MINISTRY OF EDUCATION

NAMIBIA SENIOR SECONDARY CERTIFICATE

PHYSICAL SCIENCE SPECIMEN PAPERS 2 – 3 AND MARK SCHEMES
ORDINARY LEVEL
GRADES 11 – 12

THESE PAPERS AND MARK SCHEMES SERVE TO EXEMPLIFY THE SPECIFICATIONS IN THE LOCALISED NSSC PHYSICAL SCIENCE ORDINARY LEVEL SYLLABUS

2006
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MINISTRY OF EDUCATION

Namibia Senior Secondary Certificate (NSSC)

PHYSICAL SCIENCE: ORDINARY LEVEL

PAPER 2:
SPECIMEN PAPER

TIME: 2 hours

MARKS: 100

INSTRUCTIONS TO LEARNERS

Write your Centre number and Learner number in the space at the top of this page.

Answer all questions.
Write your answers in the spaces provided on this question paper.
Use a sharp pencil for your drawings. Coloured pencils or crayons should not be used.

INFORMATION TO LEARNERS

The intended number of marks are given in brackets [ ] at the end of each question.
Periodic Table provided at end of this paper.
QUESTION 1

1. Properties of some oxides of elements in period 3:

<table>
<thead>
<tr>
<th>Formula of oxide</th>
<th>Group 1 (Na₂O)</th>
<th>Group 2 (MgO)</th>
<th>Group 3 (Al₂O₃)</th>
<th>Group 4 (SiO₂)</th>
<th>Group 6 (SO₂)</th>
<th>Group 7 (Cl₂O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of oxide (at 20°C)</td>
<td>Solid</td>
<td>Solid</td>
<td>Solid</td>
<td>……</td>
<td>……</td>
<td>Gas</td>
</tr>
<tr>
<td>Conduction of electricity by molten or liquid oxide</td>
<td>Good</td>
<td>Good</td>
<td>…..</td>
<td>Poor</td>
<td>Nil</td>
<td>…..</td>
</tr>
<tr>
<td>Structure of oxide</td>
<td>ionic</td>
<td>……</td>
<td>covalent</td>
<td>Giant structure</td>
<td>…..</td>
<td>Giant structure</td>
</tr>
<tr>
<td>Nature of oxide</td>
<td>…..</td>
<td>Weakly alkaline</td>
<td>…..</td>
<td>Acid</td>
<td>Acid</td>
<td>Acid</td>
</tr>
</tbody>
</table>

(a) Complete the table by filling in the missing properties of oxides of elements in period 3.

(b) In Group 7 the formula of chorine oxide is Cl₂O. From this information state the relationship between the group number and the number of outer shell electrons.

(c) Silicon in group 4 will form a giant covalent structure with oxygen. Draw a possible structure of silicon dioxide.

(d) Describe what you will observe when a piece of sodium (Na) is put in water at room temperature.

(e) Write down the oxidation state of Al in Al₂O₃.
(f) MgSO₄ is a white compound while FeSO₄ is a pale green compound. What can you deduce from this statement.

[2]

2. The table shows physical properties of halogens.

<table>
<thead>
<tr>
<th>Name of element</th>
<th>Colour</th>
<th>Melting point</th>
<th>Boiling point</th>
<th>State at Room Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Pale yellow</td>
<td>-220</td>
<td>-188</td>
<td>Gas</td>
</tr>
<tr>
<td>Cl</td>
<td>-101</td>
<td>-35</td>
<td>Gas</td>
<td></td>
</tr>
<tr>
<td>Br</td>
<td>Red Brown</td>
<td>-7</td>
<td>59</td>
<td>...</td>
</tr>
<tr>
<td>I</td>
<td>...</td>
<td>113</td>
<td>183</td>
<td>solid</td>
</tr>
</tbody>
</table>

(a) (i) Complete the colours of chlorine and iodine and the state of bromine at room temperature.

[2]

(ii) Explain the trend in melting points of the elements from F to I.

[2]
QUESTION 2

Fig. 1 shows a balance which is being used to measure the mass of some gold.

(a) (i) Calculate the weight of the gold. The total mass of the gold is 0.38 kg (380 g). Give the units for your answer. (g = 10 N / kg)

\[ \text{weight} = \ldots \quad [1] \]

(ii) Calculate the moment the gold produces about the pivot. Show your working.

\[ \text{moment} = \ldots \quad \text{N cm} \quad [1] \]

(b) The density of gold is 19 g/cm\(^3\). Calculate the volume of gold on the balance. Show your working.

\[ \text{volume} = \ldots \quad \text{cm}^3 \quad [2] \]

(c) Gold is found in nature as a pure metal. State what this tells us about its position in the reactivity series.

..................................................................................................................................................
..................................................................................................................................................
..................................................................................................................................................
.................................................................................................................................................. [1]
QUESTION 3

For some medical conditions, a radioactive isotope of iodine is injected into the bloodstream.

(a) Explain what is meant by the term isotope.

………………………………………………………………………………………... [2]

(b) The isotope emits β-particles. Explain what a β-particle is.

………………………………………………………………………………………... [2]

(c) The half-life of the isotope is 8 days. Explain why an isotope with a relatively short half-life is used.

………………………………………………………………………………………... [1]
QUESTION 4

Fig. 2 shows a boy standing 240 m from a cliff.

When he shouts, he hears an echo from the cliff after 1.5 s.

(a) Calculate the total distance the sound travelled. ................ m [1]

(b) Use your value from (a) to calculate the speed at which the sound travelled. Write down the equation that you use and show your working.

.................. m/s [2]
QUESTION 5

Fig. 3 shows the structure of a simple electric motor.

(a) Name the parts labelled A, B and C.

A .................................................................

B .................................................................

C ................................................................. [3]

(b) State two design changes that would allow the motor to lift larger loads.

(i) .................................................................

.................................................................

(ii) .................................................................

................................................................. [2]

(c) Explain what would happen if a larger a potential difference were put across the input.

........................................................................... [2]
QUESTION 6

(a) The formula of a hydrocarbon compound is C_{20}H_{42}.

(i) Give the formula of the next hydrocarbon in the same homologous series.

................................................................. [1]

(ii) Name this homologous series.

................................................................. [1]

(iii) Describe a chemical test to distinguish between alkanes (saturated hydrocarbons) and alkenes (unsaturated hydrocarbons).

test .................................................................

result for alkanes ...........................................

result for alkenes ........................................... [3]

(b) One use of the hydrocarbon, C_{20}H_{42}, mp 37°C, is in candles.

(i) Candles burn with a yellow sooty flame. Name three chemical products formed when a candle burns.

1. .................................................................

2. .................................................................

3. ................................................................. [3]
Fig. 4 shows an electrical circuit.

The reading on the ammeter is 0.8 A, and the potential difference across the resistor labelled $R$ is 4.0 V.

(a) Complete the diagram to show how a voltmeter would be connected to measure the potential difference across resistor $R$. [1]

b) (i) Calculate the value of the resistor $R$.

resistance = ............... Ω [1]

(ii) Calculate the total resistance in the circuit.

resistance = ............... Ω [1]

(iii) Calculate the total potential difference across the battery

= ............... V [2]
QUESTION 8

When copper nitrate \((\text{Cu(NO}_3\text{)}_2)\) is heated the copper nitrate decomposes to form copper oxide \((\text{CuO})\), nitrogen dioxide \((\text{NO}_2)\) and oxygen \((\text{O}_2)\).

(a) Write down the balanced reaction of the above equation.

(b) Use the Periodic Table to calculate the relative formula mass \(M_r\) of copper nitrate.

(c) (i) Calculate the number of moles of \(\text{Cu(NO}_3\text{)}_2\) in 9.4 grams of the compound.

(ii) Calculate the number of moles of oxygen that would be formed when 9.4 g of copper nitrate is heated.

(iii) Calculate the volume of oxygen gas at r.t.p that would be produced by the complete combustion of 9.4 g of copper nitrate. (One mole of gas at r.t.p. occupies 24 dm\(^3\).)
QUESTION 9

Read the following passage carefully. Then use it to help you answer the questions.

The use of metals increases every year. Many ores are getting more difficult to find and we need to conserve the metal reserves we have. This could be done by using less metal, recycling metal goods and designing metal goods to last longer.

One of the main things that stops metal goods lasting is corrosion (rust). A car exhaust pipe made of mild steel will probably rust within two years; if the manufacturer had used stainless steel instead it would have lasted ten years or even longer. Stainless steel exhausts are twice as expensive but last five times as long.

Steel is often protected from corrosion by coating it in zinc metal. This is called galvanising. The zinc rots away instead of the steel. Rolls-Royce cars are made from galvanised steel and they last for many years without rusting.

(a) Explain why we need to conserve metal reserves.

(b) Suggest ways in which pure metal reserves can be made to last longer.

(c) Suggest what stops metals from lasting a long time.

(d) Explain why it is better to use a stainless steel exhaust pipe.

(e) Painting and galvanising are ways to protect steel from corrosion. Describe one other way in which a steel object can be protected from rusting and explain how this works.
QUESTION 10

Aluminium is produced from molten aluminium oxide by electrolysis as shown below.

(a) Suggest why carbon graphite is used as the cathode.
........................................................................................................... [1]

(b) Suggest why the aluminium oxide needs to be molten.
........................................................................................................... [1]

(c) Describe what happens to the graphite blocks during the process.
...........................................................................................................
........................................................................................................... [1]

(d) State one use of aluminium.
........................................................................................................... [1]
QUESTION 11

A child is playing with a bowl of water. The child discovers that she can make waves by dipping a pencil in the water, as shown in Fig. 6.

(a) On Fig. 8, mark one wavelength of the waves. [1]

(b) The child puts a barrier in the water and sends straight wavefronts towards it, as shown in the view from above, Fig. 7. The arrows show the direction of travel of the wavefronts.

(i) State what will happen when the waves hit the barrier.

........................................................................................................ [1]

(ii) On Fig. 7, draw three wavefronts after they hit the barrier and draw arrows to show their direction of travel.

........................................................................................................ [3]
QUESTION 12

(a) The graph in Fig. 8 shows how the temperature of a certain substance changes when the substance is heated steadily.

![Graph showing temperature change over time](image)

(i) Determine the melting point of the substance.

............................... °C

(ii) Determine the boiling point of the substance.

............................... °C [2]

(b) (i) State, in terms of molecules, two differences between gases and liquids.

1. .................................................................

2. ................................................................. [2]

(ii) Describe what happens during the process of condensation.

.................................................................

.................................................................

................................................................. [2]
Fig. 9 shows a section through a box which campers can use to keep things cool. Water is poured onto the specially shaped top of the box, as shown. The water soaks into the porous material and then evaporates. When the water has evaporated, some more is poured on.

![Diagram of a box with water poured on the top and porous material inside]

(i) Explain briefly why this box keeps things cool.

........................................................................................................................................

........................................................................................................................................ [2]
A player kicks a stationary ball of mass 0.4 kg. The ball moves off with a speed of 3 m/s along the ground.

(a) Calculate the kinetic energy of the ball immediately after it has been kicked. Write down the equation that you use and show all your working.

\[
\text{kinetic energy} = \frac{1}{2}mv^2 \quad [2]
\]

(b) Write down the maximum potential energy of the ball.

\[
\text{potential energy} = \text{constant} \quad [1]
\]

(c) (i) The player then kicks the ball straight upwards with the same initial speed, 3 m/s. Calculate the maximum height that the ball could reach. Write down the equation that you use and show all your working. \([g = 10 \text{ N/kg}]\)

\[
\text{maximum height} = \frac{v^2}{2g} \quad [3]
\]

(ii) Explain why it is unlikely that this height will be reached by the ball.

..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
..........................................................................................................................
.......................................................................................................................... [2]
QUESTION 14

Water is an important natural resource in Namibia. Water resources are scarce and should be protected as much as possible.

(a) (i) State the three stages in the purification of water [3]

(ii) Name two industrial uses of water. [2]

(b) Inorganic fertilizers may pose a threat to natural water resources if applied in excess. Describe the negative effect of overuse of fertilizers on water resources. [4]

(c) State one advantage of using fertilizers. [1]

Acknowledgement

The Ministry of Education, acknowledges the assistance of the University of Cambridge Local Examination Syndicate, (UCLES), in granting permission to use resources and ideas towards the production of these specimen question, notably for questions 1 to 12.
MINISTRY OF EDUCATION

Namibia Senior Secondary Certificate (NSSC)

PHYSICAL SCIENCE: ORDINARY LEVEL

PAPER 2:
MARK SCHEME

QUESTION 1
(a) solid, gas, good, nil ionic, covalent, basic, acidic [4]
(b) Cl in group 7 and O in group 6 relating to electrons in outer shell [1]
(c) check that Si connected to 4 Oxygens in giant structure – should not look like carbon dioxide [1]
(d) the questions request “describe what is observed” – any of the following: Sodium reacts violently with water/ whizzing over surface/ fizzing / vigorous/ bubbles given off – Do not accept gas given off [2]
(e) 3 [1]
(f) that Fe is a transition element [1]

Section 2
(a) (i) yellow & dark purple / liquid [3]
(ii) melting point increase due to weaker electro negativity increase in electrons / repulsion [2]

Total [15]

QUESTION 2
(a) (i) 3.8 N [1]
(ii) 76 (do not accept 0.76 N m since the unit N cm is pre-printed in the question) [1]
(b) 20 (no unit since unit cm³ is pre-printed in the question) [2]
(c) low reactivity / inert [1]

Total [5]

QUESTION 3
(a) same number of protons but different numbers of neutrons
or alternative:
1 mark for same atomic number but different mass number
1 mark for different number of neutrons [2]
(b) 1 mark for electron
1 mark for “fast moving” [2]
(c) To have the radioactive isotope in body for only a short time [1]

Total [5]

QUESTION 4
(a) 480 [1]
(b) 480÷1.5 = 320 [2]

Total [3]
QUESTION 5
(a) A rotor
   B brush
   C split rings [3]
(b) more windings
   stronger magnet [2]
(c) stronger turning effect/faster [2]
Total [7]

QUESTION 6
(a) (i) C_{21}H_{44} [1]
     (ii) alkanes [1]
     (iii) bromine water
           no colour change
           colour change from orange to clear [3]
(b) (i) carbon dioxide, water & carbon [3]
Total [8]

QUESTION 7
(a) correct parallel connection [1]
(b) \[ E = \frac{V}{I} = 5 \ \Omega \] [1]
(c) \[ 5 + 4 + 6 = 15 \ \Omega \] [1]
(d) \[ V = I \times R = 0.8 \ A \times 15 \ \Omega = 12 \ V \] [2]
Total [5]

QUESTION 8
(a) \[ 2\text{Cu(NO}_3\text{)}_2 \rightarrow 2\text{CuO} + 4\text{NO}_2 + \text{O}_2 \] [2]
(b) 188 (not unit since relative formula mass is required) [1]
(c) 0.05 mol [1]
(d) 0.025 mol [1]
(e) 0.6 dm^3 [2]
Total [7]

QUESTION 9
(a) metal ore is non-renewable [1]
(b) recycle, rust reduction, alternative materials [2]
(c) oxidation with air / rust [1]
(d) last longer [2]
(e) alloying/mixing with other metals [2]
Total [8]

QUESTION 10
(a) (i) good conductor / does not react with metal [1]
     (ii) to conduct electricity [1]
     (iii) oxygen attacks the graphite and erodes it [1]
     (iv) any correct use(cars, aeroplanes, etc.) [1]
Total [4]
QUESTION 11
(a) correct indication [1]
(b) (i) waves will be reflected [1]
(ii) 1 mark for 3 wavefronts
1 mark if \( i = r \) and normal is indicated
1 mark for direction [3]

Total [5]

QUESTION 12
(a) (i) 4 [1]
(ii) 80 [1]
(b) (i) spaces between molecules, movement, attraction forces [2]
(ii) gas to liquid phase change [2]
(c) evaporation is endothermic / removes heat from camper box [2]

Total [8]

QUESTION 13
(a) Kinetic Energy = \( \frac{1}{2}mv^2 \)
\[ = 0.5 \times 0.4 \times 9 \]
\[ = 1.8 \text{ J} \] [2]
(b) Potential Energy = 0 J [1]
(c) (i) Potential Energy = Kinetic Energy
\[ mgh = \frac{1}{2}mv^2 \]
\[ h = \frac{v^2}{2g} \]
\[ h = 0.45 \text{ m} \] [3]
(ii) Friction of air particles [2]

Total [8]

QUESTION 14
(a) filter, sedimentation, filter & disinfecting / sterilisation [3]
(b) cooling/ washing [2]
(c) phosphates and nitrates are plant nutrients
process called eutrophication/
algae growth / die and rot / bacteria live of dead algae
bacteria need oxygen [4]
(d) supply phosphates and nitrates which are plant nutrients [1]

Total [10]
MINISTRY OF EDUCATION

Namibia Senior Secondary Certificate (NSSC)

PHYSICAL SCIENCE: ORDINARY LEVEL

PAPER 3: APPLIED PRACTICAL SKILLS PAPER
SPECIMEN PAPER

TIME: 1 hour 15 minutes

MARKS: 60

INSTRUCTIONS TO LEARNERS

Write your Centre number and Learner number in the space at the top of this page.

Answer all questions.
Write your answers in the spaces provided on this question paper.
Use a sharp pencil for your drawings. Coloured pencils or crayons should not be used.

INFORMATION TO LEARNERS

The intended number of marks are given in brackets [ ] at the end of each question.
A copy of the Periodic Table is provided at end of this paper.
QUESTION 1:

A student does tests on three substances, white powder X, powdered metal Z and dilute acid Y.

(a) Complete the results tables shown in Figs. 1, 2 and 3.

(i) Tests on white powder X

<table>
<thead>
<tr>
<th>test</th>
<th>observation</th>
<th>conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Heat a little of X in a dry test-tube and test the gas given off with a glowing splint.</td>
<td>[2] Oxygen is given off.</td>
</tr>
<tr>
<td>2.</td>
<td>Add acid Y to a little of X and test the gas given off with blue litmus.</td>
<td>Blue litmus paper turns red and then white.</td>
</tr>
</tbody>
</table>

Fig. 1

(ii) Tests on powdered metal Z

<table>
<thead>
<tr>
<th>test</th>
<th>observation</th>
<th>conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. (a)</td>
<td>Add acid Y to a little powdered metal Z and test the gas given off.</td>
<td>Bubbles are formed Gas is given off.</td>
</tr>
<tr>
<td>(b)</td>
<td>State the test to identify the gas given off in (a)</td>
<td>The gas is hydrogen.</td>
</tr>
<tr>
<td>4.</td>
<td>Add powdered metal Z to 20 cm$^3$ of aqueous copper (II) sulphate until no further change is seen.</td>
<td>The reaction is exothermic.</td>
</tr>
<tr>
<td>5.</td>
<td>Filter the mixture from 4. To 2 cm$^3$ of the filtrate, add a few drops of aqueous sodium hydroxide.</td>
<td>The presence of zinc is suspected.</td>
</tr>
<tr>
<td>6.</td>
<td>Add more aqueous sodium hydroxide to the mixture from 5 until no further change is seen.</td>
<td>The presence of zinc is confirmed.</td>
</tr>
</tbody>
</table>

Fig. 2
(b) Test on dilute acid Y

<table>
<thead>
<tr>
<th>test</th>
<th>observation</th>
<th>conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. To 2 cm$^3$ of acid Y, add 2 cm$^3$ of dilute nitric acid and 2 cm$^3$ of silver nitrate.</td>
<td>A white precipitate is formed which darkens when exposed to light.</td>
<td>[1]</td>
</tr>
</tbody>
</table>

Fig. 3

(c) (i) Name dilute acid Y.

………………………………………………………………………………………………………………………… [1]

(ii) Draw a labelled diagram to show how the mixture from test 5 is filtered.

[2]
QUESTION 2:

A student investigated the way in which a current in a piece of wire varied with its length. The student set up the circuit shown in Fig. 4.

- The student closed the switch and touched the contact on the wire at the 100 mm (10 cm) mark.
- The student read the ammeter and recorded the reading in Fig. 5.
- The student repeated this procedure, touching the wire at the lengths shown in Fig. 5.
(a) The ammeter scale for three of his readings is shown in Fig. 6. Record the readings in Fig. 5.

<table>
<thead>
<tr>
<th>length of wire / mm</th>
<th>100</th>
<th>200</th>
<th>450</th>
<th>650</th>
</tr>
</thead>
<tbody>
<tr>
<td>ammeter reading / mA</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 5

length of wire = 200 mm

length of wire = 450 mm

length of wire = 650 mm

Fig. 6

Fig. 7
(b) Plot a graph of current (I) against the length of wire \(l\) on the grid provided. Draw a suitable line through the points.

Fig. 8

(c) Use your graph to determine the current flowing through an identical piece of wire of length 1 000 mm.

\[ \text{……………………………………………………………………………………..} \]  [1]

(d) Using the value of \(I\) from (c), calculate the resistance of 1 000 mm of this wire using the formula

\[ R = \frac{E}{I} \times 1000 \]

where \(E\) is the voltage of the cell used in the circuit, 1.5 V.

\[ \text{resistance of 1000 mm of wire} = \text{……………….. ohms (Ω)} \]  [1]

28
Ohm's Law states that the current through a wire is directly proportional to the voltage across its end. Briefly explain how you would carry out an experiment to verify Ohm's Law. Draw a diagram of the circuit you would use. Include in the circuit a variable resistor and a voltmeter.

.......................................................... ..........................................................

.......................................................... ..........................................................

.......................................................... ..........................................................

.......................................................... .......................................................... [3]
QUESTION 3:

This question is about the rate of the decomposition of aqueous hydrogen peroxide into water and oxygen. Manganese (IV) oxide acts as a catalyst when hydrogen peroxide decomposes.

\[
2\text{H}_2\text{O}_2(\text{aq}) \rightarrow 2\text{H}_2\text{O}(l) + \text{O}_2(\text{g})
\]

A student did two experiments to decompose aqueous hydrogen peroxide. The student collected the gas in a burette. A burette is shown in Fig. 9.

Fig. 9

The apparatus was set up as shown in Fig. 10.

Fig. 10
• In the first experiment, the student placed 0.1 g of manganese (IV) oxide in the flask.
• The student placed 5 cm³ of aqueous hydrogen peroxide solution in the small tube which was held upright by the piece of cotton.
• The student filled the burette with water and placed it over the end of the delivery tube.

(a) Why was only a very small amount of manganese (IV) oxide needed for this reaction?

……………………………………………………………………………………………………………………… [1]

• The student started the reaction by tipping the flask.
• The aqueous hydrogen peroxide came out of the small tube and mixed with the manganese (IV) oxide. Gas was given off and was collected in the burette.
• Every 30 seconds, the student read the scale of the burette and noted the volume in the results table, Fig. 11.

<table>
<thead>
<tr>
<th>Time t/s</th>
<th>30</th>
<th>60</th>
<th>90</th>
<th>120</th>
<th>150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burette reading/cm³</td>
<td>24.0</td>
<td>7.5</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 11

Fig. 12 shows the scale of the burette at time 60 s and time 120 s.

(b) Read the burette scales in Fig. 12 and record the readings in Fig. 11. [2]
(c) Calculate the total volume of oxygen given off between \( t = 30 \text{ s} \) and \( t = 150 \text{ s} \).

……………………………………………………………………………………
…………………………………………………………………………… [1]

In the second experiment, the student refilled the burette with water.

- The student placed a fresh 5 cm\(^3\) sample of aqueous hydrogen peroxide in the small tube.
- The flask still contained the mixture left from the first experiment.
- The student did not put any more manganese (IV) oxide into the flask.
- Then the student tipped the flask so that the reaction began again.

(d) Would the results of this second experiment be the same as the first, or different? Explain your answer.

……………………………………………………………………………………
……………………………………………………………………………………
…………………………………………………………………………………… [2]

(e) The student filtered the mixture from the flask after the two experiments. The student dried and weighed the residue.

(i) Name the residue. …………………………………………………………… [1]

(ii) What was the mass of the residue? (Ignore the mass of the filter paper).

………………… g [1]
QUESTION 4:

An experiment in which a ray of light is refracted by a transparent prism is represented by Fig. 13

![Diagram of light ray through prism](image)

Fig. 13

(a) The incident ray travels through points O and P and meets the face of the prism at the point Q. On the diagram indicate the point Q and draw the line (including the direction) which represents the incident ray. Label this line with the letter A. [2]

(b) Draw in the line which represents the path of the ray which is refracted through the prism. Label this line with the letter B. [2]

(c) After passing through the prism, the path of the emergent ray is marked by the points S and R. On the diagram (Fig. 13), indicated the point S and R and draw the line which represents the emergent ray. This line should start at the face of the prism. Label this line with the letter C. [2]

(d) Now you are to measure the angle of incidence at the point Q. To do this you must draw in the normal at this point. Before you do this, state how long the normal should be.

Length of normal .................................................................

Why did you choose this length for the normal?

........................................................................................................

........................................................................................................

Now draw in a normal and label the angle of incidence. Measure and record the angle of incidence.

Angle of incidence = ............................................................... [5]
QUESTION 5:

The diagrams A, B, C and D in Fig. 14 show different methods of separating mixtures.

(a) Name the method of separation shown in each diagram.

Diagram A shows ........................................................

Diagram B shows ........................................................

Diagram C shows ........................................................

Diagram D shows ........................................................ [4]

(b) Name the pieces of apparatus labelled X and Y in diagram D.

X is ........................................................

Y is ........................................................ [2]
(c) Identify the methods of separation, A, B, C or D, to separate each of the following mixtures.

You must choose a different method for each mixture.

(i) a mixture of coloured inks method ....................

(ii) a mixture of sand and water method ....................

(iii) a mixture of alcohol and water method ....................

(iv) a mixture of sugar and water method .................... [4]
QUESTION 6:

A student investigated how the solubility of solids in water changed with temperature.

- The student weighed out 50 g of potassium chloride and added it to 100 cm³ of water in a beaker.
- The student gently heated the beaker until all of the potassium chloride had dissolved.
- The student then placed the beaker in a bowl of cold water to cool it.
- The student recorded the temperature when crystals began to form.

The experiment was continued as follows:

- The student added 25 cm³ of water to the beaker, making the volume up to 125 cm³.
- The student warmed the mixture until all the potassium chloride had dissolved again.
- Then the student cooled the beaker again and recorded the new temperature at which crystals appeared.
- The student carried out this method three more times, adding further volumes of water. The total volumes of water used were 150 cm³, 175 cm³ and 200 cm³.

(a) The thermometer readings for these last three volumes are shown in Fig. 15.
Read the thermometers and record the results in the table, Fig. 16.

<table>
<thead>
<tr>
<th>Mass of solid / g</th>
<th>Volume of water / cm³</th>
<th>Temperature / °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>50</td>
<td>125</td>
<td>56</td>
</tr>
<tr>
<td>50</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 16**

(b) The unit of solubility is g/100 cm³ of water. Solubility is calculated using the formula below.

\[
\text{Solubility} = \frac{\text{mass of solid}}{\text{volume of water}} \times 100
\]

Using this formula and the values in Fig. 16, calculate the solubility of potassium chloride at

1. 80°C,
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................ [2]

2. 56°C.
   ........................................................................................................
   ........................................................................................................
   ........................................................................................................ [2]
(c) The graph in Fig. 17 shows the change in solubility of three solids, A, B and C, with temperature.

![Graph showing solubility of solids A, B, and C with temperature](image)

**(i)** Interpret the solubility of A and B at point X.

\[ \text{Solution:} \]

\[ \text{Solubility of A and B at point X.} \] \[ \text{[1]} \]

**(ii)** Predict which of A, B or C is the most soluble solid at 10°C.

\[ \text{Solution:} \]

\[ \text{Solid C is the most soluble at 10°C.} \] \[ \text{[1]} \]

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MINISTRY OF EDUCATION

Namibia Senior Secondary Certificate (NSSC)

PHYSICAL SCIENCE: ORDINARY LEVEL

PAPER 3: APPLIED PRACTICAL SKILLS PAPER
MARK SCHEME

QUESTION 1

(a) (i) 1. Observation - splint relights [1]
2. Conclusion - gas is acidic [1]
gas is chlorine [1]

(ii) 3. (b) Test - lighted/burning splint [1]
Observation - gas “pops”/explodes [1]
4. Observation - container becomes warm [1]
(not "energy" is given off or heat produced)
5. Observation - white precipitate [1]
6. Observation - white precipitate dissolves in excess [1]
7. Conclusion - chlorine/Cl\(^{-}\) ions/silver chloride formed [1]

(b) (i) Hydrochloric acid/HCl [1]
(ii) Drawing clearly shows filter funnel/paper [1]
with collecting vessel [1]

Total [12]

QUESTION 2

(a) 78, 57, 47 [3]

(b) 1 mark for heading [1]
(Please Note: By convention and for consistency with Mathematics and Biology the heading will always have the dependent vs. the independent as title)
2 marks for points plotted correctly [1]
1 mark for spacing [1]
1 mark for best line curve [5]

(c) between 30 and 40 mA [1]

(d) ± 40 (ecf from (c)) [1]

(e) 1 mark for conductor with non heating effect [1]
1 mark for correct voltmeter in correct position [1]
1 mark for variable resistor [3]

Total [13]
QUESTION 3

(a) Small amount needed because it is a catalyst and catalysts are not used up during reaction [1]

(b) Readings are: 13. [1] and 4.0 (do not allow 4) [1]

(c) Total volume of oxygen = 24 - 1.5 = 22.5 cm³ [1]

(d) Results same because same amount of oxygen produced [1] Results different because hydrogen peroxide is diluted in second experiment [1]

(e) (i) Manganese (IV) oxide (allow manganese oxide) [1] (ii) 0.1 g [1] Total [8]

QUESTION 4

(a) 1 mark for incidence line (letter A) 1 mark for direction and indicated the point Q [2]

(b) 1 mark for line (letter B) (line clearly changes direction) 1 mark for pass through all points marked by the points Q and R. [2]

(c) 1 mark for line (letter C) (line clearly changes direction) 1 mark for pass through all points marked by the points R and S [2]


QUESTION 5


(b) Apparatus X – thermometer Apparatus Y - (Liebig) condenser [2]

(c) Allow name or letter {Allow ecf from incorrect name in (a)} (i) Chromatography or C (ii) Filtering or A (iii) Distillation or D (iv) Evaporation or B [4] Total [10]
QUESTION 6

(a) Temperatures are: 32 (do not allow 32 °C)
    24 (do not allow 24 °C)
    18 (do not allow 18 °C)
    (no tolerance allowed)      [3]

(b) (i) Solubility at 80 °C = \( \frac{50}{100} \times 100 = 50 \text{ (g/100 cm}^3\) \) Unit not required
    Allow 2 marks for correct answer (with/without working)
    Allow 1 mark for correct substitution with incorrect answer        [2]

(ii) Solubility at 56 °C = \( \frac{50}{125} \times 100 = 40 \text{ (g/100 cm}^3\) \) Unit not required
    Allow 2 marks for correct answer (with/without working)
    Allow 1 mark for correct substitution with incorrect answer        [2]

(c) (i) The solubilities are equal/the same          [1]

(ii) B                        [1]

Total [6]