basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## PHYSICAL SCIENCES: PHYSICS (P1)

## NOVEMBER 2011

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 15 pages and 3 data sheets.**

## INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of TWO sections:

   SECTION A (25)
   SECTION B (125)

3. Answer ALL the questions in the ANSWER BOOK.

4. You may use a non-programmable calculator.

5. You may use appropriate mathematical instruments.

6. Number the answers correctly according to the numbering system used in this question paper.

7. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.

8. Give brief motivations, discussions, et cetera where required.

9. Round off your final numerical answers to a minimum of TWO decimal places.

## SECTION A

### QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The rate at which work is done (1)

1.2 The term that describes two sources that produce waves that have a constant phase relationship to each other (1)

1.3 The general name given to the insulating material between the plates of capacitors (1)

1.4 The type of current produced by an electric generator which has slip rings (1)

1.5 The unit of measurement of electric field (1)
**[5]**

### QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

2.1 Impulse is equal to the …

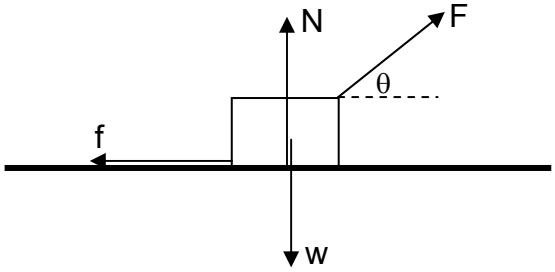
A initial momentum of a body.

B final momentum of a body.

C change in momentum of a body.

D rate of change in momentum of a body. (2)

2.2 An object is pulled along a straight horizontal road to the right without being lifted. The force diagram below shows all the forces acting on the object.




Which ONE of the above forces does POSITIVE WORK on the object?

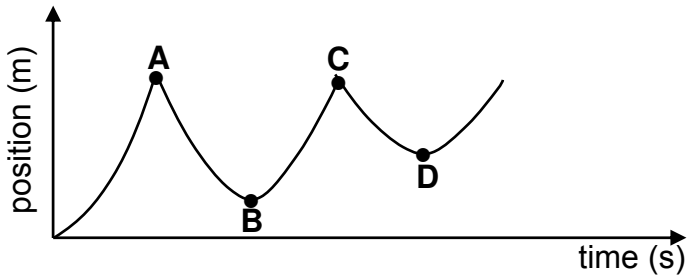
A w

B N

C f

D F (2)

2.3 A ball is released from rest from a certain height above the floor and bounces off the floor a number of times. The position-time graph below represents the motion of the bouncing ball from the instant it is released from rest.




Neglecting air resistance, which point (**A**, **B**, **C** or **D**) on the graph represents the position-time coordinates of the maximum height reached by the ball after the SECOND bounce?

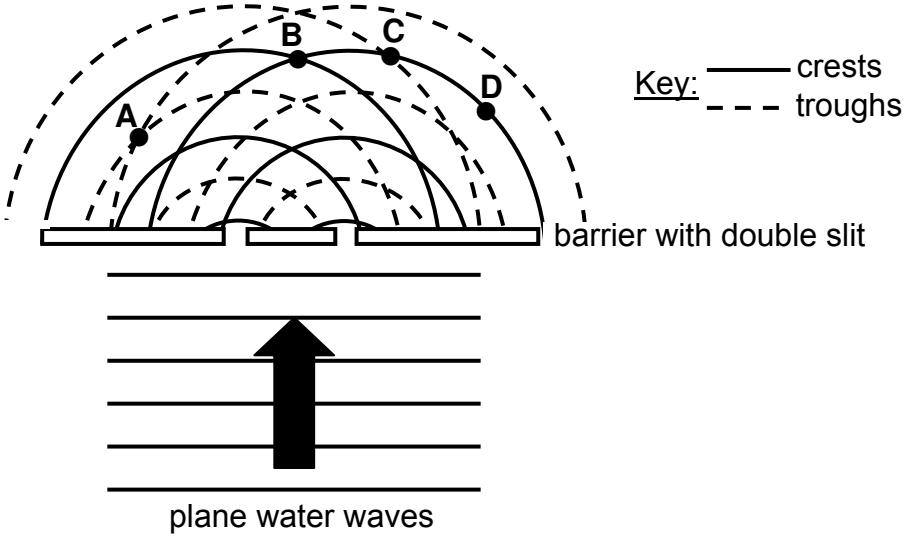
A A

B B

C C

D D (2)

2.4 Water waves pass through a double slit. The resulting circular wavefronts produced are shown as dotted and solid lines in the diagram below.




Which ONE of the points (**A**, **B**, **C** or **D**) lies on a nodal line?

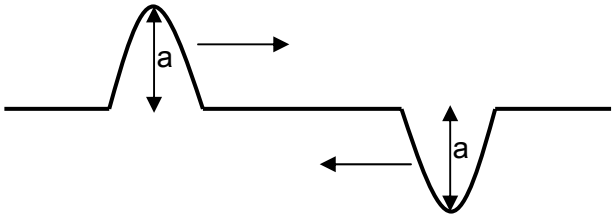
A A

B B

C C

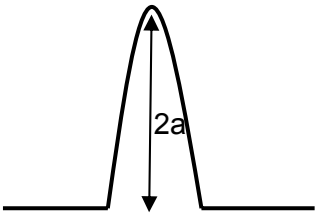
D D (2)

2.5 The diagram below represents two pulses, each of amplitude *a*, travelling in opposite directions along a slinky coil.




Which ONE of the following represents the resultant amplitude at the instant that these two pulses meet?

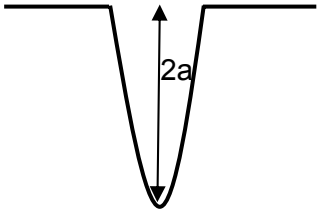
A



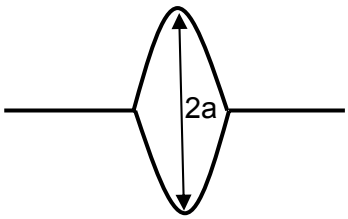

B



C




D

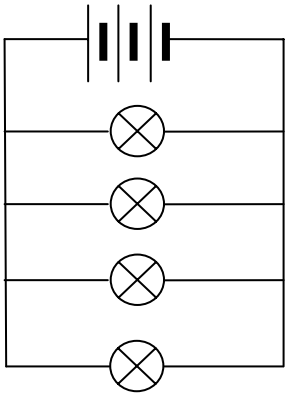



(2)

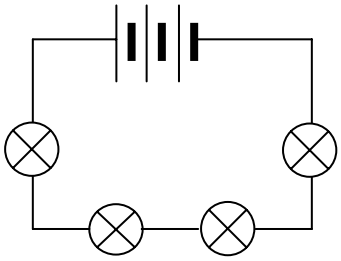
2.6 A set of identical light bulbs are connected as shown in the circuit diagrams below. The internal resistance of the battery is negligible.

In which ONE of these circuits will the light bulbs glow the brightest?

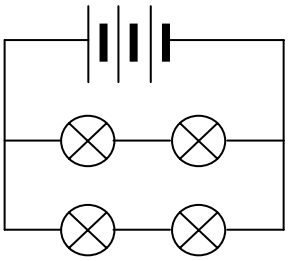
A



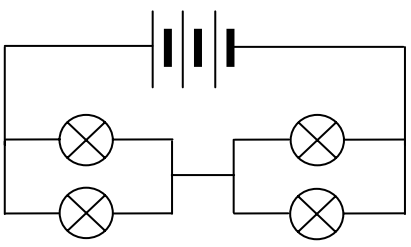
B



C



D



(2)

2.7 The unit of measurement of THE RATE OF FLOW OF CHARGE in a conductor is …

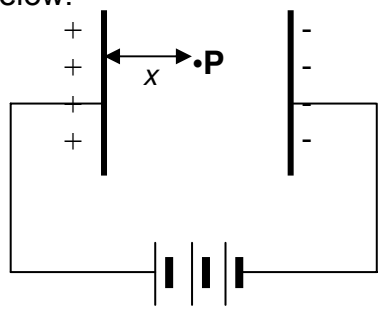
A watt.

B volt.

C ampere.

D coulomb. (2)

2.8 Point **P** is a distance *x* from the positive plate of a parallel-plate capacitor as shown in the diagram below.




The magnitude of the electric field at **P** is *E*. At a distance $\frac{1}{2}x$ from the positive plate, the magnitude of the electric field will be …

A $\frac{1}{4}E$

B $\frac{1}{2}E$

C $E$

D $2E$ (2)

2.9 Which ONE of the following descriptions best explains the formation of a line emission spectrum?

A line emission spectrum is formed when …

A white light passes through a cold gas.

B white light passes through a triangular prism.

C electrons in the ground state move to a higher energy level.

D electrons in the excited state move to a lower energy level. (2)

2.10 Which ONE of the following electromagnetic waves has the shortest wavelength?

A Radio waves

B Gamma rays

C Infrared rays

D Ultraviolet rays (2)

**[20]**

**TOTAL SECTION A: 25**

## SECTION B

## INSTRUCTIONS AND INFORMATION

1. Start EACH question on a NEW page.

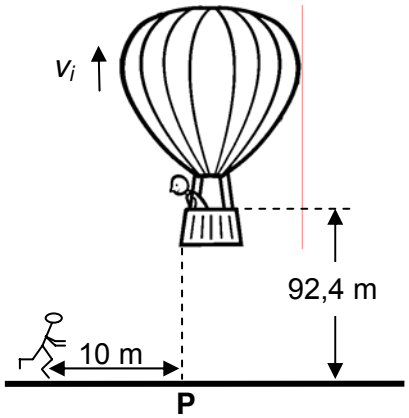
2. Leave ONE line between two subquestions, for example between QUESTION 3.1 and QUESTION 3.2.

3. Show the formulae and substitutions in ALL calculations.

4. Round off your final numerical answers to a minimum of TWO decimal places.

## QUESTION 3 (Start on a new page.)

A hot-air balloon is moving vertically upwards at a constant speed. A camera is accidentally dropped from the balloon at a height of 92,4 m as shown in the diagram below. The camera strikes the ground after 6 s. Ignore the effects of friction.




3.1 At the instant the camera is dropped, it moves upwards. Give a reason for this observation. (1)

3.2 Calculate the speed $v_i$ at which the balloon is rising when the camera is dropped. (4)

3.3 Draw a sketch graph of velocity versus time for the entire motion of the camera.

Indicate the following on the graph:

- Initial velocity
- Time at which it reaches the ground (4)

3.4 If a jogger, 10 m away from point **P** as shown in the above diagram and running at a constant speed of 2 $m \cdot s^{-1}$, sees the camera at the same instant it starts falling from the balloon, will he be able to catch the camera before it strikes the ground?

Use a calculation to show how you arrived at the answer. (5)
**[14]**

**QUESTION 4 (Start on a new page.)**

A patrol car is moving on a straight horizontal road at a velocity of 10 m·s$^{-1}$ east. At the same time a thief in a car ahead of him is driving at a velocity of 40 m·s$^{-1}$ in the same direction.


$v_{PG}$: velocity of the **p**atrol car relative to the **g**round
$v_{TG}$: velocity of the **t**hief's car relative to the **g**round

4.1 Write down the velocity of the thief's car relative to the patrol car. (2)

A person in the patrol car fires a bullet at the thief's car. The bullet leaves the gun with an initial horizontal velocity of 100 m·s$^{-1}$ relative to the patrol car. Ignore the effects of friction.

4.2 Write down the initial velocity of the **b**ullet relative to the **t**hief's car. (2)

While travelling at 40 m·s$^{-1}$, the thief's car of mass 1 000 kg, collides head-on with a truck of mass 5 000 kg moving at 20 m·s$^{-1}$. After the collision, the car and the truck move together. Ignore the effects of friction.


4.3 State the *law of conservation of linear momentum* in words. (2)

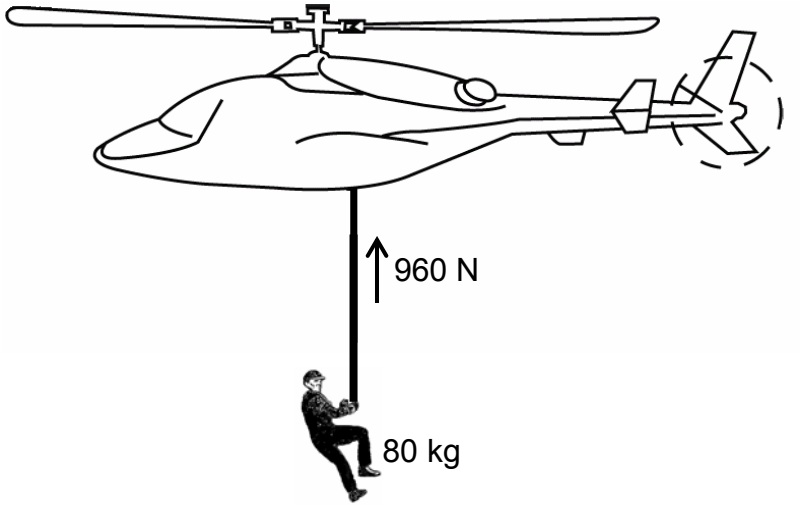
4.4 Calculate the velocity of the thief's car immediately after the collision. (6)

4.5 Research has shown that forces greater than 85 000 N during collisions may cause fatal injuries. The collision described above lasts for 0,5 s.

Determine, by means of a calculation, whether the collision above could result in a fatal injury. (5)
**[17]**

**QUESTION 5 (Start on a new page.)**

A rescue helicopter is stationary (hovers) above a soldier. The soldier of mass 80 kg is lifted vertically upwards through a height of 20 m by a cable at a CONSTANT SPEED of 4 m·s$^{-1}$. The tension in the cable is 960 N. Assume that there is no sideways motion during the lift. Air friction is not to be ignored.




5.1 State the work-energy theorem in words. (2)

5.2 Draw a labelled free-body diagram showing ALL the forces acting on the soldier while being lifted upwards. (3)

5.3 Write down the name of a non-contact force that acts on the soldier during the upward lift. (1)

5.4 Use the WORK-ENERGY THEOREM to calculate the work done on the soldier by friction after moving through the height of 20 m. (5)
**[11]**

**QUESTION 6 (Start on a new page.)**

A train approaches a station at a constant speed of 20 m·s$^{-1}$ with its whistle blowing at a frequency of 458 Hz. An observer, standing on the platform, hears a change in pitch as the train approaches him, passes him and moves away from him.

6.1 Name the phenomenon that explains the change in pitch heard by the observer. (1)

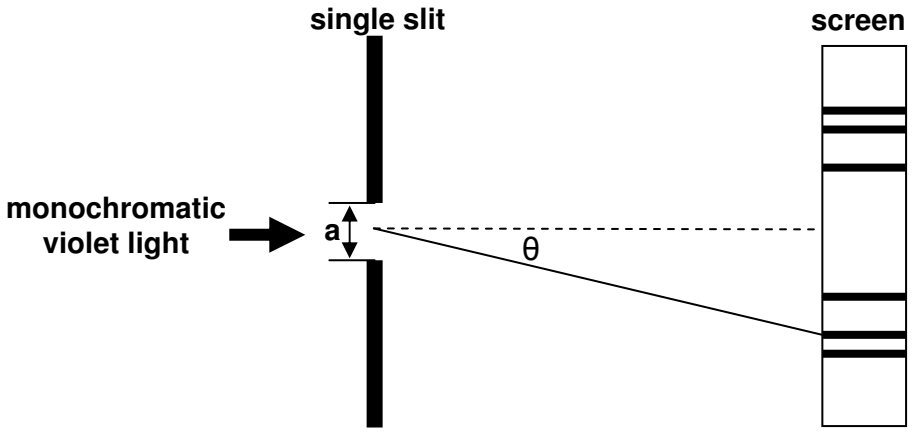
6.2 Calculate the frequency of the sound that the observer hears while the train is approaching him. Use the speed of sound in air as 340 m·s$^{-1}$. (4)

6.3 How will the observed frequency change as the train passes and moves away from the observer? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)

6.4 How will the frequency observed by the train driver compare to that of the sound waves emitted by the whistle? Write down only GREATER THAN, EQUAL TO or LESS THAN. Give a reason for the answer. (2)
**[8]**

**QUESTION 7 (Start on a new page.)**

A learner investigates the change in broadness of the central bright band in a diffraction pattern when light passes through single slits of different widths. She uses monochromatic violet light of wavelength 4 x $10^{-7}$ m. The apparatus is set up as shown in the diagram below.




7.1 Define the term *monochromatic light*. (2)

7.2 Write down the investigative question for this investigation. (2)

7.3 Write down TWO variables that are kept constant during this investigation. (2)

7.4 The learner now uses a narrower slit.

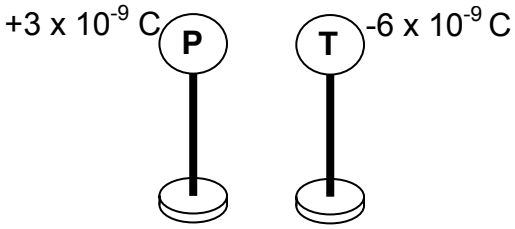
How will the broadness of the central bright band change? Write down only INCREASES, DECREASES or REMAINS THE SAME.

Give an explanation. (2)

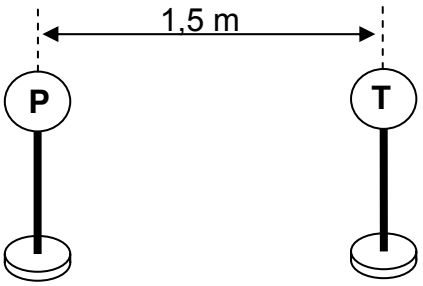
7.5 Calculate the angle θ at which the second minimum is formed if a slit of width 2,2 x $10^{-6}$ m is used. (5)
**[13]**

**QUESTION 8 (Start on a new page.)**

Two metal spheres, **P** and **T**, on insulated stands, carry charges of +3 x $10^{-9}$ C and -6 x $10^{-9}$ C respectively.




The spheres are allowed to touch each other and are then placed 1,5 m apart as shown below.




8.1 In which direction will electrons flow while spheres **P** and **T** are in contact? Write down only FROM **P** TO **T** or FROM **T** TO **P**. (1)

8.2 Calculate the net charge gained or lost by sphere **P** after the spheres have been in contact. (3)

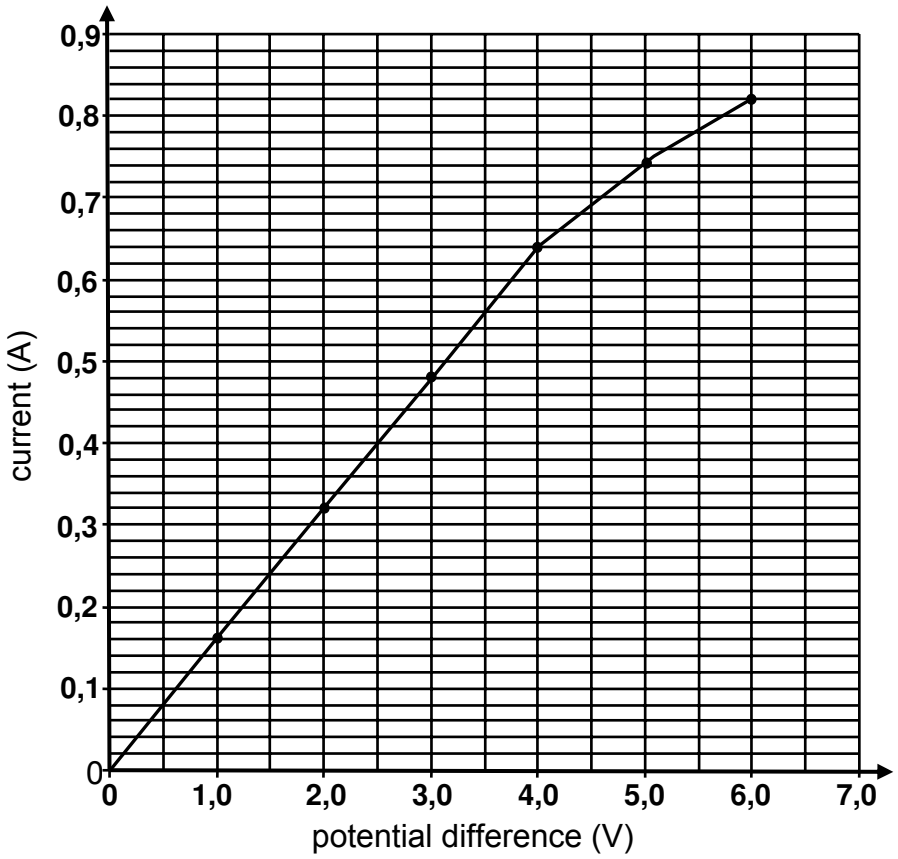
8.3 Calculate the number of electrons transferred during the process in QUESTION 8.2. (2)

8.4 A third sphere **R,** carrying a charge of -3 x $10^{-9}$ C, is NOW placed between **P** and **T** at a distance of 1 m from **T**.

Calculate the net force experienced by sphere **R** as a result of its interaction with **P** and **T**. (6)
**[12]**

**QUESTION 9 (Start on a new page.)**

Learners conduct an investigation to verify Ohm's law. They measure the current through a conducting wire for different potential differences across its ends. The results obtained are shown in the graph below.




9.1 Which ONE of the measured quantities is the dependent variable? (1)

9.2 The graph deviates from Ohm's law at some point.

9.2.1 Write down the coordinates of the plotted point on the graph beyond which Ohm's law is not obeyed. (2)

9.2.2 Give a possible reason for the deviation from Ohm's law as shown in the graph. Assume that all measurements are correct. (2)

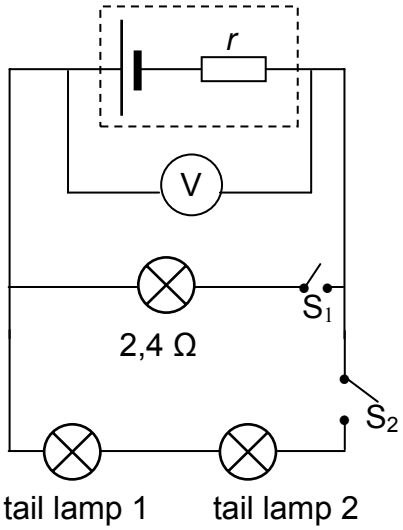
9.3 Calculate the gradient of the graph for the section where Ohm's law is obeyed.

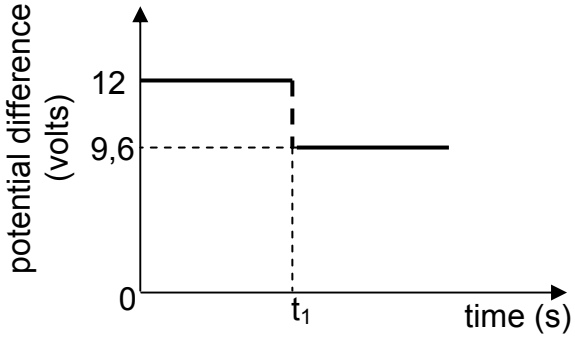
Use this to calculate the resistance of the conducting wire. (4)
**[9]**

**QUESTION 10 (Start on a new page.)**

The headlamp and two IDENTICAL tail lamps of a scooter are connected in parallel to a battery with unknown internal resistance as shown in the simplified circuit diagram below. The headlamp has a resistance of 2,4 Ω and is controlled by switch **$S_1$**. The tail lamps are controlled by switch **$S_2$**. The resistance of the connecting wires may be ignored.

The graph alongside shows the potential difference across the terminals of the battery before and after switch **$S_1$** is closed (whilst switch **$S_2$** is open). Switch **$S_1$** is closed at time $t_1$.




10.1 Use the graph to determine the emf of the battery. (1)

10.2 WITH ONLY SWITCH **$S_1$** CLOSED, calculate the following:

10.2.1 Current through the headlamp (3)

10.2.2 Internal resistance, *r*, of the battery (3)

10.3 BOTH SWITCHES **$S_1$** AND **$S_2$** ARE NOW CLOSED. The battery delivers a current of 6 A during this period.

Calculate the resistance of each tail lamp. (5)

10.4 How will the reading on the voltmeter be affected if the headlamp burns out? (Both switches **$S_1$** and **$S_2$** are still closed.)

Write down only INCREASES, DECREASES or REMAINS THE SAME.

Give an explanation. (3)
**[15]**

**QUESTION 11 (Start on a new page.)**

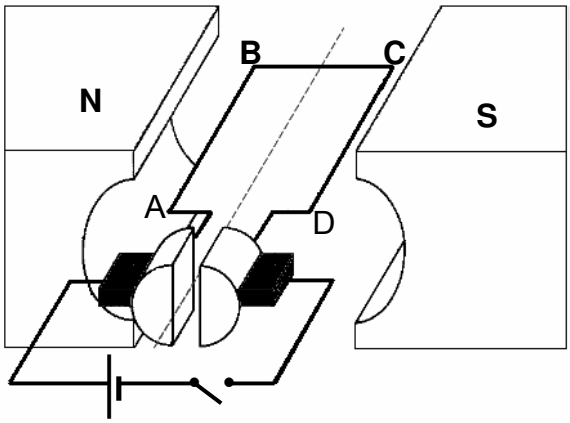
Diesel-electric trains make use of electric motors as well as generators.

11.1 The table below compares a motor and a generator in terms of the type of energy conversion and the underlying principle on which each operates. Complete the table by writing down only the question number (11.1.1–11.1.4) in the ANSWER BOOK and next to each number the answer.

| | TYPE OF ENERGY CONVERSION | PRINCIPLE OF OPERATION |
|---|---|---|
| **Motor** | 11.1.1 | 11.1.3 |
| **Generator** | 11.1.2 | 11.1.4 |

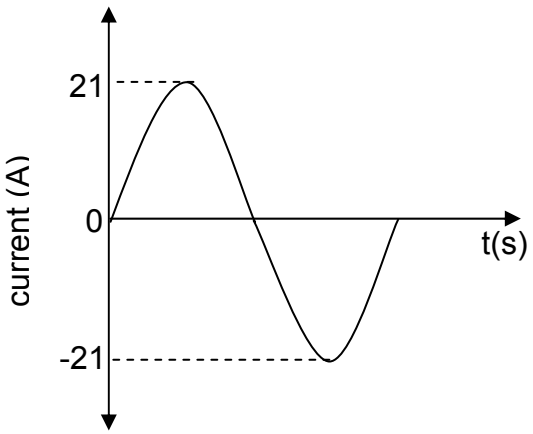
(4)

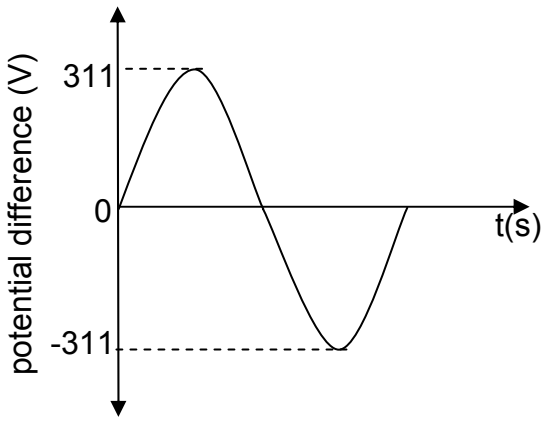
The simplified diagram below represents an electric motor.




11.2 Give a reason why the section of the coil labelled **BC** in the above diagram does not experience a magnetic force whilst the coil is in the position as shown. (2)

11.3 Graphs of the current and potential difference outputs of an AC generator are shown below.



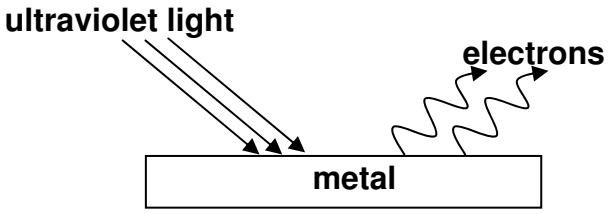




Calculate the average power output of this generator. (6)
**[12]**

**QUESTION 12 (Start on a new page.)**

A metal surface is illuminated with ultraviolet light of wavelength 330 nm. Electrons are emitted from the metal surface.

The minimum amount of energy required to emit an electron from the surface of this metal is $3,5 \times 10^{-19}$ J.




12.1 Name the phenomenon illustrated above. (1)

12.2 Give ONE word or term for the underlined sentence in the above paragraph. (1)

12.3 Calculate the frequency of the ultraviolet light. (4)

12.4 Calculate the kinetic energy of a photoelectron emitted from the surface of the metal when the ultraviolet light shines on it. (4)

12.5 The intensity of the ultraviolet light illuminating the metal is now increased. What effect will this change have on the following:

12.5.1 Kinetic energy of the emitted photoelectrons (Write down only INCREASES, DECREASES or REMAINS THE SAME.) (1)

12.5.2 Number of photoelectrons emitted per second (Write down only INCREASES, DECREASES or REMAINS THE SAME.) (1)

12.6 Overexposure to sunlight causes damage to skin cells.

12.6.1 Which type of radiation in sunlight is said to be primarily responsible for this damage? (1)

12.6.2 Name the property of this radiation responsible for the damage. (1)
**[14]**

**TOTAL SECTION B: 125**
**GRAND TOTAL: 150**

# DATA FOR PHYSICAL SCIENCES GRADE 12
# PAPER 1 (PHYSICS)

## *GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12*
## *VRAESTEL 1 (FISIKA)*

### TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Acceleration due to gravity<br>*Swaartekragversnelling* | g | 9,8 $m \cdot s^{-2}$ |
| Speed of light in a vacuum<br>*Spoed van lig in 'n vakuum* | c | $3,0 \times 10^{8}$ $m \cdot s^{-1}$ |
| Planck's constant<br>*Planck se konstante* | h | $6,63 \times 10^{-34}$ J·s |
| Coulomb's constant<br>*Coulomb se konstante* | k | $9,0 \times 10^{9}$ $N \cdot m^{2} \cdot C^{-2}$ |
| Charge on electron<br>*Lading op elektron* | e | $-1,6 \times 10^{-19}$ C |
| Electron mass<br>*Elektronmassa* | $m_e$ | $9,11 \times 10^{-31}$ kg |
| Permittivity of free space<br>*Permittiwiteit van vry ruimte* | $\varepsilon_0$ | $8,85 \times 10^{-12}$ $F \cdot m^{-1}$ |

## TABLE 2: FORMULAE/*TABEL 2: FORMULES*

### MOTION/*BEWEGING*

| | |
|---|---|
| $v_f = v_i + a\,\Delta t$ | $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ |
| $v_f^{\,2} = v_i^{\,2} + 2a\Delta x$ or/*of* $v_f^{\,2} = v_i^{\,2} + 2a\Delta y$ | $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ |

### FORCE/*KRAG*

| | |
|---|---|
| $F_{net} = ma$ | $p = mv$ |
| $F_{net}\Delta t = \Delta p$<br>$\Delta p = mv_f - mv_i$ | $w = mg$ |

### WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

| | | |
|---|---|---|
| $W = F\Delta x\cos\theta$ | $U = mgh$ or/*of* $E_P = mgh$ | |
| $K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$ | $W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$<br>$\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$ | |
| $P = \frac{W}{\Delta t}$ | $P = Fv$ | |

### WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

| | |
|---|---|
| $v = f\lambda$ | $T = \frac{1}{f}$ |
| $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/*of* $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$ | $E = hf$<br>$E = h\frac{c}{\lambda}$ |
| $\sin\theta = \frac{m\lambda}{a}$ | $E = W_o + E_k$<br>where/*waar*<br>$E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_k = \frac{1}{2}mv^2$ |

## ELECTROSTATICS/*ELEKTROSTATIKA*

| | |
|---|---|
| $F = \frac{kQ_1Q_2}{r^2}$ | $E = \frac{kQ}{r^2}$ |
| $E = \frac{V}{d}$ | $E = \frac{F}{q}$ |
| $U = \frac{kQ_1Q_2}{r}$ | $V = \frac{W}{q}$ |
| $C = \frac{Q}{V}$ | $C = \frac{\varepsilon_0 A}{d}$ |

## ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

| | |
|---|---|
| $R = \frac{V}{I}$ | emf ($\varepsilon$) = I(R + r)<br>emk ($\varepsilon$) = I(R + r) |
| $R_s = R_1 + R_2 + \ldots$<br>$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$ | $q = I\,\Delta t$ |
| W = Vq<br>W = VI$\Delta$t<br>W= $I^2R\,\Delta t$<br>W= $\frac{V^2\Delta t}{R}$ | $P = \frac{W}{\Delta t}$<br>P = VI<br>P = $I^2R$<br>P = $\frac{V^2}{R}$ |

## ALTERNATING CURRENT/*WISSELSTROOM*

| | | | |
|---|---|---|---|
| $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ | / | $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$ | $P_{average} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$ |
| | | | $P_{average} = I_{rms}^2R$ / $P_{gemiddeld} = I_{wgk}^2R$ |
| $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ | / | $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$ | $P_{average} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$ |

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

# NATIONAL SENIOR CERTIFICATE
# *NASIONALE SENIOR SERTIFIKAAT*

## GRADE/*GRAAD* 12

## PHYSICAL SCIENCES: PHYSICS (P1)
## *FISIESE WETENSKAPPE: FISIKA (V1)*

## NOVEMBER 2011

## MEMORANDUM

**MARKS/*PUNTE*: 150**

**This memorandum consists of 13 pages.**
***Hierdie memorandum bestaan uit 13 bladsye.***

## SECTION A

### QUESTION 1 / *VRAAG 1*

1.1 Power ✓
*Drywing / Arbeidstempo* ✓ (1)

1.2 Coherent / *Koherent* ✓ (1)

1.3 Dielectric / *Diëlektrikum* ✓ (1)

1.4 Alternating (current) / AC / ac ✓
*Wissel(stroom) / WS / ws* ✓ (1)

1.5 $N \cdot C^{-1}$ / $V \cdot m^{-1}$ / newton per coulomb / volt per meter ✓ (1)
**[5]**

### QUESTION 2 / *VRAAG 2*

2.1 C ✓✓ (2)

2.2 D ✓✓ (2)

2.3 D ✓✓ (2)

2.4 C ✓✓ (2)

2.5 B ✓✓ (2)

2.6 A ✓✓ (2)

2.7 C ✓✓ (2)

2.8 C ✓✓ (2)

2.9 D ✓✓ (2)

2.10 B ✓✓ (2)
**[20]**

**TOTAL SECTION A / *TOTAAL AFDELING A*: 25**

## SECTION B / *AFDELING B*

## QUESTION 3 / *VRAAG 3*

3.1 The initial velocity / speed of the camera is the same ✓
(as that of the balloon).
*Die begin<u>snelheid / spoed van die kamera</u> is <u>dieselfde</u> ✓(as dié van die ballon).* (1)

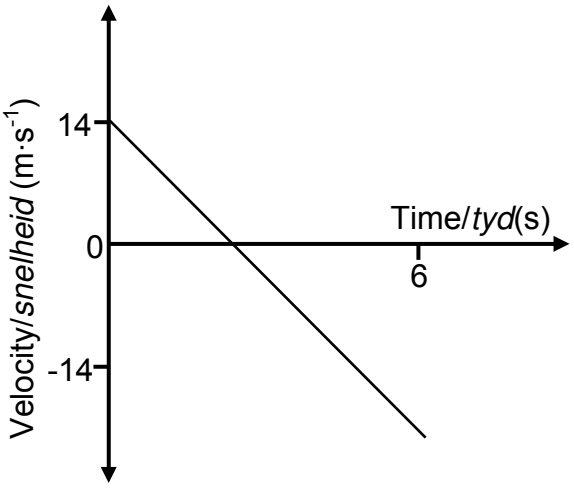
3.2 **Downward positive:**
***Afwaarts positief:***

$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$\therefore 92,4$ ✓$= \underline{v_i(6) + ½(9,8)(6)^2}$ ✓
$\therefore v_i = -14\ m{\cdot}s^{-1}$
$\therefore v_i = 14\ m{\cdot}s^{-1}$ ✓

**Downward negative:**
***Afwaarts negatief:***

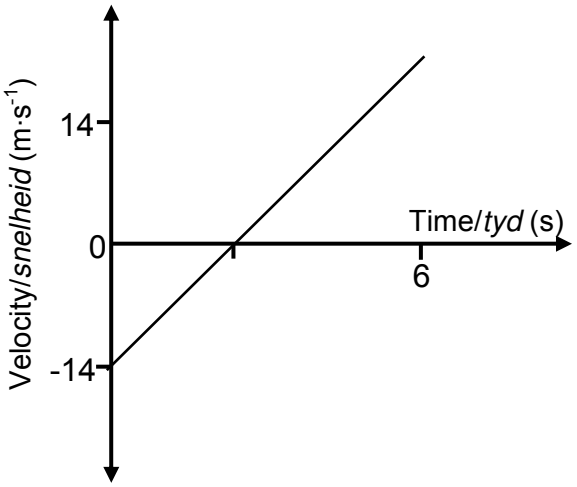
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓
$\therefore -92,4$ ✓$= \underline{v_i(6) + ½(-9,8)(6)^2}$ ✓
$\therefore v_i = 14\ m{\cdot}s^{-1}$ ✓ (4)

3.3 Upward positive/*Opwaarts positief*:




| **Criteria for graph/*Kriteria vir grafiek:*** | Marks/ *Punte* |
|---|---|
| Correct shape as shown.(straight line with gradient)<br>Korrekte *vorm soos getoon.(reguitlyn met gradient)* | ✓ |
| Graph starts at v = 14 $m{\cdot}s^{-1}$ / $v_i$ at t = 0 s.<br>*Grafiek begin by v = 14 $m{\cdot}s^{-1}$ / $v_i$ by t = 0 s.* | ✓ |
| Graph extends below t axis until t = 6 s.<br>*Grafiek verleng onder t-as tot t = 6 s.* | ✓ |
| Section of graph below t axis longer than section above t axis.<br>*Gedeelte van grafiek onderkant t-as langer as gedeelte bokant t-as.* | ✓ |

Upward negative / *Opwaarts negatief:*




| **Criteria for graph/*Kriteria vir grafiek:*** | Marks/ *Punte* |
|---|---|
| Correct shape as shown.<br>Korrekte *vorm soos getoon.* | ✓ |
| Graph starts at v / $v_i$ = -14 m·s$^{-1}$ at t = 0 s.<br>*Grafiek begin by v/$v_i$ = -14 m·s$^{-1}$ by t = 0 s.* | ✓ |
| Graph extends above t axis until t = 6 s.<br>*Grafiek verleng bokant t-as tot t = 6 s.* | ✓ |
| Section of graph above t axis longer than section below t axis.<br>*Gedeelte van grafiek bokant t-as langer as gedeelte onderkant t-as.* | ✓ |

(4)

3.4

**Option 1 / *Opsie 1*:**

$\Delta x = v\Delta t$✓

$\therefore 10$ ✓$= (2)\Delta t$ ✓

$\therefore \Delta t = 5$ s ✓

Yes/ Will catch the camera, time is less than 6 s. ✓

*Ja / Sal die kamera vang, tyd is kleiner as 6 s.* ✓

**Option 2/*Opsie 2*:**

$\Delta x = v\Delta t$✓

$= (2)$✓$(6)$ ✓

$= 12$ m ✓

Yes / Will catch the camera, distance covered is greater than 10 m. ✓

*Ja / Sal die kamera vang , afstand afgelê is groter as 10 m.* ✓

**Option 3 / *Opsie 3*:**

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$\therefore 10$ ✓$= (2)\Delta t$ ✓$+ ½(0)\Delta t$

$\therefore \Delta t = 5$ s ✓

Yes/ will catch the camera, time is less than 6 s✓.

*Ja / Sal die kamera vang, tyd is kleiner as 6 s.* ✓

**Option 4 / *Opsie 4*:**

$\Delta x = (\frac{v_i + v_f}{2})\Delta t$ ✓ $\therefore 10$ ✓$= (\frac{2+2}{2})\Delta t$ ✓ $\therefore \Delta t = 5$ s ✓

Yes / Will catch the camera, time is less than 6 s.✓

*Ja / Sal die kamera vang, tyd is kleiner as 6 s.* ✓

**Option 5 / *Opsie 5*:**

$\Delta x = (\frac{v_i + v_f}{2})\Delta t$ ✓ $= (\frac{2+2}{2})$✓$6$ ✓ $= 12$ m·✓

Yes / Will catch the camera, distance covered is greater than 10 m. ✓

*Ja / Sal die kamera vang , afstand afgelê is groter as 10 m.* ✓

(5)
**[14]**

## QUESTION 4 / *VRAAG 4*

4.1 $30\ m\cdot s^{-1}$ ✓east / *oos* ✓

**Notes / *Aantekeninge*:**
$v_{TP} = v_{TG} - v_{PG} = 40 - 10 = 30$
$\therefore v_{TP} = 30\ m\cdot s^{-1}$ east/*oos*

OR/*OF*
$v_{TP} = v_{TG} + v_{GP} = 40 + (-10) = 30$
$\therefore v_{TP} = 30\ m\cdot s^{-1}$ east/*oos*

(2)

4.2 $70\ m\cdot s^{-1}$ ✓ east / *oos* ✓

**Notes / *Aantekeninge*:**

**Solution 1 / *Oplossing 1*:**
$v_{BT} = v_{BP} - v_{TP}$
$= 100 - 30 = 70$
$\therefore v_{BT} = 70\ m\cdot s^{-1}$ east / *oos*

**Solution 2 / *Oplossing 2***
$v_{BT} = v_{BP} + v_{PT}$
$= 100 + (-30) = 70$
$\therefore v_{BT} = 70\ m\cdot s^{-1}$ east/*oos*

**OR / OF**
$v_{BT} = v_{BP} + v_{PG} + v_{GT}$
$= 100 + 10 + (-40)$
$= 70$
$\therefore v_{BT} = 70\ m\cdot s^{-1}$ east / *oos*

**Solution 3 / *Oplossing 3***
$v_{BT} = v_{BP} + v_{PG} + v_{GT}$
$= 100 + 10 + (-40)$
$= 70$
$\therefore v_{BT} = 70\ m\cdot s^{-1}$ east / *oos*

**Solution 4 / *Oplossing 4***
$v_{BG} = v_{BP} + v_{PG}$
$= 100 + 10 = 110$
$\therefore v_{BG} = 110\ m\cdot s^{-1}$
$v_{BT} = v_{BG} + v_{GT}$
$= 110 + (-40) = 70$
$\therefore v_{BT} = 70\ m\cdot s^{-1}$ east / *oos*

(2)

4.3 The total (linear) momentum remains constant/is conserved / does not change. ✓
in an isolated/a closed system/the absence of external forces. ✓

*Die totale (liniêre) momentum bly konstant / behoue / verander nie ✓*
*in 'n geïsoleerde sisteem / geslote sisteem / die afwesigheid van eksterne kragte. ✓*

(2)

4.4

**Option 1 / *Opsie 1*:**

To the right as positive / *Na regs as positief:*

$\Sigma p_{before/\ voor} = \Sigma p_{after/\ na}$ ✓

$\underline{(1\ 000)(40)}$ ✓ + $\underline{(5\ 000)(-20)}$ ✓ = $\underline{(1\ 000 + 5\ 000)v_f}$ ✓

$\therefore v_f = -10\ m{\cdot}s^{-1}$ ✓

$\therefore v_f = 10\ m{\cdot}s^{-1}$ $\underline{\text{left / } na\ links}$ ✓ **OR** / ***OF*** west / *wes*

**Option 2 / *Opsie 2*:**

To the right as positive / *Na regs as positief:*

$\Delta p_{car} = -\Delta p_{truck}$ ✓

$m(v_f - v_i) = -m(v_f - v_i)$

$\underline{(1000)(v_f - (40))}$ ✓ = $\underline{-(5\ 000)(v_f}$ ✓ $- (-20))$ ✓

$6\ 000v_f = -60\ 000$

$\therefore v_f = -10\ m{\cdot}s^{-1}$ ✓

$\therefore v_f = 10\ m{\cdot}s^{-1}$ $\underline{\text{left / } na\ links}$ ✓ **OR**/***OF*** west / *wes* (6)

4.5

| | |
|---|---|
| **Option 1 / *Opsie 1:*** | |
| Force on car / *Krag op motor:* | Force on car / *Krag op motor:* |
| To the right as positive / *Na regs as positief:* | To the left as positive / *Na links as positief:* |
| $F_{net}\Delta t = \Delta p$ ✓ $= mv_f - mv_i$ | $F_{net}\Delta t = \Delta p$ ✓ $= mv_f - mv_i$ |
| $F_{net}(0,5)$ ✓ = $\underline{1\ 000(-10 - 40)}$ ✓ | $F_{net}(0,5)$ ✓ = $\underline{1\ 000(10 - (-40))}$ ✓ |
| $\therefore F_{net} = -1 \times 10^5$ N ✓ OR/*OF* | $\therefore F_{net} = 1 \times 10^5$ N ✓ (100 000 N) |
| $\therefore F_{net} = 1 \times 10^5$ N (100 000 N) | $\therefore F_{net} > 85\ 000$ N |
| $\therefore F_{net} > 85\ 000$ N | Yes, collision is fatal. / *Ja, botsing is fatal.* ✓ |
| Yes, collision is fatal. / *Ja botsing is fataal.* ✓ | |
| **Option 2 / *Opsie 2:*** | |
| Force on truck / *Krag op vragmotor:* | Force on truck / *Krag op vragmotor:* |
| To the right as positive / *Na regs as positief:* | To the left as positive / *Na links as positief:* |
| $F_{net}\Delta t = \Delta p$ ✓ $= mv_f - mv_i$ | $F_{net}\Delta t = \Delta p$ ✓ $= mv_f - mv_i$ |
| $F_{net}(0,5)$ ✓ = $\underline{5\ 000(-10 - (-20))}$ ✓ | $F_{net}(0,5)$ ✓ = $\underline{5\ 000(10 - 20)}$ ✓ |
| $\therefore F_{net} = 1 \times 10^5$ N ✓ (100 000 N) | $\therefore F_{net} = -1 \times 10^5$ N ✓ |
| $\therefore F_{net} > 85\ 000$ N | $\therefore F_{net} = 1 \times 10^5$ N (100 000 N) |
| Yes, collision is fatal. / *Ja, botsing is fataal.* ✓ | $\therefore F_{net} > 85\ 000$ N |
| | Yes, collision is fatal / *Ja, botsing is fataal.* ✓ |
| **Option 3 / *Opsie 3:*** | |
| Force on car / *Krag op motor:* | Force on car / *Krag op motor:* |
| To the right as positive / *Na regs as positief:* | To the left as positive / *Na links as positief:* |
| $v_f = v_i + a\,\Delta t$ ✓ Both formulae/ *Beide formules* | $v_f = v_i + a\,\Delta t$ ✓ Both formulae/ *Beide formules* |
| $\therefore -10 = 40 + a(0,5)$ ✓ | $\therefore 10 = -40 + a(0,5)$ ✓ |
| $\therefore a = -100$ | $\therefore a = 100$ |
| $F_{net} = ma = (1\ 000)(-100)$ ✓ | $F_{net} = ma = (1\ 000)(100)$ ✓ |
| $\therefore F_{net} = -1 \times 10^5$ N ✓ (-100 000 N) | $\therefore F_{net} = 1 \times 10^5$ N ✓ (100 000 N) |
| $\therefore F_{net} = 1 \times 10^5$ N (100 000 N) | |
| $\therefore F_{net} > 85\ 000$ N | $\therefore F_{net} > 85\ 000$ N |
| Yes, collision is fatal. / *Ja, botsing is fataal.* ✓ | Yes, collision is fatal. / *Ja, botsing is fataal.* ✓ |

| **Option 4 / *Opsie 4*:** | |
|---|---|
| Force on truck */ Krag op vragmotor:*<br>To the right as positive / *Na regs as positief:*<br><br>$v_f = v_i + a\,\Delta t$<br>$\therefore$ -10 = -20 + a(0,5) ✓<br>$\therefore a = 20$<br>$F_{net} = ma = (5\,000)(20)$ ✓<br>$\therefore F_{net} = 1 \times 10^5$ N ✓ (100 000 N)<br><br>$\therefore F_{net} > 85\,000$ N<br><br>Yes, collision is fatal. / *Ja, botsing is fataal.* ✓<br><br>✓ Both formulae/ *Beide formules* | Force on truck */ Krag op vragmotor:*<br>To the left as positive / *Na links as positief:*<br><br>$v_f = v_i + a\,\Delta t$<br>$\therefore$ 10 = 20 + a(0,5) ✓<br>$\therefore a = -20$<br>$F_{net} = ma = (5\,000)(-20)$ ✓<br>$\therefore F_{net} = -1 \times 10^5$ N ✓ (-100 000 N)<br>$\therefore F_{net} = 1 \times 10^5$ N (100 000 N)<br><br>$\therefore F_{net} > 85\,000$ N<br><br>Yes, collision is fatal. / *Ja, botsing is fataal.* ✓<br><br>✓ Both formulae/ *Beide formules* |

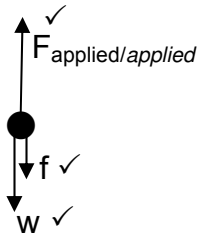
**(5)**
**[17]**

## QUESTION 5 / *VRAAG 5*

5.1 The net (total) work (done on an object) ✓
is equal to the change in kinetic energy (of the object.) ✓
*Die netto (totale) arbeid (verrig op 'n voorwerp)* ✓
*is gelyk aan die verandering in kinetiese energie (van die voorwerp)* ✓

**OR / *OF***
The work done (on an object) by a net (resultant) force ✓
is equal to the change in (the object's) kinetic energy. ✓
*Die arbeid verrig (op 'n voorwerp) deur 'n netto (resulterende) krag* ✓
*is gelyk aan die verandering in kinetiese energie (van die voorwerp.)* ✓ (2)

5.2




(3)

5.3 Gravitational force/weight (of soldier) ✓
*Gravitasiekrag/gewig (van soldaat)* (1)

5.4 $W_{net} = \Delta K$ ✓

$F\Delta y\cos\theta + F_w\Delta y\cos\theta + W_f = \Delta K$

(960)(20)cos0° ✓+ (80)(9,8)(20)cos180° ✓ + $W_f$ = 0 ✓

19 200 – 15 680 + $W_f$ = 0

$W_f$ = - 3 520 J ✓ (5)
**[11]**

## QUESTION 6 / *VRAAG 6*

6.1 Doppler effect / *Doppler-effek* ✓ (1)

6.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

$\therefore f_L = \frac{340 \pm 0}{340 - 20}$ ✓ (458) ✓

$\therefore$ $f_L$ = 486,63 Hz ✓ (4)

6.3 Decreases/*Verlaag* ✓ (1)

6.4 Equal to/*Gelyk aan* ✓

Velocity of train driver relative to the whistle is zero. ✓
*Snelheid van treindrywer relatief tot fluitjie is nul.*

**OR** / ***OF***
Train driver has same velocity as whistle.
*Treindrywer het dieselfde snelheid as die fluitjie.*

**OR** / ***OF***
There is no relative motion between source and observer.
*Daar is geen relatiewe beweging tussen bron en waarnemer.* (2)
**[8]**

## QUESTION 7 / *VRAAG 7*

7.1 Light of a single wavelength **OR** single frequency. ✓✓
*Lig van 'n enkele golflengte **OF** enkele frekwensie.* ✓✓ (2)

7.2

| **Criteria for investigative question:** ***Kriteria vir ondersoekende vraag:*** | **Mark/** ***Punt*** |
|---|---|
| The dependent and independent variables are stated. *Die afhanklike en onafhanklike veranderlikes is genoem.* | ✓ |
| Asks a question about the relationship between dependent and independent variables. *Vra 'n vraag oor die verwantskap tussen die afhanklike en onafhanklike veranderlikes.* | ✓ |

**Examples/*Voorbeelde:***
- How will the broadness / width of the central band change / differ when slit width changes / is increased / is decreased?
*Hoe sal die breedte / wydte van die sentrale helderband verander / verskil wanneer die spleetwydte verander / toeneem / afneem?*

- What is the relationship between the broadness of the central bright band and slit width?
*Wat is die verwantskap tussen die breedte van die sentrale helderband en spleetwydte?* (2)

7.3 Wavelength (of light) / Frequency (of light) / Colour of light/ Light source ✓
Distance between slit and screen. ✓

*Golflengte (van lig) / Frekwensie (van lig) / Kleur van lig / Ligbron* ✓
*Afstand tussen spleet en skerm*. ✓ (2)

7.4 Increases / *Vermeerder* ✓
Diffraction is inversely proportional to slit width. ✓
*Diffraksie is omgekeerd eweredig aan spleetwydte*. ✓

**OR/*OF***
Increases / *Vermeerder* ✓
Diffraction / *Diffraksie* OR/*OF* $\sin\theta \ \alpha \ \frac{1}{a}$ ✓ (2)

7.5 **Option 1 / *Opsie 1:***

$\sin\theta = \frac{m\lambda}{a}$ ✓
✓
$\sin\theta = \frac{(2)(4\times10^{-7})}{2{,}2\times10^{-6}}$ ✓✓

$\therefore \ \theta = 21{,}32°$ ✓

**Option 2 / *Opsie 2:***

$\sin\theta = \frac{m\lambda}{a}$ ✓
✓
$\sin\theta = \frac{(-2)(4\times10^{-7})}{2{,}2\times10^{-6}}$ ✓✓

$\therefore \ \theta = -21{,}32°$ ✓ (5)
**[13]**

**QUESTION 8 / *VRAAG 8***

8.1 T to/*na* P ✓ (1)

8.2 $Q = \frac{3\times10^{-9}+(-6\times10^{-9})}{2}$ ✓ = -1,5 x $10^{-9}$ C

$\Delta Q_P = Q_P(\text{final}) - Q_P(\text{initial})$
= -1,5 x $10^{-9}$ – 3 x $10^{-9}$ ✓
= -4,5 x $10^{-9}$ C ✓

**OR / *OF***
$\Delta Q_T = Q_T(\text{final}) - Q_T(\text{initial})$
= -1,5 x $10^{-9}$ – (-6 x $10^{-9}$) ✓
= 4,5 x $10^{-9}$ C ✓ (3)

8.3 Number of electrons / *Getal elektrone* = $\frac{-4{,}5\times10^{-9}}{-1{,}6\times10^{-19}}$ ✓
= 2,81 x $10^{10}$ ✓ (2)

8.4

**Option 1 / *Opsie 1***

$F_{TR} = \frac{kQ_1Q_2}{r^2}$ ✓

$= \frac{(9\times10^{9})(1{,}5\times10^{-9})(3\times10^{-9})}{1^2}$ ✓

$= 4{,}05 \times 10^{-8}$ N to the left/towards P
*na links/na P toe*

$F_{PR} = \frac{kQ_1Q_2}{r^2}$

$= \frac{(9\times10^{9})(1{,}5\times10^{-9})(3\times10^{-9})}{0{,}5^2}$ ✓

$= 1{,}62 \times 10^{-7}$ N to the right/towards T
*na regs/na T toe*

✓Any one
*Enige een*

To the right / towards T as positive: / *Na regs* / *na T toe as positief*
$F_{net} = 1{,}62 \times 10^{-7} - 4{,}05 \times 10^{-8}$
$= 1{,}22 \times 10^{-7}$ N (1,215 x $10^{-7}$ N)
$= 1{,}22 \times 10^{-7}$ N ✓ to the right / towards T / *na regs / na T toe* ✓

(6)
**[12]**

## QUESTION 9 / *VRAAG 9*

9.1 Current / I / *stroom* ✓ (1)

9.2
9.2.1 (4,0 ✓ ; 0,64) ✓ (2)

9.2.2 Temperature was not kept constant. ✓✓
*Temperatuur is nie konstant gehou nie.* ✓✓ (2)

9.3 Gradient/m = $\frac{\Delta y}{\Delta x} = \frac{0{,}64 - 0}{4 - 0}$ ✓ ✓ = 0,16

$R = \frac{1}{0{,}16}$ = 6,25 Ω ✓✓

(4)
**[9]**

## QUESTION 10 / *VRAAG 10*

10.1 12 V ✓ (1)

10.2.1

| **Option 1 / *Opsie 1:*** | **Option 2 / *Opsie 2:*** |
|---|---|
| $I = \frac{V}{R}$ ✓ $= \frac{9{,}6}{2{,}4}$ ✓ = 4 A | emf = IR + Ir✓<br>12 = I(2,4) + 2,4✓ ∴ I = 4 A✓ |

(3)

10.2.2

| **Option 1 / *Opsie 1:*** | **Option 2 / *Opsie 2*:** |
|---|---|
| emf/*emk* = IR + Ir ✓<br>12 = 9,6 + 4r ✓<br>∴ r = 0,6 Ω ✓ | $V_{lost/verlore}$ = Ir ✓<br>2,4 = 4r ✓<br>∴ r = 0,6 Ω ✓ |
| **Option 3 / *Opsie 3*:**<br>emf/*emk* = I(R + r) ✓<br>12 = 4(2,4 + r) ✓ ∴ r = 0,6 Ω ✓ | |

(3)

10.3

| **Option 1 / *Opsie 1*:** | **Option 2 / *Opsie 2*:** |
|---|---|
| emf/*emk* = I(R + r) ✓<br>12 = 6(R + 0,6) ✓<br>$R_{ext/eks}$ = 1,4 Ω<br>$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓<br>$\frac{1}{1,4} = \frac{1}{2,4} + \frac{1}{R}$ ✓<br>∴ R = 3,36 Ω<br><br>Each tail lamp/*Elke agterlig:*<br>: R = 1,68 Ω ✓ | Emf = $V_{terminal}$ + Ir ✓<br>12 = $V_{terminal}$ + 6(0,6) ✓<br>∴ $V_{terminal}$ = 8,4 V<br>$I_{2,4\ \Omega} = \frac{V}{R} = \frac{8,4}{2,4}$ = 3,5 A<br>$I_{\text{tail lamps/agterligte}}$ = 6 – 3,5 = 2,5 A<br>$R_{\text{tail lamps/agterligte}} = \frac{V}{I}$ ✓ $= \frac{8,4}{2,5}$ ✓ = 3,36 Ω<br><br>$R_{\text{tail lamp/agterlig}}$ = 1,68 Ω ✓ |
| **Option 3 / *Opsie 3:*** | **Option 4 / *Opsie 4:*** |
| V = IR ✓<br>12 = (6)R ✓<br>$R_{ext}$ = 2 Ω<br>∴$R_{parallel}$ = 2 – 0,6 = 1,4 Ω<br>$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓<br>$\frac{1}{1,4} = \frac{1}{2,4} + \frac{1}{R}$ ✓<br>∴ R = 3,36 Ω<br><br>Each tail lamp/*Elke agterlig*: R = 1,68 Ω ✓ | For parallel combination: $I_1 + I_2$ = 6 A<br>*Vir parallelle kombinasie: $I_1 + I_2$ = 6 A*<br><br>∴ $\frac{V}{2,4} + \frac{V}{R_{taillamps}}$ ✓ = 6 ✓<br>8,4✓ $(\frac{1}{2,4} + \frac{1}{R_{taillamps}})$✓ = 6<br><br>∴ $R_{\text{tail lamps/agterligte}}$ = 3,36<br><br>$R_{\text{tail lamp/agterligte}}$ = 1,68 Ω ✓ |

(5)

10.4 Increases / *Vermeerder* ✓
Resistance increases, current decreases ✓
Ir (lost volts) decreases ✓

*Vermeerder* ✓
*Weerstand verhoog, stroom verlaag* ✓
*Ir (verlore volts) verminder / neem af.* ✓

(3)
**[15]**

## QUESTION 11 / *VRAAG 11*

11.1.1 Electrical (energy) to mechanical / kinetic (energy) ✓
*Elektriese (energie) na meganiese / kinetiese (energie)* ✓ (1)

11.1.2 Mechanical / kinetic (energy) to electrical (energy) ✓
*Meganiese / kinetiese (energie) na elektriese (energie)* ✓ (1)

11.1.3 Motor effect / *Motor-effek* ✓ (1)

11.1.4 Electromagnetic induction ✓
*Elektromagnetiese induksie* ✓ (1)

11.2 BC / conductor is parallel ✓ to the magnetic field. ✓
*BC / geleier is parallel* ✓ *aan die magneetveld.* ✓

**OR / *OF***
Open switch ✓, no current. ✓
*Oop skakelaar* ✓*, geen stroom.* ✓ (2)

11.3

**Option 1 / *Opsie 1*:**

$P_{ave} = V_{rms}I_{rms}$ ✓
$= \frac{V_{max}}{\sqrt{2}}$ ✓ . $\frac{I_{max}}{\sqrt{2}}$ ✓
$= \frac{(311)(21)}{2}$ ✓✓
$= 3\,265{,}5$ W ✓

**OR / OF**
$P_{max} = V_{max}I_{max}$ ✓
$= (311)$ ✓ $(21)$ ✓
$= 6531$ W
$\therefore P_{ave} = \frac{P_{max}}{2}$ ✓✓ $= \frac{6531}{2}$
$= 3\,265{,}5$ W ✓

**Option 2 / *Opsie 2*:**

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$= \frac{311}{\sqrt{2}}$ ✓
$= 219{,}91$ V
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓
$= \frac{21}{\sqrt{2}}$ ✓
$= 14{,}85$ A
$P_{ave} = V_{rms}I_{rms}$ ✓
$= (219{,}91)(14{,}85)$
$= 3\,265{,}66$ W ✓

**Option 3 / *Opsie 3***

$R = \frac{V}{I}$ ✓ $= \frac{311}{21}$ ✓ $= 14{,}81\ \Omega$
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓
$= \frac{21}{\sqrt{2}}$ ✓
$= 14{,}85$ A
$P_{ave} = I^2_{rms}R$ ✓
$= (14{,}85)^2(14{,}81)$
$= 3\,265{,}83$ W ✓

**Option 4 / *Opsie 4***

$R = \frac{V}{I}$ ✓ $= \frac{311}{21}$ ✓ $= 14{,}81\ \Omega$
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
$= \frac{311}{\sqrt{2}}$ ✓
$= 219{,}91$ V
$P_{ave} = \frac{V^2_{rms}}{R}$ ✓
$= \frac{219{,}41^2}{14{,}81}$
$= 3\,265{,}83$ W ✓

(6)

**[12]**

**QUESTION 12 / *VRAAG 12***

12.1 Photo-electric effect / *Foto-elektriese effek* ✓ (1)

12.2 Work function / *Werkfunksie / Arbeidsfunksie* ✓ (1)

12.3 $c = f\lambda$ ✓
$3 \times 10^8$ ✓ $= f(330 \times 10^{-9})$ ✓
$\therefore f = 9{,}09 \times 10^{14}$ Hz ✓

**OR/*OF***

$E = \frac{hc}{\lambda} = \frac{(6{,}63 \times 10^{-34})(3 \times 10^8)}{330 \times 10^{-9}}$ ✓ $= 6{,}03 \times 10^{-19}$ J
$E = hf$
$6{,}03 \times 10^{-19} = (6{,}63 \times 10^{-34})f$ ✓
$\therefore f = 9{,}09 \times 10^{14}$ Hz ✓

✓ for both equations
*vir beide vergelykings*

(4)

12.4

**Option 1 / *Opsie 1*:**

$E = W_o + K$
$\frac{hc}{\lambda} = W_o + K$
✓ Any one / *Enige een*

$\therefore \frac{(6{,}63 \times 10^{-34})(3 \times 10^8)}{330 \times 10^{-9}}$ ✓ $= 3{,}5 \times 10^{-19} + K$ ✓
$\therefore K = 2{,}53 \times 10^{-19}$ J ✓

**Option 2 / *Opsie 2*:**

$E = W_o + K$
$hf = W_o + K$
✓ Any one / *Enige een*

$\therefore (6{,}63 \times 10^{-34})(9{,}09 \times 10^{14})$ ✓ $= 3{,}5 \times 10^{-19} + K$ ✓
$\therefore K = 2{,}53 \times 10^{-19}$ J ✓

(4)

12.5

12.5.1 Remains the same / *Bly dieselfde* ✓ (1)

12.5.2 Increases / *Vermeerder* ✓ (1)

12.6

12.6.1 Ultraviolet radiation / *Ultraviolet-straling* ✓ (1)

12.6.2 High energy / high frequency ✓
*Hoë energie / hoë frekwensie* (1)

**[14]**

**TOTAL SECTION B/TOTAAL AFDELING B: 125**
**GRAND TOTAL/*GROOTTOTAAL*: 150**

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## PHYSICAL SCIENCES: CHEMISTRY (P2)

## NOVEMBER 2011

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 15 pages and 4 data sheets.**

## INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.

2. Answer ALL the questions in the ANSWER BOOK.

3. This question paper consists of TWO sections:

   SECTION A (25)
   SECTION B (125)

4. You may use a non-programmable calculator.

5. You may use appropriate mathematical instruments.

6. Number the answers correctly according to the numbering system used in this question paper.

7. Data sheets and a periodic table are attached for your use.

8. Give brief motivations, discussions, et cetera where required.

9. Round off your final numerical answers to a minimum of TWO decimal places.

## SECTION A

### QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The homologous series to which the compound $CH_3C\ell$ belongs (1)

1.2 The general term that describes compounds that consist of hydrogen and carbon atoms only (1)

1.3 The stage reached in a reversible chemical reaction when the rate of the forward reaction is equal to the rate of the reverse reaction (1)

1.4 The name of the chemical substance in which $A\ell_2O_3$ is dissolved to lower its melting point during the industrial extraction of aluminium (1)

1.5 The ability of a cell to store charge (1)
**[5]**

### QUESTION 2: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A–D) next to the question number (2.1–2.10) in the ANSWER BOOK.

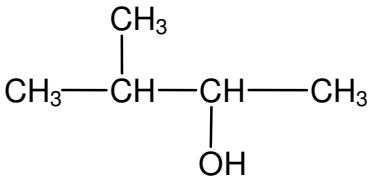
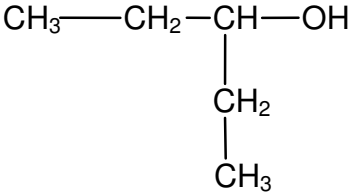
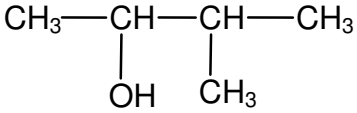
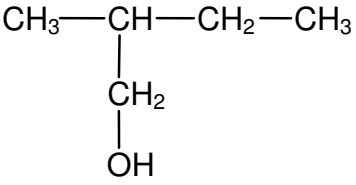
2.1 Which ONE of the following general formulae represents alkynes?

A $C_nH_{2n+2}$
B $C_nH_{2n-2}$
C $C_nH_{2n}$
D $C_nH_{2n-1}$ (2)

2.2 Which ONE of the following homologous series does NOT contain a CARBONYL group ( $\diagdown C{=}O \diagup$ )?

A Aldehydes
B Alcohols
C Carboxylic acids
D Esters (2)

2.3 The structures of four organic compounds are shown below.

| | | | |
|---|---|---|---|
| **I** |  | **II** |  |
| **III** |  | **IV** |  |

Which of the above compounds have the same IUPAC name?

A I and II only
B III and IV only
C I and III only
D II and IV only (2)

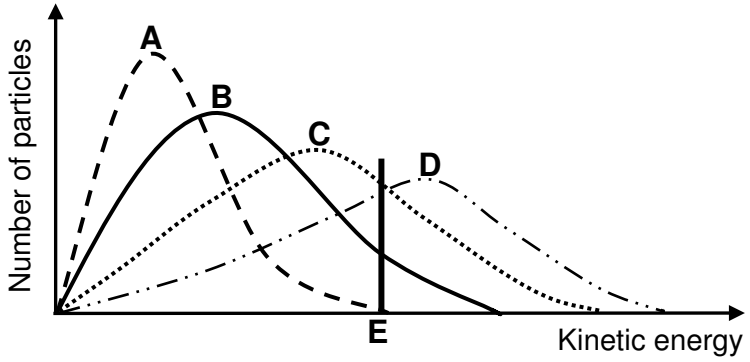
2.4 The reaction represented by the equation below reaches equilibrium.

$$2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O(\ell)$$
yellow orange

Which ONE of the following changes to the reaction mixture will change its colour from yellow to orange?

A Add a catalyst.
B Add water to the reaction mixture.
C Add a few drops of sodium hydroxide solution to the reaction mixture.
D Add a few drops of concentrated hydrochloric acid to the reaction mixture. (2)

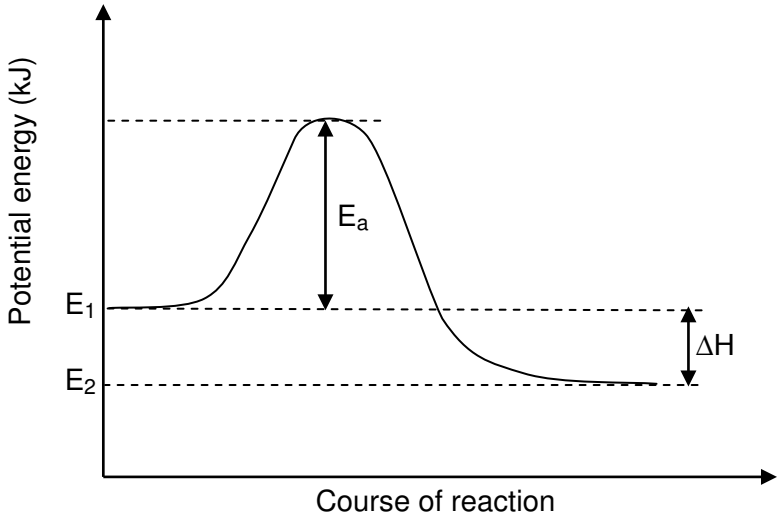
2.5 The Maxwell-Boltzmann energy distribution curves below show the number of particles as a function of their kinetic energy for a reaction at four different temperatures. The minimum kinetic energy needed for effective collisions to take place is represented by **E**.




Which ONE of these curves represents the reaction with the highest rate?

A A
B B
C C
D D (2)

2.6 A certain chemical reaction is represented by the potential energy diagram below.




Which ONE of the following quantities will change when a catalyst is added?

A $E_2$
B $E_1$
C $E_a$
D $\Delta H$ (2)

2.7 When a metallic atom becomes an ion, it …

A loses electrons and is oxidised.
B loses electrons and is reduced.
C gains electrons and is oxidised.
D gains electrons and is reduced. (2)

2.8 Which ONE of the following substances CANNOT be used as a fertiliser?

A Nitrogen gas
B Guano
C Bone meal
D Ammonium sulphate (2)

2.9 Consider the two half-reactions below that occur in a battery.

$$Zn(s) + 2OH^-(aq) \rightarrow ZnO(s) + H_2O(\ell) + 2e^-$$

$$Ag_2O(s) + H_2O(\ell) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq)$$

Which ONE of the following statements is CORRECT?

A Ag(s) is reduced.
B Zn(s) is the anode.
C $Ag_2O(s)$ is the negative electrode.
D Electrons are transferred from Ag(s) to Zn(s). (2)

2.10 The oxidation number of copper (Cu) in the compound $CuSO_4$ is ...

A - 2
B - 4
C + 2
D + 4 (2)

**[20]**

**TOTAL SECTION A: 25**

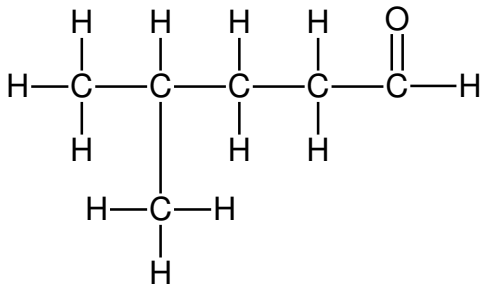
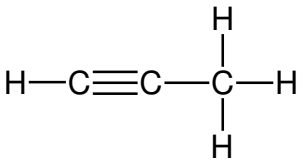
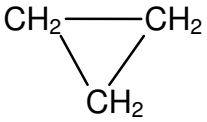
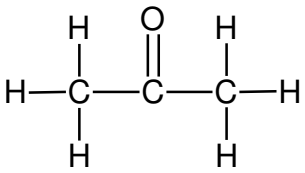
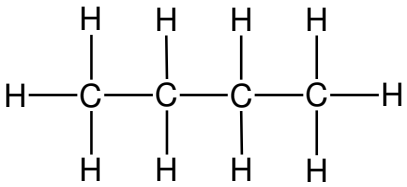
## SECTION B

## INSTRUCTIONS

1. Start EACH question on a NEW page.
2. Leave ONE line between two subquestions, for example between QUESTION 3.1 and QUESTION 3.2.
3. Show the formulae and substitutions in ALL calculations.
4. Round off ALL final numerical answers to a minimum of TWO decimal places.

## QUESTION 3 (Start on a new page.)

The letters **A** to **F** in the table below represent six organic compounds.

| | |
|---|---|
| **A**  | **B**  |
| **C**  | **D**  |
| **E**  | **F** ethyl butanoate |

3.1 Write down the letter that represents the following:

3.1.1 A ketone (1)

3.1.2 A compound which is an isomer of prop-1-ene (1)

3.2 Write down the IUPAC name of the following:

3.2.1 Compound **A** (2)

3.2.2 Compound **B** (2)

3.3 Write down the NAME or FORMULA of EACH of the TWO products formed during the complete combustion of compound **E**. (2)

3.4 Compound **F** is the organic product of the reaction between a carboxylic acid and ethanol. Write down the following:

3.4.1 The name of the homologous series to which compound **F** belongs (1)

3.4.2 The structural formula of the FUNCTIONAL GROUP of carboxylic acids (1)

3.4.3 The IUPAC name of the carboxylic acid from which compound **F** is prepared (2)

3.4.4 The structural formula of compound **F** (2)
**[14]**

**QUESTION 4 (Start on a new page.)**

Three hydrocarbons (**A**, **B** and **C**) with molecular formula $C_5H_{12}$ are used to investigate the effect of BRANCHING on the BOILING POINTS of hydrocarbons.

The results obtained are shown in the table below.

| HYDROCARBON | BOILING POINT (° C) |
|---|---|
| **A** | 36 |
| **B** | 28 |
| **C** | 10 |

4.1 Write down the term used to describe compounds with the same molecular formula, but with different structural formulae. (1)

4.2 Write down for this investigation the following:

4.2.1 Dependent variable (1)

4.2.2 Independent variable (1)

4.2.3 Controlled variable (1)

4.3 Are these hydrocarbons saturated or unsaturated? Explain the answer. (3)

4.4 One of the hydrocarbons (**A**, **B** or **C**) has a straight chain with no branches. Write down the following:

4.4.1 The letter (**A**, **B** or **C**) that represents this hydrocarbon (1)

4.4.2 Its IUPAC name (2)

4.5 Consider hydrocarbon **C** and its boiling point.

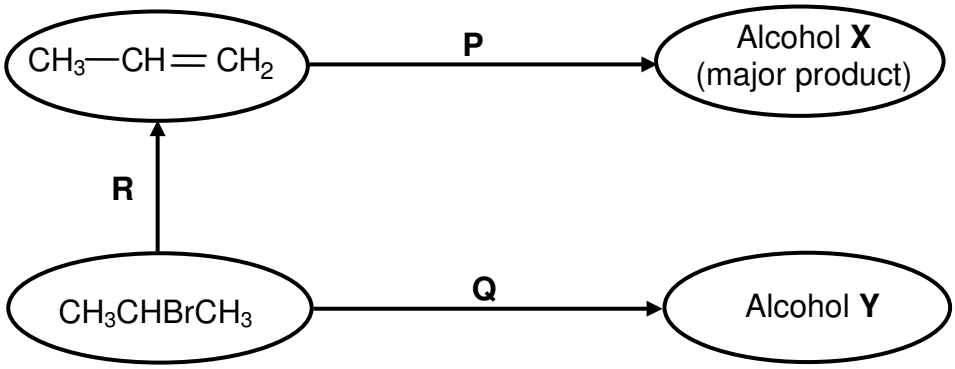
4.5.1 Write down the structural formula of hydrocarbon **C**. (2)

4.5.2 Explain why hydrocarbon **C** has the lowest boiling point. In your explanation, refer to its structure, intermolecular forces and the energy involved. (3)

4.6 Which ONE of hydrocarbons (**A**, **B** or **C**) has the highest vapour pressure? Refer to the data in the table to give a reason for the answer. (2)
**[17]**

**QUESTION 5 (Start on a new page.)**

In the flow diagram below **R**, **P** and **Q** represent different types of reactions.




5.1 Name the type of reaction represented by:

5.1.1 **P** (1)

5.1.2 **Q** (1)

5.1.3 **R** (1)

5.2 Using structural formulae, write down a balanced equation for reaction **P**. (4)

5.3 Write down the IUPAC name of alcohol **Y**. (2)

5.4 Reaction **Q** takes place in the presence of a BASE. Write down TWO reaction conditions for this reaction. (2)
**[11]**

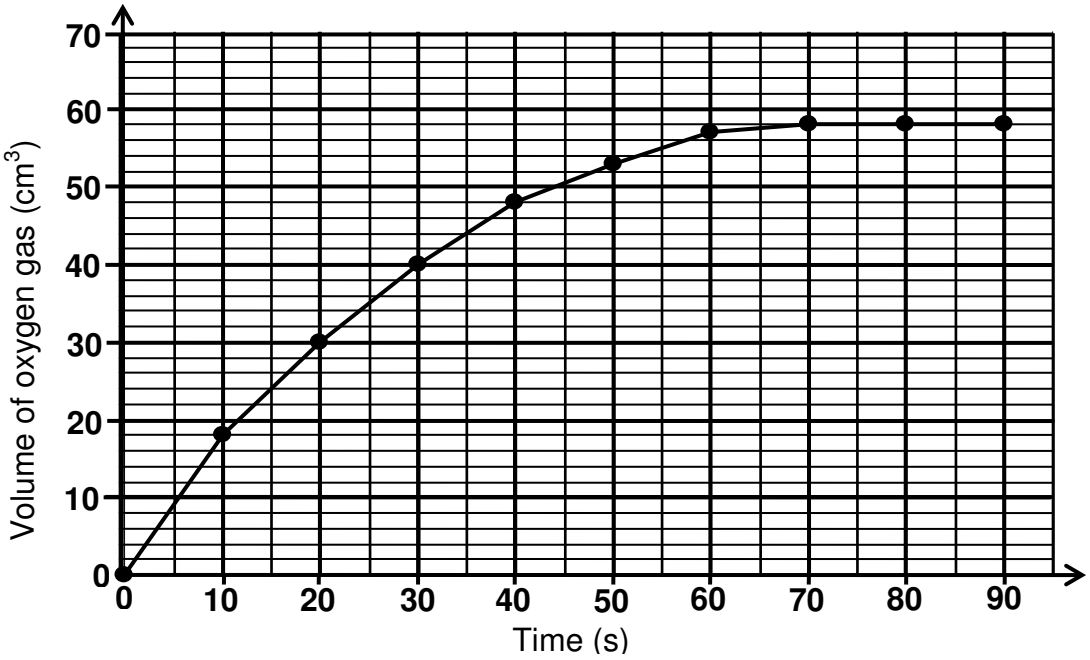
**QUESTION 6 (Start on a new page.)**

Learners use copper(II) oxide POWDER to decompose hydrogen peroxide. They add 1 g copper(II) oxide to 100 $cm^3$ hydrogen peroxide in a flask connected to a delivery tube. The reaction that takes place is represented by the following balanced equation:

$$2H_2O_2(\ell) \xrightarrow{CuO(s)} 2H_2O(\ell) + O_2(g)$$

6.1 Write down the name of ONE item of apparatus that can be used to measure the volume of the gas produced. (1)

The volume of oxygen gas produced is measured every 10 seconds. The results obtained are shown in the graph below.




6.2 Use the graph to determine the volume of oxygen gas collected in the container at 15 seconds. (2)

6.3 How does the rate of the reaction change between t = 40 s and t = 70 s? Write down only INCREASES, DECREASES or REMAINS THE SAME. Refer to the graph to explain the answer. (2)

6.4 What is the function of the copper(II) oxide in this reaction? (1)

6.5 Apart from oxygen, write down the NAMES or FORMULAE of TWO substances present in the flask after 90 seconds. (2)

6.6 The learners found that oxygen is produced at a slower rate when 1 g of a SOLID LUMP of copper(II) oxide is used. Fully explain this observation. (2)

6.7 It is known that bad breath is due to bacterial activity in the mouth in the absence of oxygen.

Use the reaction above to explain why a solution containing hydrogen peroxide can be used as mouthwash to improve bad breath. (2)

**[12]**

**QUESTION 7 (Start on a new page.)**

7.1 The industrial preparation of hydrogen gas is represented by the equation below.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H > 0$$

The reaction reaches equilibrium at 1 000 °C in a closed container.

7.1.1 State Le Chatelier's principle. (3)

7.1.2 How will an increase in pressure at 1 000 °C (by decreasing the volume) affect the yield of hydrogen gas? Write down only INCREASES, DECREASES OR NO EFFECT. Explain the answer. (3)

7.1.3 Give TWO reasons why high temperatures are used for this reaction. (2)

7.2 Study the reversible reaction represented by the balanced equation below.

$$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$$

Initially x moles of $H_2(g)$ is mixed with 0,3 moles of $CO_2(g)$ in a sealed 10 $dm^3$ container. When equilibrium is reached at a certain temperature, it is found that 0,2 moles of $H_2O(g)$ is present.

The equilibrium constant ($K_c$) for the reaction at this temperature is 4.

7.2.1 Calculate the initial number of moles of $H_2(g)$, x, that was in the container. (8)

7.2.2 The reaction is now carried out at a much higher temperature. It is found that $K_c$ decreases at this higher temperature.

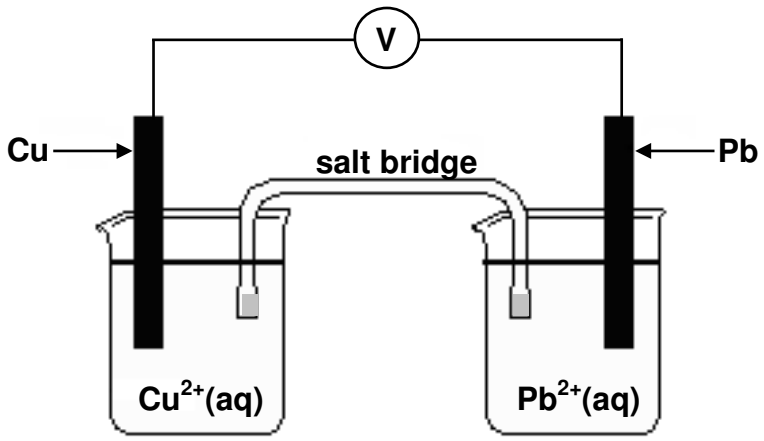
Is this reaction exothermic or endothermic? Explain the answer. (3)

**[19]**

**QUESTION 8 (Start on a new page.)**

The potential difference of a galvanic cell, measured experimentally by learners, is COMPARED with its potential difference calculated at standard conditions**.**

They set up the galvanic cell shown below.




The voltmeter measures an initial reading of 0,3 V.

8.1 Write down the energy conversion that takes place in this cell. (1)

8.2 State ONE function of the salt bridge. (1)

8.3 Write down the half-reaction that takes place at the anode. (2)

8.4 In which direction do electrons flow in the external circuit when this cell delivers a current? Write down only 'from Cu to Pb' or 'from Pb to Cu'. (1)

8.5 Write down the balanced net (overall) cell reaction. (3)

8.6 Is the cell reaction exothermic or endothermic? (1)

8.7 Use the Table of Standard Reduction Potentials to calculate the initial potential difference (emf) of the above cell at STANDARD CONDITIONS. (4)

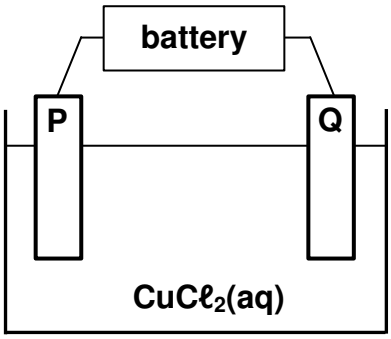
8.8 From the results obtained the learners conclude that the measured potential difference differs from the calculated potential difference.

Give TWO possible reasons for this difference in values. (4)
**[17]**

**QUESTION 9 (Start on a new page.)**

In the electrolytic cell, represented below, two CARBON RODS are used as electrodes and a concentrated copper(II) chloride solution is used as electrolyte.




When the cell is functioning, a gas is released at electrode **P**, whilst electrode **Q** is coated with a reddish brown layer.

9.1 Define the term *electrolyte.* (2)

9.2 Write down a half-reaction to explain the observation made at:

9.2.1 Electrode **P** (2)

9.2.2 Electrode **Q** (2)

9.3 Which electrode, **P** or **Q**, is the cathode? Give a reason for the answer. (2)

9.4 The carbon rods in the above cell are now replaced with COPPER RODS.

The following observations are made at electrode **P**:

- No gas is released.
- Its surface appears rough and eroded.

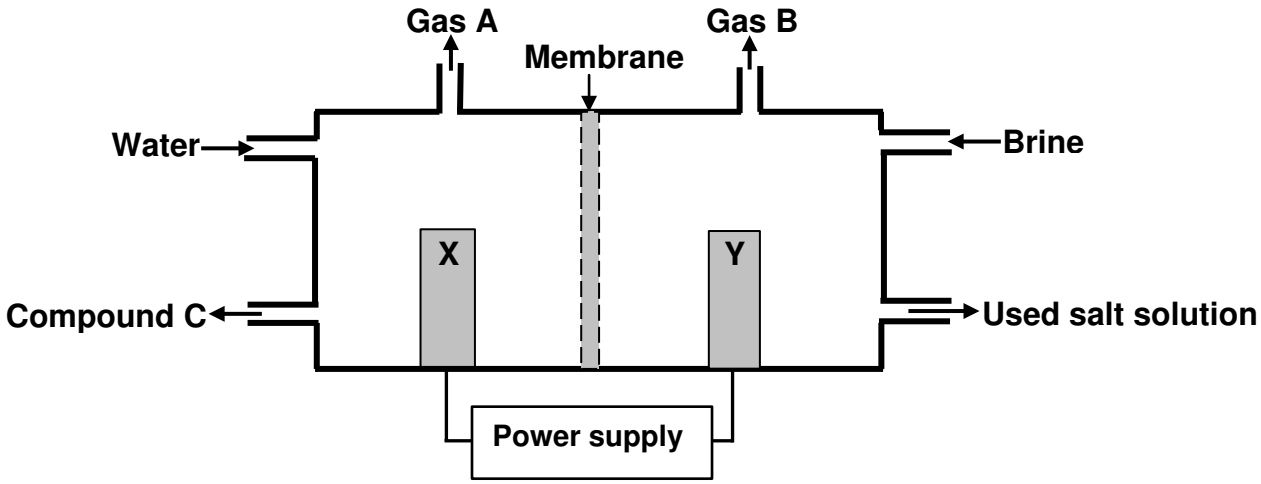
9.4.1 Refer to the RELATIVE STRENGTHS OF REDUCING AGENTS to explain this observation. (3)

9.4.2 This cell can be used for the refining of copper. Which electrode (**P** or **Q**) will be replaced with impure copper during the refining process? (1)
**[12]**

**QUESTION 10 (Start on a new page.)**

The simplified diagram of a membrane cell used in the chlor-alkali industry is shown below. Gas **A**, gas **B** and compound **C** are the three major products formed during this process. **X** and **Y** represent the two electrodes.




10.1 Write down the function of the membrane in this cell. (1)

10.2 Which electrode, **X** or **Y**, is connected to the positive terminal of the power supply? Briefly explain how you arrived at the answer. (2)

10.3 Write down the NAME or FORMULA of:

10.3.1 Gas **A** (1)

10.3.2 Gas **B** (1)

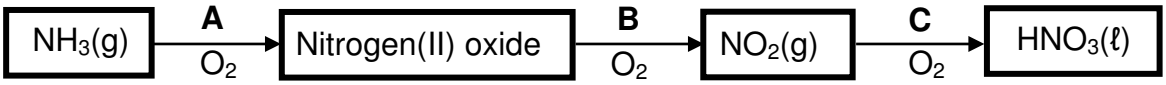
10.3.3 Compound **C** (1)

10.4 Write down the balanced net (overall) cell reaction taking place in this cell. (3)

10.5 The chlor-alkali industry is sometimes blamed for contributing to the greenhouse effect. Briefly explain how the above cell contributes to the greenhouse effect. (2)
**[11]**

**QUESTION 11 (Start on a new page.)**

Nitric acid is used in the preparation of fertiliser. The flow diagram below shows the three steps (**A**, **B** and **C**) in the industrial preparation of nitric acid.




11.1 Write down the following:

11.1.1 Name of this industrial process in the preparation of nitric acid (1)

11.1.2 Balanced equation for step **B** (3)

11.2 $NH_3(g)$ reacts with $O_2(g)$ to form two products in step **A**. One of the products is nitrogen(II) oxide. Write down the NAME or FORMULA of the OTHER product. (1)

11.3 In step **C**, water is added to the reaction mixture. This step can be represented by the following incomplete equation:

$$NO_2(g) + \_\_\_ + H_2O(\ell) \rightarrow HNO_3(\ell)$$

Copy the above incomplete equation into your ANSWER BOOK, fill in the missing reactant and balance the equation. (2)

11.4 A 50 kg bag of fertiliser is labelled as shown in the diagram below.


Calculate the mass of nitrogen present in this bag of fertiliser. (3)

11.5 Uncontrolled use of fertiliser may cause excess fertiliser to run down into streams and rivers, leading to eutrophication.

State ONE negative impact that eutrophication in water may have on humans. (2)
**[12]**

**TOTAL SECTION B: 125**
**GRAND TOTAL: 150**

# DATA FOR PHYSICAL SCIENCES GRADE 12
# PAPER 2 (CHEMISTRY)

## *GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12*
## *VRAESTEL 2 (CHEMIE)*

### TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Standard pressure<br>*Standaarddruk* | $p^{\theta}$ | $1{,}013 \times 10^5$ Pa |
| Molar gas volume at STP<br>*Molêre gasvolume by STD* | $V_m$ | 22,4 $dm^3 \cdot mol^{-1}$ |
| Standard temperature<br>*Standaardtemperatuur* | $T^{\theta}$ | 273 K |
| Charge on electron<br>*Lading op elektron* | e | $-1{,}6 \times 10^{-19}$ C |

### TABLE 2: FORMULAE/*TABEL 2: FORMULES*

| | |
|---|---|
| $n = \frac{m}{M}$ | $c = \frac{n}{V}$<br>or/*of*<br>$c = \frac{m}{MV}$ |
| $q = I\Delta t$<br>$W = Vq$ | $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$<br>or/*of*<br>$E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$<br>or/*of*<br>$E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$ |

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# TABLE 3: THE PERIODIC TABLE OF ELEMENTS
## *TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

| 1 (I) | 2 (II) | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 (III) | 14 (IV) | 15 (V) | 16 (VI) | 17 (VII) | 18 (VIII) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2,1 **1 H 1** | | | | | | | | | | | | | | | | | **2 He 4** |
| 1,0 **3 Li 7** | 1,5 **4 Be 9** | | | | | | | | | | | 2,0 **5 B 11** | 2,5 **6 C 12** | 3,0 **7 N 14** | 3,5 **8 O 16** | 4,0 **9 F 19** | **10 Ne 20** |
| 0,9 **11 Na 23** | 1,2 **12 Mg 24** | | | | | | | | | | | 1,5 **13 Aℓ 27** | 1,8 **14 Si 28** | 2,1 **15 P 31** | 2,5 **16 S 32** | 3,0 **17 Cℓ 35,5** | **18 Ar 40** |
| 0,8 **19 K 39** | 1,0 **20 Ca 40** | 1,3 **21 Sc 45** | 1,5 **22 Ti 48** | 1,6 **23 V 51** | 1,6 **24 Cr 52** | 1,5 **25 Mn 55** | 1,8 **26 Fe 56** | 1,8 **27 Co 59** | 1,8 **28 Ni 59** | 1,9 **29 Cu 63,5** | 1,6 **30 Zn 65** | 1,6 **31 Ga 70** | 1,8 **32 Ge 73** | 2,0 **33 As 75** | 2,4 **34 Se 79** | 2,8 **35 Br 80** | **36 Kr 84** |
| 0,8 **37 Rb 86** | 1,0 **38 Sr 88** | 1,2 **39 Y 89** | 1,4 **40 Zr 91** | **41 Nb 92** | 1,8 **42 Mo 96** | 1,9 **43 Tc** | 2,2 **44 Ru 101** | 2,2 **45 Rh 103** | 2,2 **46 Pd 106** | 1,9 **47 Ag 108** | 1,7 **48 Cd 112** | 1,7 **49 In 115** | 1,8 **50 Sn 119** | 1,9 **51 Sb 122** | 2,1 **52 Te 128** | 2,5 **53 I 127** | **54 Xe 131** |
| 0,7 **55 Cs 133** | 0,9 **56 Ba 137** | **57 La 139** | 1,6 **72 Hf 179** | **73 Ta 181** | **74 W 184** | **75 Re 186** | **76 Os 190** | **77 Ir 192** | **78 Pt 195** | **79 Au 197** | **80 Hg 201** | 1,8 **81 Tℓ 204** | 1,8 **82 Pb 207** | 1,9 **83 Bi 209** | 2,0 **84 Po** | 2,5 **85 At** | **86 Rn** |
| 0,7 **87 Fr** | 0,9 **88 Ra 226** | **89 Ac** | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **58 Ce 140** | **59 Pr 141** | **60 Nd 144** | **61 Pm** | **62 Sm 150** | **63 Eu 152** | **64 Gd 157** | **65 Tb 159** | **66 Dy 163** | **67 Ho 165** | **68 Er 167** | **69 Tm 169** | **70 Yb 173** | **71 Lu 175** |
| **90 Th 232** | **91 Pa** | **92 U 238** | **93 Np** | **94 Pu** | **95 Am** | **96 Cm** | **97 Bk** | **98 Cf** | **99 Es** | **100 Fm** | **101 Md** | **102 No** | **103 Lr** |

**KEY/*SLEUTEL***

**Atomic number**
***Atoomgetal***

**Electronegativity**
***Elektronegatiwiteit***

**29 Cu 1,9 63,5**

**Symbol**
***Simbool***

**Approximate relative atomic mass**
***Benaderde relatiewe atoommassa***

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## TABLE 4A: STANDARD REDUCTION POTENTIALS
## *TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE*

| Half-reactions/*Halfreaksies* | | | $E^{\ominus}$ (V) |
|---|---|---|---|
| $F_2(g) + 2e^-$ | $\rightleftharpoons$ | $2F^-$ | + 2,87 |
| $Co^{3+} + e^-$ | $\rightleftharpoons$ | $Co^{2+}$ | + 1,81 |
| $H_2O_2 + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $2H_2O$ | +1,77 |
| $MnO_4^- + 8H^+ + 5e^-$ | $\rightleftharpoons$ | $Mn^{2+} + 4H_2O$ | + 1,51 |
| $C\ell_2(g) + 2e^-$ | $\rightleftharpoons$ | $2C\ell^-$ | + 1,36 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^-$ | $\rightleftharpoons$ | $2Cr^{3+} + 7H_2O$ | + 1,33 |
| $O_2(g) + 4H^+ + 4e^-$ | $\rightleftharpoons$ | $2H_2O$ | + 1,23 |
| $MnO_2 + 4H^+ + 2e^-$ | $\rightleftharpoons$ | $Mn^{2+} + 2H_2O$ | + 1,23 |
| $Pt^{2+} + 2e^-$ | $\rightleftharpoons$ | $Pt$ | + 1,20 |
| $Br_2(\ell) + 2e^-$ | $\rightleftharpoons$ | $2Br^-$ | + 1,07 |
| $NO_3^- + 4H^+ + 3e^-$ | $\rightleftharpoons$ | $NO(g) + 2H_2O$ | + 0,96 |
| $Hg^{2+} + 2e^-$ | $\rightleftharpoons$ | $Hg(\ell)$ | + 0,85 |
| $Ag^+ + e^-$ | $\rightleftharpoons$ | $Ag$ | + 0,80 |
| $NO_3^- + 2H^+ + e^-$ | $\rightleftharpoons$ | $NO_2(g) + H_2O$ | + 0,80 |
| $Fe^{3+} + e^-$ | $\rightleftharpoons$ | $Fe^{2+}$ | + 0,77 |
| $O_2(g) + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2O_2$ | + 0,68 |
| $I_2 + 2e^-$ | $\rightleftharpoons$ | $2I^-$ | + 0,54 |
| $Cu^+ + e^-$ | $\rightleftharpoons$ | $Cu$ | + 0,52 |
| $SO_2 + 4H^+ + 4e^-$ | $\rightleftharpoons$ | $S + 2H_2O$ | + 0,45 |
| $2H_2O + O_2 + 4e^-$ | $\rightleftharpoons$ | $4OH^-$ | + 0,40 |
| $Cu^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cu$ | + 0,34 |
| $SO_4^{2-} + 4H^+ + 2e^-$ | $\rightleftharpoons$ | $SO_2(g) + 2H_2O$ | + 0,17 |
| $Cu^{2+} + e^-$ | $\rightleftharpoons$ | $Cu^+$ | + 0,16 |
| $Sn^{4+} + 2e^-$ | $\rightleftharpoons$ | $Sn^{2+}$ | + 0,15 |
| $S + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2S(g)$ | + 0,14 |
| **$2H^+ + 2e^-$** | **$\rightleftharpoons$** | **$H_2(g)$** | **0,00** |
| $Fe^{3+} + 3e^-$ | $\rightleftharpoons$ | $Fe$ | – 0,06 |
| $Pb^{2+} + 2e^-$ | $\rightleftharpoons$ | $Pb$ | – 0,13 |
| $Sn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Sn$ | – 0,14 |
| $Ni^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ni$ | – 0,27 |
| $Co^{2+} + 2e^-$ | $\rightleftharpoons$ | $Co$ | – 0,28 |
| $Cd^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cd$ | – 0,40 |
| $Cr^{3+} + e^-$ | $\rightleftharpoons$ | $Cr^{2+}$ | – 0,41 |
| $Fe^{2+} + 2e^-$ | $\rightleftharpoons$ | $Fe$ | – 0,44 |
| $Cr^{3+} + 3e^-$ | $\rightleftharpoons$ | $Cr$ | – 0,74 |
| $Zn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Zn$ | – 0,76 |
| $2H_2O + 2e^-$ | $\rightleftharpoons$ | $H_2(g) + 2OH^-$ | – 0,83 |
| $Cr^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cr$ | – 0,91 |
| $Mn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Mn$ | – 1,18 |
| $A\ell^{3+} + 3e^-$ | $\rightleftharpoons$ | $A\ell$ | – 1,66 |
| $Mg^{2+} + 2e^-$ | $\rightleftharpoons$ | $Mg$ | – 2,36 |
| $Na^+ + e^-$ | $\rightleftharpoons$ | $Na$ | – 2,71 |
| $Ca^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ca$ | – 2,87 |
| $Sr^{2+} + 2e^-$ | $\rightleftharpoons$ | $Sr$ | – 2,89 |
| $Ba^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ba$ | – 2,90 |
| $Cs^+ + e^-$ | $\rightleftharpoons$ | $Cs$ | - 2,92 |
| $K^+ + e^-$ | $\rightleftharpoons$ | $K$ | – 2,93 |
| $Li^+ + e^-$ | $\rightleftharpoons$ | $Li$ | – 3,05 |

**Increasing oxidising ability/*Toenemende oksiderende vermoë***

**Increasing reducing ability/*Toenemende reduserende vermoë***

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## TABLE 4B: STANDARD REDUCTION POTENTIALS
## *TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE*

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

| Half-reactions/*Halfreaksies* | | | $E^{\ominus}$ (V) |
|---|---|---|---|
| $Li^+ + e^-$ | $\rightleftharpoons$ | $Li$ | − 3,05 |
| $K^+ + e^-$ | $\rightleftharpoons$ | $K$ | − 2,93 |
| $Cs^+ + e^-$ | $\rightleftharpoons$ | $Cs$ | − 2,92 |
| $Ba^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ba$ | − 2,90 |
| $Sr^{2+} + 2e^-$ | $\rightleftharpoons$ | $Sr$ | − 2,89 |
| $Ca^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ca$ | − 2,87 |
| $Na^+ + e^-$ | $\rightleftharpoons$ | $Na$ | − 2,71 |
| $Mg^{2+} + 2e^-$ | $\rightleftharpoons$ | $Mg$ | − 2,36 |
| $A\ell^{3+} + 3e^-$ | $\rightleftharpoons$ | $A\ell$ | − 1,66 |
| $Mn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Mn$ | − 1,18 |
| $Cr^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cr$ | − 0,91 |
| $2H_2O + 2e^-$ | $\rightleftharpoons$ | $H_2(g) + 2OH^-$ | − 0,83 |
| $Zn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Zn$ | − 0,76 |
| $Cr^{3+} + 3e^-$ | $\rightleftharpoons$ | $Cr$ | − 0,74 |
| $Fe^{2+} + 2e^-$ | $\rightleftharpoons$ | $Fe$ | − 0,44 |
| $Cr^{3+} + e^-$ | $\rightleftharpoons$ | $Cr^{2+}$ | − 0,41 |
| $Cd^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cd$ | − 0,40 |
| $Co^{2+} + 2e^-$ | $\rightleftharpoons$ | $Co$ | − 0,28 |
| $Ni^{2+} + 2e^-$ | $\rightleftharpoons$ | $Ni$ | − 0,27 |
| $Sn^{2+} + 2e^-$ | $\rightleftharpoons$ | $Sn$ | − 0,14 |
| $Pb^{2+} + 2e^-$ | $\rightleftharpoons$ | $Pb$ | − 0,13 |
| $Fe^{3+} + 3e^-$ | $\rightleftharpoons$ | $Fe$ | − 0,06 |
| **$2H^+ + 2e^-$** | **$\rightleftharpoons$** | **$H_2(g)$** | **0,00** |
| $S + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2S(g)$ | + 0,14 |
| $Sn^{4+} + 2e^-$ | $\rightleftharpoons$ | $Sn^{2+}$ | + 0,15 |
| $Cu^{2+} + e^-$ | $\rightleftharpoons$ | $Cu^+$ | + 0,16 |
| $SO_4^{2-} + 4H^+ + 2e^-$ | $\rightleftharpoons$ | $SO_2(g) + 2H_2O$ | + 0,17 |
| $Cu^{2+} + 2e^-$ | $\rightleftharpoons$ | $Cu$ | + 0,34 |
| $2H_2O + O_2 + 4e^-$ | $\rightleftharpoons$ | $4OH^-$ | + 0,40 |
| $SO_2 + 4H^+ + 4e^-$ | $\rightleftharpoons$ | $S + 2H_2O$ | + 0,45 |
| $Cu^+ + e^-$ | $\rightleftharpoons$ | $Cu$ | + 0,52 |
| $I_2 + 2e^-$ | $\rightleftharpoons$ | $2I^-$ | + 0,54 |
| $O_2(g) + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $H_2O_2$ | + 0,68 |
| $Fe^{3+} + e^-$ | $\rightleftharpoons$ | $Fe^{2+}$ | + 0,77 |
| $NO_3^- + 2H^+ + e^-$ | $\rightleftharpoons$ | $NO_2(g) + H_2O$ | + 0,80 |
| $Ag^+ + e^-$ | $\rightleftharpoons$ | $Ag$ | + 0,80 |
| $Hg^{2+} + 2e^-$ | $\rightleftharpoons$ | $Hg(\ell)$ | + 0,85 |
| $NO_3^- + 4H^+ + 3e^-$ | $\rightleftharpoons$ | $NO(g) + 2H_2O$ | + 0,96 |
| $Br_2(\ell) + 2e^-$ | $\rightleftharpoons$ | $2Br^-$ | + 1,07 |
| $Pt^{2+} + 2e^-$ | $\rightleftharpoons$ | $Pt$ | + 1,20 |
| $MnO_2 + 4H^+ + 2e^-$ | $\rightleftharpoons$ | $Mn^{2+} + 2H_2O$ | + 1,23 |
| $O_2(g) + 4H^+ + 4e^-$ | $\rightleftharpoons$ | $2H_2O$ | + 1,23 |
| $Cr_2O_7^{2-} + 14H^+ + 6e^-$ | $\rightleftharpoons$ | $2Cr^{3+} + 7H_2O$ | + 1,33 |
| $C\ell_2(g) + 2e^-$ | $\rightleftharpoons$ | $2C\ell^-$ | + 1,36 |
| $MnO_4^- + 8H^+ + 5e^-$ | $\rightleftharpoons$ | $Mn^{2+} + 4H_2O$ | + 1,51 |
| $H_2O_2 + 2H^+ + 2e^-$ | $\rightleftharpoons$ | $2H_2O$ | +1,77 |
| $Co^{3+} + e^-$ | $\rightleftharpoons$ | $Co^{2+}$ | + 1,81 |
| $F_2(g) + 2e^-$ | $\rightleftharpoons$ | $2F^-$ | + 2,87 |

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

# NATIONAL SENIOR CERTIFICATE
# *NASIONALE SENIOR SERTIFIKAAT*

## GRADE/*GRAAD* 12

## PHYSICAL SCIENCES: CHEMISTRY (P2)
## *FISIESE WETENSKAPPE: CHEMIE (V2)*

## NOVEMBER 2011

## MEMORANDUM

**MARKS/*PUNTE*: 150**

**This memorandum consists of 12 pages.**
***Hierdie memorandum bestaan uit 12 bladsye.***

## SECTION A / *AFDELING A*

### QUESTION 1 / *VRAAG 1*

1.1 Haloalkane / *Haloalkaan* ✓ (1)

1.2 Hydrocarbons / *Koolwaterstowwe* ✓ (1)

1.3 (Dynamic) equilibrium / (Chemical) equilibrium ✓
*(Dinamiese) ewewig / (Chemiese) ewewig* ✓ (1)

1.4 Cryolite / *Krioliet* ✓ (1)

1.5 (Cell) capacity / (*Sel)kapasiteit* ✓ (1)
**[5]**

### QUESTION 2 / *VRAAG 2*

2.1 B ✓✓ (2)

2.2 B ✓✓ (2)

2.3 C ✓✓ (2)

2.4 D ✓✓ (2)

2.5 D ✓✓ (2)

2.6 C ✓✓ (2)

2.7 A ✓✓ (2)

2.8 A ✓✓ (2)

2.9 B ✓✓ (2)

2.10 C ✓✓ (2)
**[20]**

**TOTAL SECTION A / *TOTAAL AFDELING*: 25**

## SECTION B / *AFDELING B*

## QUESTION 3 / *VRAAG 3*

3.1
3.1.1 D ✓ (1)

3.1.2 C ✓ (1)

3.2
3.2.1 4-methylpentanal / *4-metielpentanaal* ✓✓ (2)

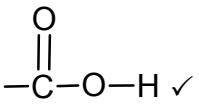
3.2.2 prop-1-yne / *prop-1-yn* ✓✓
**Accept** / ***Aanvaar:***
propyne / *propyn*
1-propyne / *1-propyn* (2)

3.3 $H_2O$ / water ✓

$CO_2$ / carbon dioxide ✓
*$CO_2$ / koolstofdioksied / koolsuurgas*✓ (2)

3.4
3.4.1 Esters ✓ (1)

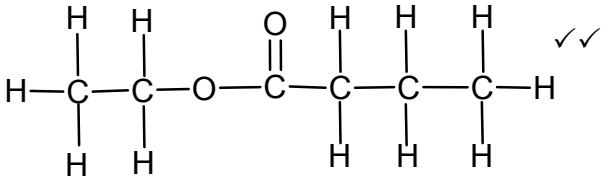
3.4.1



✓ (1)

3.4.3 Butanoic acid / *Butanoësuur* ✓✓ (2)

3.4.4



✓✓ (2)
**[14]**

## QUESTION 4 / *VRAAG 4*

4.1 (Structural) isomers / *(Struktuur)isomere* ✓ (1)

4.2
4.2.1 Boiling point / *Kookpunt* ✓ (1)

4.2.2 Branching / *Vertakking* ✓ (1)

4.2.3 Number of C atoms / *Aantal C-atome* ✓

**OR**/***OF***
Molecular or molar mass or molecular formula / $C_5H_{12}$ ✓
*Molekulêre of molêre massa of molekulêre formule* / *$C_5H_{12}$* ✓ (1)

4.3 Saturated / *Versadig* ✓
No carbon-carbon double (or triple) bonds. ✓✓
*Geen koolstof-koolstofdubbelbindings (of trippelbindings).* ✓✓

**OR** / **OF**
Saturated / *Versadig* ✓
Only single bonds between C artoms. / *Slegs enkelbindings tussen C-atome.* ✓✓

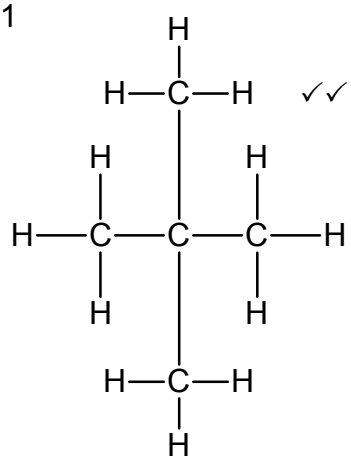
**OR** / **OF**
Saturated / *Versadig* ✓
No multiple bonds. / *Geen meervoudige bindings.* ✓✓ (3)

4.4
4.4.1 A ✓ (1)

4.4.2
Pentane / *Pentaan* ✓✓

(2)

4.5.1



(2)

4.5.2
- Most branching / Molecules most compact or spherical / Smallest surface area (over which intermolecular forces act.).✓
- Least / Weakest intermolecular forces. ✓
- Least energy needed to overcome intermolecular forces. ✓

- *Die meeste vertak. / Molekule mees kompak of sferies / Kleinste oppervlakte (waaroor intermolekulêre kragte werk.)* ✓
- *Minste / Swakste intermolekulêre kragte.* ✓
- *Die minste energie benodig om intermolekulêre kragte te oorkom.* ✓ (3)

4.6 C ✓
Lowest boiling point / *Laagste kookpunt* ✓ (2)
**[17]**

## QUESTION 5/*VRAAG 5*

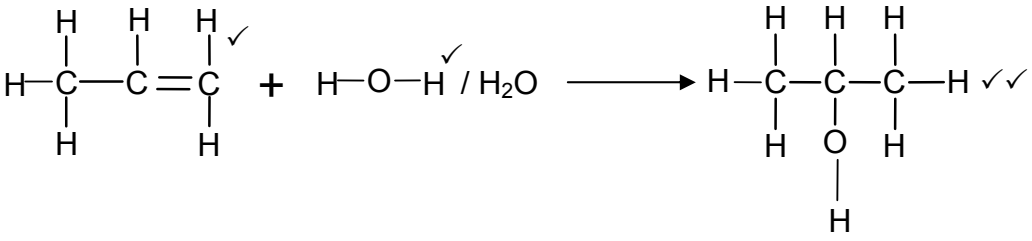
5.1

5.1.1 Addition / hydration ✓
*Addisie / hidratering / hidrasie* ✓ (1)

5.1.2 Substitution / Hydrolysis ✓
*Substitusie / Hidrolise* ✓ (1)

5.1.3 Elimination / Dehydrohalogenation / Dehydrobromination ✓
*Eliminasie / Dehidrohalogenering / Dehidrobrominering* ✓ (1)

5.2




(4)

5.3

Propan-2-ol

**Accept** / ***Aanvaar:***
2-propanol (2)

5.4
- Dilute base ✓
  *Verdunde basis* ✓
- Mild heat
  *Matige hitte* ✓

(2)
**[11]**

## QUESTION 6/*VRAAG 6*

6.1 (Gas) syringe / burette / measuring cylinder ✓
*(Gas)spuit / buret / maatsilinder* ✓ (1)

6.2 24 $cm^3$ ✓✓ (2)

6.3 Decreases ✓
The gradient of the graph decreases. ✓

*Verminder* ✓
*Die gradiënt van die grafiek neem af.* ✓ (2)

6.4 Catalyst / *Katalisator* ✓ (1)

6.5 $H_2O$ / water ✓

CuO / copper(II) oxide ✓
*CuO / koper(II)oksied* ✓ (2)

6.6 **In terms of lump:** / ***In terme van soliede stuk:***
Smaller (exposed) surface area / contact area ✓
Less hydrogen peroxide molecules per unit time comes in contact with the catalyst. ✓
*Kleiner (blootgestelde) reaksieoppervlakte / kontakoppervlakte.* ✓
*Minder waterstofperoksied per eenheidstyd kom in kontak met katalisator.* ✓

**OR**/***OF***
**In terms of powder:** / ***In terme van poeier:***
Larger (exposed) surface area / contact area ✓
More hydrogen peroxide molecules per unit time comes in contact with the catalyst. ✓
*Groter (blootgestelde) reaksieoppervlakte / kontakarea.* ✓
*Meer waterstofperoksied per eenheidstyd kom in kontak met katalisator.* ✓ (2)

6.7 Decomposition of hydrogen peroxide releases oxygen ✓
that resists the functioning of the bacteria. / oxidises the bacteria. ✓
*Ontbinding van waterstofperoksied stel suurstof vry* ✓
*wat die werking van bakterie teenwerk./ wat bakterieë oksideer.* ✓
(2)
**[12]**

## QUESTION 7/*VRAAG 7*

7.1
7.1.1 When the equilibrium in a closed system is disturbed ✓
the system will shift the equilibrium position **OR** re-instate a new equilibrium as to **OR** favour the reaction that will ✓
oppose **OR** cancel **OR** counteract the change **OR** disturbance. ✓

*Wanneer die ewewig in 'n geslote sisteem versteur word*, ✓
*skuif die sisteem die ewewigsposisie sodanig deur **OF** word 'n nuwe ewewig ingestel* deur OF die reaksie bevoordeel wat ✓
*die effek van die versteuring **OF** verandering teen te werk **OF** te kanselleer.* ✓

**OR** / ***OF***
When a stress / change is placed on a system in equilibrium ✓
The system shifts the equilibrium (position) **OR** re-instate a new equilibrium ✓
so as to remove **OR** cancel **OR** oppose the stress / change. ✓

*Wanneer 'n sisteem in ewewig onderhewig is aan 'n spanning **OF** verandering,* ✓
*skuif die sisteem die ewewig(posisie) sodanig **OF** word 'n nuwe ewewig ingestel* ✓*deur*
*die spanning /verandering te verwyder **OF** teen te werk **OF** te kanselleer.* ✓

**OR** / **OF**
When the conditions affecting an equilibrium are changed, ✓
the equilibrium (position) shifts in such a way ✓
as to oppose the change **OR** cancel the change. ✓
*Wanneer die toestande wat 'n ewewig beïnvloed, verander word,* ✓
*sal die ewewig(posisie) sodanig verskuif* ✓
*dat die verandering teengewerk word **OF** gekanselleer word.* ✓ (3)

7.1.2 Decreases ✓
When the pressure is increased,
the reverse reaction is favoured. ✓
The reaction that produced the smaller volume/amount of gas is favoured. ✓
**OR**
4 mol or volumes of gas produces 2 mol or volumes of gas.

*Verminder* ✓
*Wanneer die druk verhoog word,*
*word die terugwaartse reaksie bevoordeel.* ✓
*Die reaksie wat 'n kleiner volume / aantal mol vorm, word bevoordeel.* ✓
***OF***
*4 mol of volumes gas reageer om 2 mol of volumes gas te vorm.* (3)

7.1.3 Products form at faster rate. ✓
Higher yield of products. ✓

*Produkte vorm teen 'n vinniger tempo.* ✓
*Groter opbrengs van produkte.* ✓ (2)

7.2
7.2.1 **CALCULATIONS USING NUMBER OF MOLES**
***BEREKENINGE WAT AANTAL MOL GEBRUIK***

**Option 1** / ***Opsie 1:***
$n(H_2O)$ at equilibrium / *by ewewig* = 0,2 mol (given)

$n(H_2O)$ formed / *gevorm* = $n(CO)$ formed/*gevorm* = 0,2 (mol)
$n(H_2)$ reacted = (0,2 mol): $n(CO_2)$ reacted = (0,2 mol) } ✓

At equilibrium / *By ewewig*:
$n(H_2)$ = (x – 0,2)/(x – change / *verandering*)
$n(CO_2)$ = 0,1 (mol)/(0,3 – change / *verandering*) } ✓
$n(H_2O) = n(CO)$ = 0,2 (mol) ✓

Equilibrium concentration / *Ewewigskonsentrasies:*

$$c(H_2) = \frac{n}{V} = \frac{x-0,2}{10}$$
$$c(CO_2) = \frac{n}{V} = \frac{0,1}{10}$$
$$c(H_2O) = \frac{n}{V} = \frac{0,2}{10}$$
$$c(CO) = \frac{n}{V} = \frac{0,2}{10}$$ } ✓

$$K_C = \frac{[CO][H_2O]}{[H_2][CO_2]} \checkmark \quad \therefore \quad \frac{(0,02)(0,02)}{\left(\frac{x-0,2}{10}\right)(0,01)} \checkmark = 4 \checkmark$$

$\therefore x = 0,3 \quad \therefore n(H_2) = 0,3$ mol ✓

**Option 2/*Opsie 2***

| | $H_2$ | $CO_2$ | $H_2O$ | CO |
|---|---|---|---|---|
| Initial quantity (mol)<br>*Aanvangshoeveelheid (mol)* | x | 0,3 | 0 | 0 |
| Change (mol)<br>*Verandering (mol)* | - 0,2 | -0,2 | + 0,2 | + 0,2 |
| Quantity at equilibrium (mol)/<br>*Hoeveelheid by ewewig(mol)* | x -0,2 | 0,1 ✓ | 0,2 | 0,2✓ |
| Equilibrium concentration ($mol\cdot dm^{-3}$)<br>*Ewewigskonsentrasie ($mol\cdot dm^{-3}$)* | $\frac{x-0,2}{10}$ | 0,01 | 0,02 | 0,02 |

ratio ✓
*verhouding*

Divide by 10✓
*Deel deur 10*

$K_C = \frac{[CO][H_2O]}{[H_2][CO_2]}$ ✓ ∴ $\frac{(0,02)(0,02)}{\left(\frac{x-0,2}{10}\right)(0,01)}$ ✓ = 4 ✓ ∴ x = 0,3 ∴ $n(H_2)$ = 0,3 mol ✓

**CALCULATIONS USING CONCENTRATION**
***BEREKENINGE WAT KONSENTRASIE GEBRUIK***

**Option2/*Opsie2***

| | $H_2$ | $CO_2$ | $H_2O$ | CO |
|---|---|---|---|---|
| Initial concentration ($mol\cdot dm^{-3}$)<br>*Aanvangskonsentrasie ($mol\cdot dm^{-3}$)* | $\frac{x}{10}$ | 0,03 | 0 | 0 |
| Change in concentration ($mol\cdot dm^{-3}$)<br>*Verandering in konsentrasie* ($mol\cdot dm^{-3}$) | 0,02 | 0,02 | 0,02 | 0,02 |
| Equilibrium concentration ($mol\cdot dm^{-3}$)<br>*Ewewigskonsentrasie ($mol\cdot dm^{-3}$)* | $\frac{x}{10}$ – 0,02 | 0,01 ✓ | 0,02 | 0,02✓ |

Divide by 10✓

ratio ✓

$K_C = \frac{[CO][H_2O]}{[H_2][CO_2]}$ ✓ ∴ $\frac{(0,02)(0,02)}{(0,x-0,02)(0,01)}$ ✓ = 4 ✓ ∴ x = 0,3 ∴ $n(H_2)$ = 0,3 mol ✓ (8)

7.2.2 Exothermic ✓
A decrease in $K_c$ implies: Lower product concentration / less products **OR**
higher reactant concentration / more reactants. ✓
Reverse reaction favoured. ✓ This means the forward reaction is exothermic.
*Eksotermies* ✓
*'n Afname in $K_c$ beteken: 'n laer produkkonsentrasie / minder produkte* **OF**
*hoër reaktanskonsentrasie /* meer reaktanse. ✓
*Terugwaartse reaksie bevoordeel.* ✓ *Dus is die voorwaartse reaksie eksotermies.*

**OR / *OF***
Exothermic
Decrease in $K_c$ – reverse reaction is favoured. ✓
Increase in temperature favours the endothermic reaction. ✓
∴ Forward reaction is exothermic.
*Eksotermies*
*Afname in $K_c$ – terugwaartse reaksie word bevoordeel*✓
*Toename in temperatuur bevoordeel die endotermiese reaksie*✓
∴ Voorwaartse reaksie *is eksotermies.*

(3)
**[19]**

## QUESTION 8/*VRAAG 8*

8.1 Chemical (energy) to electrical (energy) ✓
*Chemiese (energie) na elektriese (energie)* ✓ (1)

8.2 Completes the circuit. / *Voltooi die stroombaan*. ✓

**OR** / ***OF***
Maintains electrical neutrality. ✓
*Handhaaf elektriese neutraliteit.* ✓ (1)

8.3 $Pb \rightarrow Pb^{2+} + 2e^{-}$ ✓✓ (2)

8.4 Pb to Cu ✓ (1)

8.5 $Pb + Cu^{2+}$ ✓→ $Pb^{2+} + Cu$ ✓ Balancing ✓ (3)

8.6 Exothermic / *eksotermies* ✓ (1)

8.7 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓
$= 0,34$ ✓$- (-0,13)$ ✓
$E^{\theta}_{cell} = 0,47$ V ✓ (4)

8.8 Measurements not done at:
Temperature of 25 °C / 298 K ✓✓
Concentration of 1 mol·dm$^{-3}$ ✓✓

*Metings nie gedoen by*:
*Temperatuur van* 25 °C / 298 K ✓✓
*Konsentrasie van* 1 mol·dm$^{-3}$ ✓✓ (4)
**[17]**

**QUESTION 9/*VRAAG 9***

9.1 A substance that forms free (positive and negative) ions when melted or dissolved. ✓✓
*'n Stof wat vrye (positiewe en negatiewe) ione vorm wanneer gesmelt of opgelos word.*

***OR / OF***
A liquid / solution / melted substance that conducts electricity through the movement of free ions. ✓✓
*A vloeistof / oplossing / gesmelte stof wat elektrisiteit gelei deur die beweging van vry* ione. ✓✓ (2)

9.2
9.2.1 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓ (2)

9.2.2 $Cu^{2+} + 2e^- \rightarrow Cu$ ✓✓ (2)

9.3 Q ✓
Reduction takes place. ✓
*Reduksie vind plaas.* ✓ (2)

9.4
9.4.1 Cu is a stronger reducing agent ✓ than the $C\ell^-$ ions. ✓
Cu will be oxidised / loses electrons, ✓
resulting in the plate becoming eroded.

*Cu is 'n sterker reduseermiddel ✓as die $C\ell^-$-ione. ✓*
*Cu sal geöksideer word / elektrone verloor, ✓*
*wat tot gevolg het dat die plaat verweer.*

**OR / *OF***
The $C\ell^-$ ion is a weaker reducing agent ✓ than Cu ✓
and will therefore not be oxidised. ✓
*Die $C\ell^-$-ioon is 'n swakker reduseermidel ✓as Cu ✓*
*en sal dus nie geöksideer word nie.* (3)

9.4.2 P ✓ (1)
**[12]**

## QUESTION 10/*VRAAG 10*

10.1 Allows only positive ions (cations/$Na^+$ ions) to migrate to cathode half-cell. ✓
*Laat slegs positiewe ione (katione/$Na^+$-ione) toe om na die katode-halfsel te migreer.*✓

**OR/*OF***

Prevents chloride ions/$C\ell^-$ ions from migrating to the cathode half-cell.
*Verhoed dat chloried-ione/$C\ell^-$-ione na die katode-halfsel migreer.* (1)

10.2 Y ✓
Chloride ions are oxidised at Y. ✓
*Chloriedione word by Y geöksideer.* ✓

**OR/ OF**
Chloride ions are negative and must be attracted to Y. ✓
*Chloriedione is negatief en word deur Y aangetrek.* ✓ (2)

10.3
10.31 Hydrogen / $H_2$ ✓
*Waterstof / $H_2$* ✓ (1)

10.3.2 Chlorine / $C\ell_2$ ✓ (1)
*Chloor / $C\ell_2$* ✓

10.3.3 Sodium hydroxide / NaOH ✓ (1)
*Natriumhidroksied / NaOH* ✓

10.4 $2H_2O + 2C\ell^-$ ✓ $\rightarrow H_2 + 2OH^- + C\ell_2$ ✓ Balancing ✓

**OR / *OF***
$2H_2O + 2NaC\ell$ ✓ $\rightarrow H_2 + 2NaOH + C\ell_2$ ✓ Balancing ✓ (3)

10.5 Uses huge amounts of electricity / energy. ✓
Combustion of coal during generation of electricity releases huge amounts of carbon dioxide into atmosphere. ✓

*Gebruik groot hoeveelhede elektrisiteit.* ✓
*Verbranding van steenkool tydens opwekking van elektrisiteit stel groot hoeveelhede koolstofdioksied in die atmosfeer vry.* ✓ (2)

**[11]**

## QUESTION 11 / *VRAAG 11*

11.1

11.1.1 Ostwald process / *Ostwaldproses* ✓ (1)

11.1.2 $2NO + O_2$ ✓→ $2NO_2$ ✓ Balancing ✓ (3)

11.2 $H_2O$ / water ✓ (1)

11.3 $4NO_2 + \underline{O_2}$ ✓$+ 2H_2O \rightarrow 4HNO_3$ Balancing ✓ (2)

11.4.

| **Option 1** / ***Opsie 1*** | **Option 2** / ***Opsie 2*** |
|---|---|
| 30% of 50 kg = 15 kg<br><br>$\frac{3}{9}$ ✓ x 15 ✓ = 5 kg ✓ | 30% of 50 kg = 15 kg<br><br>(33,33%)✓of 15 ✓ = 5 kg ✓ |
| **Option 3** / ***Opsie 3*** | |
| $\frac{3}{9}$ ✓ x 30 ✓= 10%<br>10% of 50 kg = 5 kg ✓ | |

(3)

11.5 **ANY ONE** / ***ENIGE EEN*:**

- Fish / Aquatic life dies. ✓
  Results in loss of income / jobs / food. ✓
  *Vis / Waterlewe gaan dood.* ✓
  *Lei tot verlies aan inkomste / werk / voedsel.* ✓
- Leads to poor water quality. ✓
  Not enough drinking water. / Poses health risk. ✓
  *Lei tot swak waterkwaliteit.* ✓
  *Nie genoeg drinkwater nie. / Gesondheidsrisiko.* ✓
- Water recreation areas become unattractive / dangerous. ✓
  Lack of income due to decline in tourism. / Less recreation facilities. ✓
  *Waterontspanningsareas word onaansienlik/gevaarlik.* ✓
  *Verlies aan inkomste as gevolg van afname in toerisme.* ✓

(2)
**[12]**

**TOTAL SECTION B/TOTAAL AFDELING B: 125**
**GRAND TOTAL/*GROOTTOTAAL*: 150**