index: 0.24

2. Which one of the following represents correctly the electrical charges of the three basic particles, which make up atoms?

	proton	neutron	electron
<input type="checkbox"/>	+1	0	+1
<input type="checkbox"/>	+1	0	-1
<input type="checkbox"/>	0	0	+1
<input type="checkbox"/>	+1	+1	-1

Discrimination index: 0.42

3. An atom of element X contains 13 protons and 14 neutrons. Which of the following correctly represents this?

- ${}_{13}^{14}\text{X}$
- ${}_{14}^{27}\text{X}$
- ${}_{13}^{27}\text{X}$
- ${}_{27}^{13}\text{X}$

Discrimination index: 0.48

4. The two isotopes of carbon  ${}_{6}^{12}\text{C}$  and  ${}_{6}^{14}\text{C}$ , differ from each other in:

- mass number
- atomic number
- chemical properties
- number of electrons

Discrimination index: 0.34

5. The atomic number of potassium is 19 and its relative atomic mass is 39. Which one of the following represents correctly the atomic particles found in the  $\text{K}^+$  ion:

- 19 protons    20 neutrons    19 electrons
- 19 protons    20 neutrons    18 electrons

- 20 protons    19 neutrons    20 electrons
- 20 protons    19 neutrons    18 electron

Discrimination index: 0.62

6. When a magnet is passed over a sample of powdered metal, some of the sample is attracted to the magnet and some is not. The powdered metal sample is:
- a single element
  - pure substance
  - homogeneous mixture
  - heterogeneous mixture

Discrimination index: 0.43

7. Which one of the following is usually described as a 'physical change'?
- the burning of magnesium in air
  - the rusting of iron
  - the evaporation of alcohol
  - the rotting of an apple

Discrimination index: 0.51

8. Which of the following involves at least one 'chemical change'?
- the burning of wood
  - converting water to steam in an electric kettle
  - producing salt from sea water by evaporation
  - sublimation of iodine

Discrimination index: 0.34

9. Which of the following is a pure substance?
- air
  - milk
  - carbon dioxide
  - rain

Discrimination index: 0.37

10. The solubility of AgCl in water is:
- the minimum mass of water which can dissolve in a given mass of AgCl at fixed temperature
  - the maximum mass of AgCl which can be dissolved in water at a fixed temperature
  - the mass of AgCl can be dissolved in a given mass of water at a fixed temperature
  - the maximum mass of Ag Cl can be dissolved in given mass of water at a fixed temperature

Discrimination index: 0.51

11. The solubility of a gas in a liquid
- increases as the temperature of the solution is increased.
  - increases as pressure of the gas at the surface is increased.
  - increases as the volume of the solution is increased.
  - decreases as pressure of the gas at the surface is increased.

Discrimination index: 0.51

12. What is the percent-by-mass of a solution made by adding 56g of KOH to 944g of water?

- 59%
- 5.6%
- 56%
- 5.9%

Discrimination index: 0.34

### **Section 2**

13. Give the definition of the:

- (i) atomic number of an element.
- (ii) mass number of an element.

Which of the above numbers can be changed without be changed the identity of the element

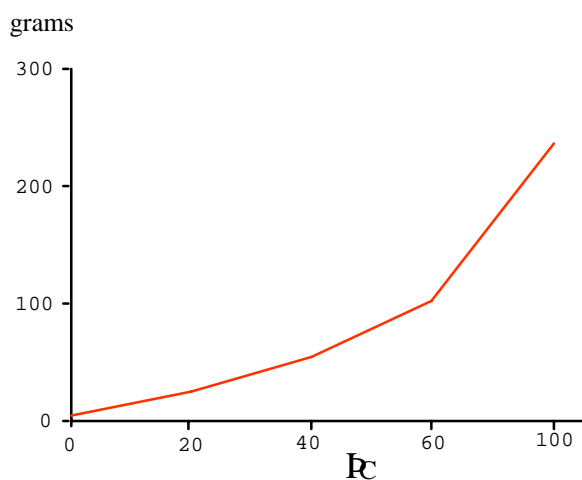
14. A coin was dropped into a graduated cylinder containing 20.20mL of water. The volume of the water increased to 20.80mL. The coin has a mass of 1.2g. What is the density of the coin?

15. What is the most important difference between a compound made from iron and sulphur and a mixture of iron and sulphur:

16. Give the number of protons, neutrons and electrons in the followings atom or ion:

neutrons	protons	electrons
.....	.....	.....
.....	.....	.....

17. A line graph showing the solubility (g per 100 mL) of potassium nitrate changes with temperature is shown below.



Use the curve to estimate:

- (i) The maximum mass of potassium nitrate that would dissolve in 50 g of water at 30 °C.
- (ii) The temperature the solubility of potassium nitrate is 70%:

(iii) The mass of crystals that would form if a solution containing 60g of potassium nitrate in 100g of water were cooled from 60 °C to 20 °C.

## Appendix 2

### Test 2: Periodic Table - Chemical bonds

#### Section 1

- You are given the following elements with atomic numbers: 7, 12, 18, 38, 54.  
Which of them have similar properties?  
Explain your answer:
- Two elements, X and Y, each forms a compound with chlorine. The chloride of X is a solid whose solution in water has a high conductivity. The chloride of Y is a liquid, which does not conduct electricity.
  - To which main group of the periodic table is X likely to belong?
  - Explain your answer.
  - To which main group of the periodic table is Y likely to belong?
  - Explain your answer.
- What do the following have in common?  $_{10}\text{Ne}$ ,  $_{9}\text{F}^-$ ,  $_{12}\text{Mg}^{2+}$

#### Section 2

- Each box in the grid below refers to an element.  
Look at the boxes and answer the questions that follow.  
(Boxes may be used as many times as you wish)

<b>A</b> The element with electron arrangement: 2.8.3	<b>B</b> Sodium	<b>C</b> Ar
<b>D</b> Magnesium	<b>E</b> The element which is a brown liquid at room temperature	<b>F</b> The elements which has 1 electron in each atom
<b>G</b> The element of atomic number 19	<b>H</b> Chlorine	<b>L</b> Nitrogen

Select the box (es) which contain:

- Elements in the same group of the periodic table.
- Elements that are gases in room temperature.
- Atoms of which element (or elements) form ions with the same electron arrangement as argon atoms.

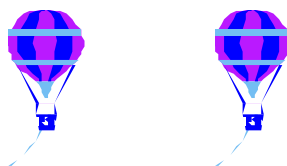
- (d) Two elements that will combine to form an ionic compound with the formula  $X_3Y_2$ .
- (e) Elements that form a covalent compound with the element that is in the box F.

## Appendix 3

### Test 3: Mole

#### Section 1

1. We have two balloons which when they are empty are identical in weight. The first is filled with 1 mol of oxygen ( $O_2$ ). The second is filled with 2 mol of methane ( $CH_4$ ). (Relative atomic mass: O =16, C = 12, H=1)



- (a) Work out the formula mass of each substance and find out which balloon now weighs more:
- (b) Which balloon has the bigger volume under STP condition?  
Explain your answer.

#### Section 2

2. Look at the boxes and answer the following questions.

Each question may have more than one answer.

(Boxes may be used as many times as you wish).

(Ar = 40, N = 14, C = 12, O = 16)

<b>A.</b> 2N <sub>A</sub> molecules	<b>B.</b> 56g	<b>C.</b> 22.4l (STP conditions)
<b>D.</b> 44g	<b>E.</b> 2mol	<b>F.</b> N <sub>A</sub> molecules
<b>G.</b> 44.8l (STP conditions)	<b>H.</b> 28g	<b>I.</b> 22g

- (a) Pick the box (es) which contain mass of 1mole of  $CO_2$ .
- (b) Pick the box(es) which contain the same amount of  $N_2$  as the one that is in the box B.

## Appendix 4

### Test 4: Acids- Bases - Salts - Oxides

#### Section 1.

Each question has only ONE correct answer. Tick the answer that you think is correct.

1. The solution of NaOH compound in water is alkaline because:
- It has hydroxide ions  $\text{OH}^-(\text{aq})$  and no hydrogen ions  $\text{H}^+(\text{aq})$
  - It has sodium ions  $\text{Na}^+(\text{aq})$  and hydroxide ions  $\text{OH}^-(\text{aq})$
  - It changes the colour of the indicators
  - It has more hydroxide ions  $\text{OH}^-(\text{aq})$  than hydrogen ions  $\text{H}^+(\text{aq})$

Discrimination index: 0.32

2. A solution of potassium chloride (KCl) has a neutral pH. This is because the solution contains:
- The same concentration of potassium ions ( $\text{K}^+$ ) and chloride ions ( $\text{Cl}^-$ )
  - The same concentration of the hydrogen ions  $\text{H}^+(\text{aq})$  and hydroxide ions  $\text{OH}^-(\text{aq})$
  - No hydrogen ions  $\text{H}^+(\text{aq})$  and hydroxide ions  $\text{OH}^-(\text{aq})$
  - Potassium chloride, which is a salt

Discrimination index: 0.13

3. Between two acids solutions the more acidic is:
- The one that has the larger pH
  - The one that has the smaller pH
  - The one that has  $\text{pH} > 7$
  - The one that has  $\text{pH} < 7$

Discrimination index: 0.56

4. A solution found in a lab has a pH of 10. In order to neutralise the solution what should we add?
- Ammonia solution
  - Sodium chloride solution
  - Sulphuric acid solution
  - Distilled water

Discrimination index: 0.29

5. When an acid reacts with a calcium carbonate, the products formed are a:
- Calcium salt, hydrogen and water
  - Calcium salt and water
  - Calcium salt, water and carbon dioxide
  - Calcium salt, hydrogen, carbon dioxide and water

Discrimination index: 0.43

6. Which compound would produce an alkaline solution when dissolved in water?
- Nitrogen dioxide
  - Calcium oxide
  - Carbon dioxide
  - Potassium chloride

Discrimination index: 0.14

7. Which compound would produce an acidic solution when dissolved in water?

- Potassium oxide
- Sodium oxide
- Sulphur dioxide
- Sodium bromide

Discrimination index: 0.21

8. Which pair of chemical could you use to make lead sulphate?

(Use information given at the end of the test for the solubility of some compounds)

- Lead nitrate and barium sulphate
- Lead nitrate and sodium sulphate
- Lead phosphate and sodium sulphate
- Lead phosphate and barium sulphate

Discrimination index: 0.33

9.

The reaction between copper oxide and nitric acid is given below



The correct balanced equation is:

- $\text{CuO} + \text{H}_2\text{NO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{H}_2\text{O}$
- $\text{CuO} + 2\text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{H}_2\text{O}$
- $\text{CuO} + \text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{H}_2\text{O}$
- $2\text{CuO} + 2\text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{H}_2\text{O}$

Discrimination index: 0.29

10. Which is the balanced equation for the reaction of barium chloride solution with zinc sulphate solution?

- $\text{BaCl}_2 + \text{ZnSO}_4 \rightarrow \text{BaSO}_4 + \text{ZnCl}_2$
- $2\text{BaCl} + \text{ZnSO}_4 \rightarrow \text{Ba}_2\text{SO}_4 + 2\text{ZnCl}$
- $\text{BaCl}_2 + \text{Zn}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{ZnCl}$
- $2\text{BaCl}_2 + \text{Zn}_2\text{SO}_4 \rightarrow \text{Ba}_2\text{SO}_4 + 2\text{ZnCl}_2$

Discrimination index: 0.51

11. When sodium reacts with water the products made are:

- a salt and hydrogen
- an alkaline solution and hydrogen
- an alkaline oxide and hydrogen
- an acid and hydrogen

Discrimination index: 0.60

12. Which of the following metals will react with the given solutions?

- Cu and  $\text{Fe(NO}_3)_2$
- Fe and  $\text{Cu(NO}_3)_2$
- Zn and  $\text{MgCl}_2$
- Ag and HCl

Discrimination index: -0.03

13.  $\text{CaCl}_2$  dissolves in water. Which of the following statements is correct:

- The number of cations and anions are the same
- The number of cations are double of the number of anions
- The number of anions are double of the number of cations
- There are no anions and cations because it has a pH= 7

Discrimination index: 0.49

## Section 2

14. Look at the boxes and answer the following questions.

Each question may have more than one answer.

(You may use the box as many times as you wish)

<b>A</b> Contains same number of hydrogen ions, $\text{H}^+(\text{aq})$ , and hydroxide ions, $\text{OH}^-$	<b>B</b> It reacts with calcium carbonate and gives carbon dioxide gas	<b>C</b> It turns universal indicator blue
<b>D</b> It turns universal indicator red	<b>E</b> It reacts with hydrochloric acid and gives a salt	<b>F</b> It forms compounds called chlorides
<b>G</b> It conducts electricity	<b>H</b> It contains many hydroxide ions	<b>I</b> It has a pH less than 7

Select the box(es) which contain statements which are true about:

- (a) Hydrochloric acid solution
- (b) Sodium hydroxide solution
- (c) Sodium chloride solution

15. Look at the boxes and answer the following questions.

Each question may have more than one answer.

(You may use the box as many times as you wish)

<b>A</b> Sodium Oxide $\text{Na}_2\text{O}$	<b>B</b> Lead Nitrate $\text{Pb}(\text{NO}_3)_2$	<b>C</b> Phosphorus Trioxide $\text{P}_2\text{O}_3$
<b>D</b> Barium Iodide $\text{BaI}_2$	<b>E</b> Calcium Oxide $\text{CaO}$	<b>F</b> Sodium Nitrate $\text{Na}(\text{NO}_3)_2$
<b>G</b> Sulphur Dioxide $\text{SO}_2$	<b>H</b> Magnesium Sulphate $\text{MgSO}_4$	<b>L</b> Nitrogen Dioxide $\text{NO}_2$



Select the box(es) that contain compounds which:

- (a) Produce alkaline solutions
  - (b) Produce acidic solutions
  - (c) Cause acid rain
  - (d) Can react with the salt in box D and give a precipitation reaction.....
- (Use information given at the end of the test for the solubility of some compounds)

### Section 3

16. When potassium reacts with water that contains phenolphthalein indicator the colour of the solution changes into red. Give an explanation why this happens and write the balanced equation for the reaction.

Explanation:

Equation:

17. Patients with stomach problems are given a 'barium meal' before being X-rayed. It consists of a suspension of barium sulphate in water. This salt can be prepared in the laboratory by a precipitation reaction. Using information given below for the solubility of some compounds, name two salts solution that could be mixed to prepare barium sulphate and write the balanced equation for the reaction.

Two salts:

Balanced Equation

18. A pupil hangs an iron nail in copper (II) sulphate solution. She notices that the surface of the nail turns brown. Give an explanation why this happens and write the balanced equation for the reaction.

Explanation:

Balanced Equation:

#### Solubility of some compounds in water

(v.s. = very soluble in water, i= insoluble in water)

Barium iodide (v.s.)	Sodium sulphate (v.s.)
Barium carbonate (i)	Copper (II) sulphate (v.s.)
Barium nitrate (v.s.)	Lead (II) sulphate (i)
Lead phosphate (i)	Lead nitrate (v.s.)
Sodium nitrate (v.s.)	Barium sulphate (i)
Magnesium sulphate (v.s.)	

## Appendix 5

### Test 5: Solutions

#### Section 1

1. A beaker contains 10g of sodium hydroxide (NaOH) and the volume of the solution is 250ml. We add water to the beaker until the new volume of the solution is 500ml. The new concentration of the solution is:

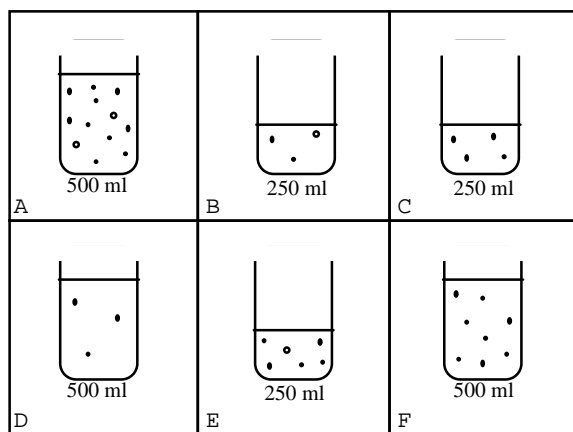
- Doubled
  - Not changed
  - Quadrupled
  - Halved
2. In a beaker, A, we have dissolved 0.2mole of NaCl in 200ml of water. In another beaker, B, we have dissolved 0.4mol of NaCl in 400ml water. Which of the following statements is correct:
- The solution in the beaker A has smaller concentration than the solution in beaker B
  - The solution in the beaker A has the same concentration as the solution in the beaker B
  - The solution in the beaker B has smaller concentration than the beaker A
  - The solution in the beaker B has double concentration of the solution in the beaker A.
3. You want to prepare 4l of a solution of potassium hydroxide with concentration 0.1mol/l. For this purpose you will use:
- 0.1moles KOH
  - 1 moles KOH
  - 0.4moles KOH
  - 4 moles KOH
4. One pupil has mixed together two solutions of Na<sub>2</sub>CO<sub>3</sub> with concentrations of 0.1 mol/l and 0.5mol/l respectively. The possible concentration of the new solution is:
- 0.01mol/l
  - 0.6mol/l
  - 0.1mol/l
  - 0.3mol/l
5. You prepared a NaCl solution by adding 1mole (58.44g) of NaCl to a 1-litre volumetric flask and then added water to dissolve it. When you have finished, the final volume in your flask looked like figure 1

The solution you prepared is

- Greater than 1mol/l because you added more solvent than necessary
- Less than 1mol/l because you added more solvent than necessary
- Less than 1mol/l because you added less solvent than necessary
- 1mol/l because the amount of solute, not solvent determines the concentration

## **Section 2**

6. Each box in the grid below represents beakers with aqueous solution of NaOH. Look at the boxes and answer the following questions.  
Each question may have more than one answer.  
(Boxes may be used as many times as you wish)



- (a) Which solution is most concentrated?
- (b) Which solution is least concentrated?
- (c) When solutions B and E are combined, the resulting solution has the same concentration as solution:
- (d) Which solutions have the same concentration?
- (e) If you evaporate half of the water from solution D, the resulting solution will have the same concentration as solution:

### **Section 3**

7. The concentration of the acid in a bottle is shown on the label as 0.5M
  - (a) Explain what this means.
  - (b) How many moles of sulphuric acid would you need to use to make 2 litre of a solution with the same concentration as in the bottle above?
  - (c) If you add water to the 2 litre solution until the final volume is 4litre, what is the new concentration of the solution: