basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

NOVEMBER 2012

MARKS: 150

TIME: 3 hours

This question paper consists of 17 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 number of complete waves that pass a point in one second (1)

1.2 A circuit component which stores electric charge and releases it instantly (1)

1.3 The component in a generator needed to change it from an AC to a DC generator (1)

1.4 The tiny 'packets' (quanta) of energy that light consists of (1)

1.5 The vector difference of two velocities measured from the same frame of reference (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 The net force acting on an object is equal to the ...

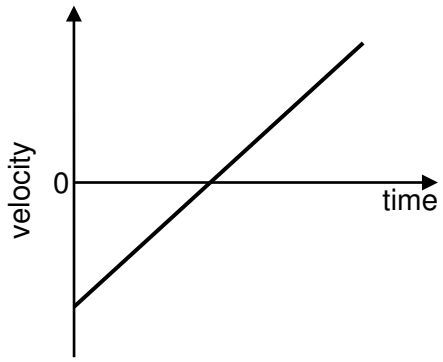
A mass of the object.

B acceleration of the object.

C change in momentum of the object.

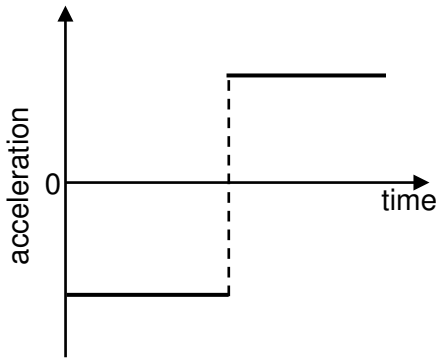
D rate of change in momentum of the object. (2)

2.2 The velocity-time graph below represents the motion of an object.

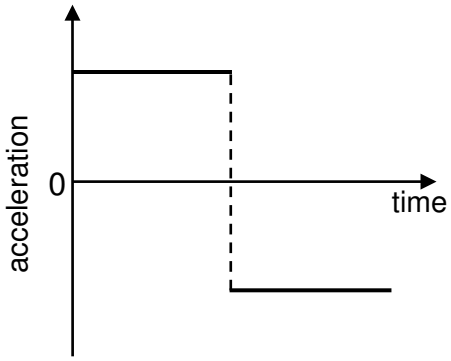


Which ONE of the following graphs represents the corresponding acceleration-time graph for the motion of this object?

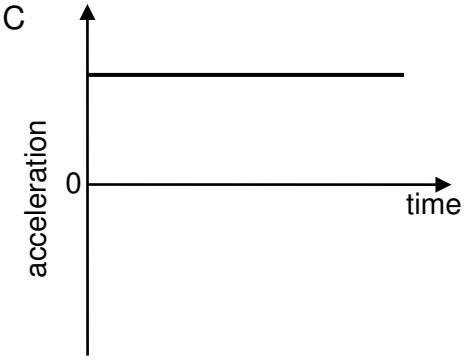
A



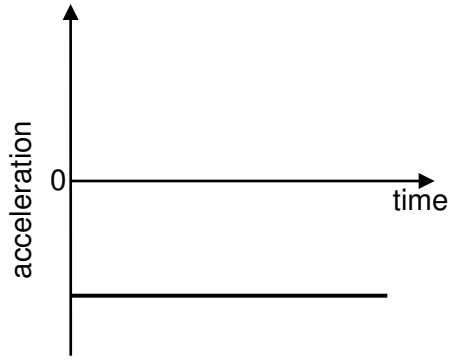
B



C



D



(2)

2.3 A car moves up a hill at CONSTANT speed. Which ONE of the following represents the work done by the weight of the car as it moves up the hill?

A ΔE_k

B ΔE_p

C $-\Delta E_k$

D $-\Delta E_p$ (2)

2.4 A central bright band is observed when light of wavelength λ passes through a single slit of width *a*.

Light of wavelength 2λ is now used. Which ONE of the following slit widths would produce a central bright band of the SAME broadness?

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

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

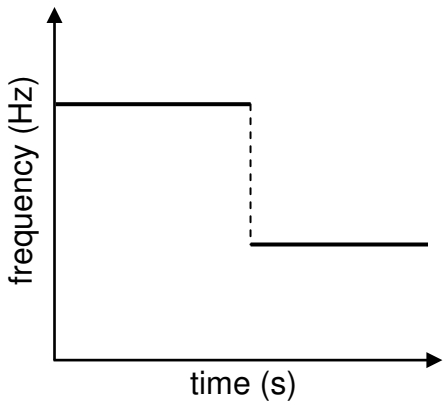
C a

D $2a$ (2)

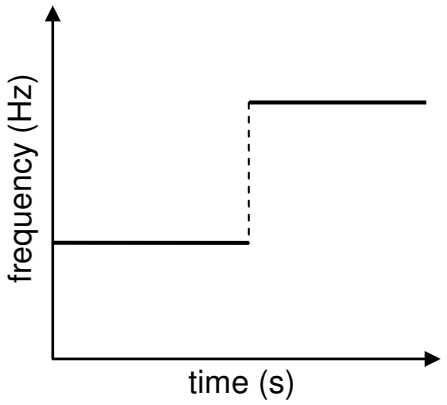
2.5 A source of sound approaches a stationary listener in a straight line at constant velocity. It passes the listener and moves away from him in the same straight line at the same constant velocity.

Which ONE of the following graphs best represents the change in observed frequency against time?

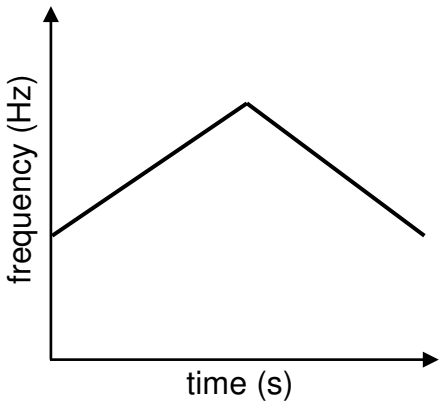
A



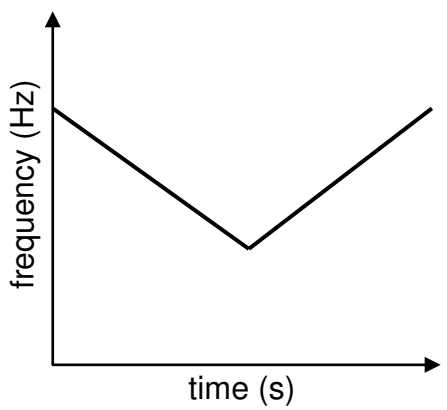
B



C



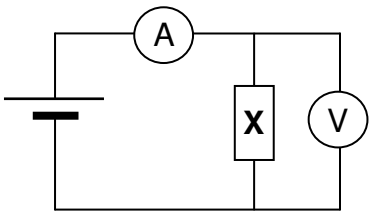
D



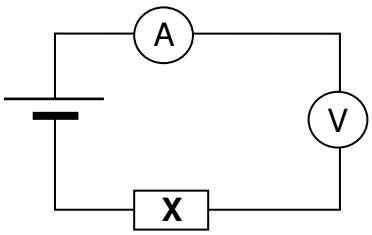
(2)

2.6 Which ONE of the circuits below can be used to measure the current in a conductor **X** and the potential difference across its ends?

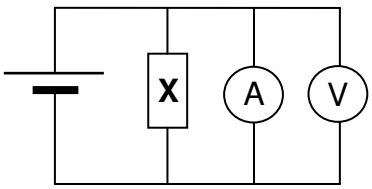
A



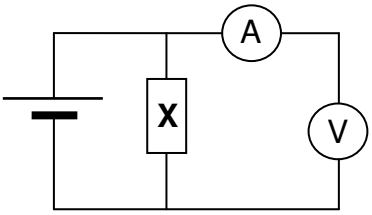
B



C

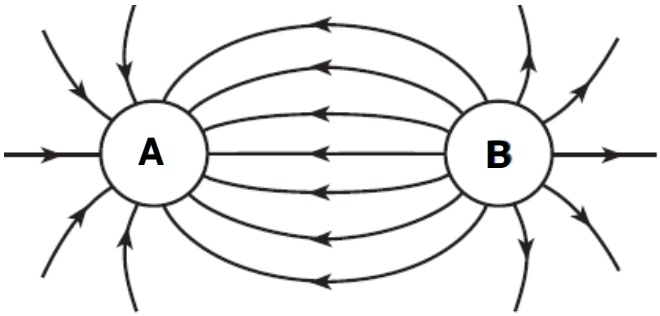


D



(2)

2.7 The electric field pattern between two charged spheres, **A** and **B**, is shown below.



Which ONE of the following statements regarding the charge on spheres **A** and **B** is CORRECT?

A Spheres **A** and **B** are both positively charged.

B Spheres **A** and **B** are both negatively charged.

C Sphere **A** is positively charged and sphere **B** is negatively charged.

D Sphere **A** is negatively charged and sphere **B** is positively charged. (2)

2.8 Which ONE of the following shows the different types of electromagnetic radiation in order of increasing frequency?

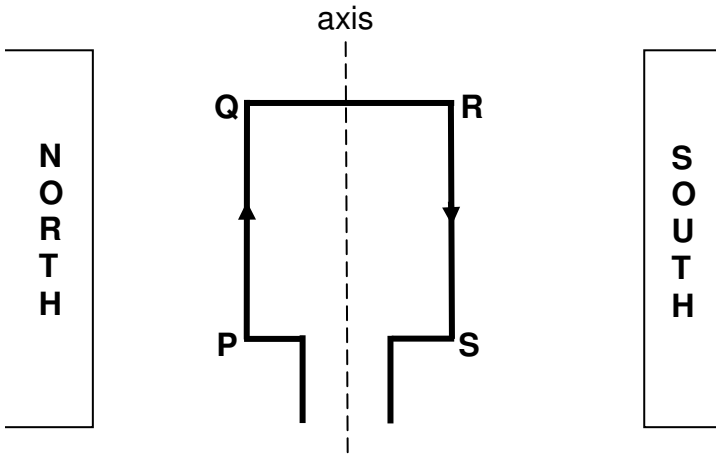
A X-rays; ultraviolet rays; infrared rays; visible light

B Infrared rays; X-rays; visible light; ultraviolet rays

C Infrared rays; visible light; ultraviolet rays; X-rays

D X-rays; ultraviolet rays; visible light; infrared rays (2)

2.9 A rectangular current-carrying coil, **PQRS**, is placed in a uniform magnetic field with its plane parallel to the field as shown below. The arrows indicate the direction of the conventional current.



The coil will ...

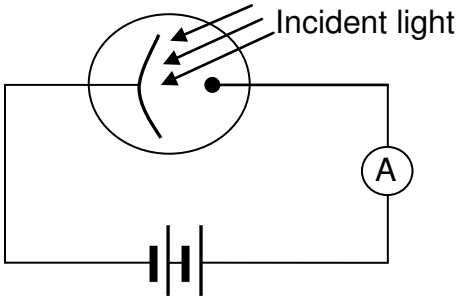
A rotate clockwise.

B remain stationary.

C rotate anticlockwise.

D rotate clockwise and then anticlockwise. (2)

2.10 The diagram below shows light incident on the cathode of a photocell. The ammeter registers a reading.



Which ONE of the following correctly describes the relationship between the intensity of the incident light and the ammeter reading?

	INTENSITY	**AMMETER READING**
A	Increases	Increases
B	Increases	Remains the same
C	Increases	Decreases
D	Decreases	Increases

(2)
[20]

TOTAL SECTION A: 25

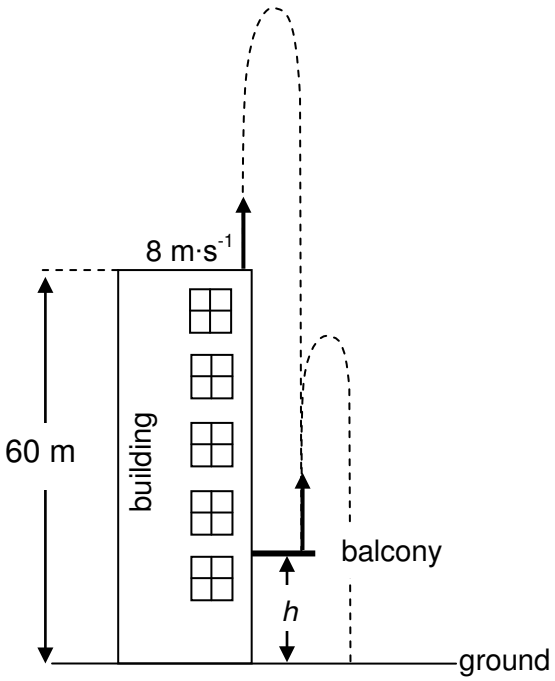
SECTION B

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.)

An object is projected vertically upwards at 8 $m \cdot s^{-1}$ from the roof of a building which is 60 m high. It strikes the balcony below after 4 s. The object then bounces off the balcony and strikes the ground as illustrated below. Ignore the effects of friction.



3.1 Is the object's acceleration at its maximum height UPWARD, DOWNWARD or ZERO? (1)

3.2 Calculate the:

3.2.1 Magnitude of the velocity at which the object strikes the balcony (4)

3.2.2 Height, *h*, of the balcony above the ground (5)

The object bounces off the balcony at a velocity of 27,13 $m \cdot s^{-1}$ and strikes the ground 6 s after leaving the balcony.

3.3 Sketch a velocity-time graph to represent the motion of the object from the moment it is projected from the ROOF of the building until it strikes the GROUND. Indicate the following velocity and time values on the graph:

- The initial velocity at which the object was projected from the roof of the building
- The velocity at which the object strikes the balcony
- The time when the object strikes the balcony
- The velocity at which the object bounces off the balcony
- The time when the object strikes the ground (6)

[16]

QUESTION 4 (Start on a new page.)

The diagram below shows a car of mass *m* travelling at a velocity of 20 $m \cdot s^{-1}$ east on a straight level road and a truck of mass 2*m* travelling at 20 $m \cdot s^{-1}$ west on the same road. Ignore the effects of friction.

4.1 Calculate the velocity of the car relative to the truck. (2)

The vehicles collide head-on and stick together during the collision.

4.2 State the *principle of conservation of linear momentum* in words. (2)

4.3 Calculate the velocity of the truck-car system immediately after the collision. (6)

4.4 On impact the car exerts a force of magnitude *F* on the truck and experiences an acceleration of magnitude *a*.

4.4.1 Determine, in terms of *F*, the magnitude of the force that the truck exerts on the car on impact. Give a reason for the answer. (2)

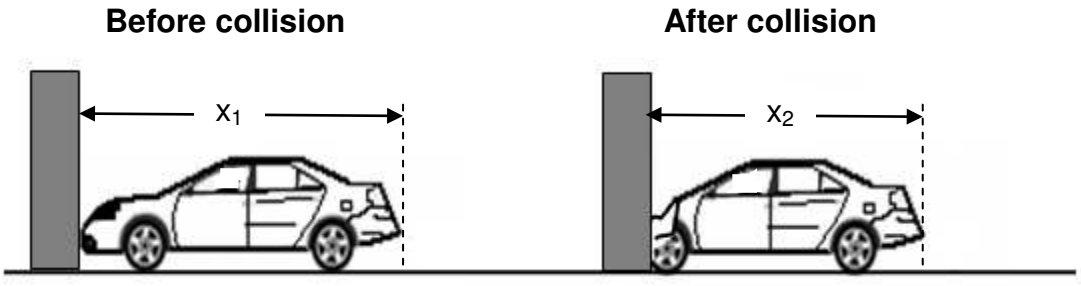
4.4.2 Determine, in terms of *a*, the acceleration that the truck experiences on impact. Give a reason for the answer. (2)

4.4.3 Both drivers are wearing identical seat belts. Which driver is likely to be more severely injured on impact? Explain the answer by referring to acceleration and velocity. (3)

[17]

QUESTION 5 (Start on a new page.)

In order to measure the net force involved during a collision, a car is allowed to collide head-on with a flat, rigid barrier. The resulting crumple distance is measured. The crumple distance is the length by which the car becomes shorter in coming to rest.



In one of the tests, a car of mass 1 200 kg strikes the barrier at a speed of 20 $m \cdot s^{-1}$. The crumple distance, $(x_1 - x_2)$, is measured as 1,02 m. (Ignore the effects of frictional forces during crumpling.)

5.1 Draw a labelled free-body diagram showing ALL the forces acting on the car during the collision. (3)

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

5.3 Assume that the net force is constant during crumpling.

5.3.1 USE THE WORK-ENERGY THEOREM to calculate the magnitude of the net force exerted on the car as it is brought to rest during crumpling. (4)

5.3.2 Calculate the time it takes the car to come to rest during crumpling. (4)
[13]

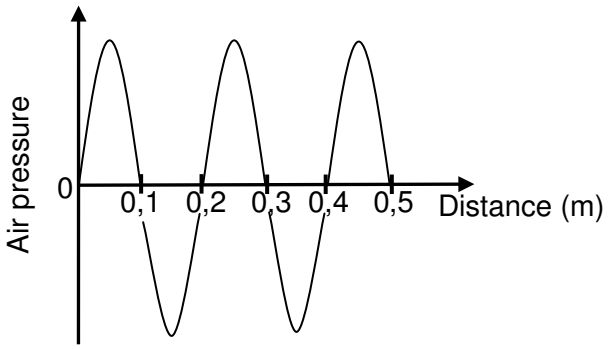
QUESTION 6 (Start on a new page.)

A bird flies directly towards a stationary birdwatcher at constant velocity. The bird constantly emits sound waves at a frequency of 1 650 Hz. The birdwatcher hears a change in pitch as the bird comes closer to him.

6.1 Write down the property of sound that is related to pitch. (1)

6.2 Give a reason why the birdwatcher observes a change in pitch as the bird approaches him. (1)

The air pressure versus distance graph below represents the waves detected by the birdwatcher as the bird comes closer to him. The speed of sound in air is 340 $m \cdot s^{-1}$.



6.3 From the graph, write down the wavelength of the detected waves. (1)

6.4 Calculate the:

6.4.1 Frequency of the waves detected by the birdwatcher (3)

6.4.2 Magnitude of the velocity at which the bird flies (5)
[11]

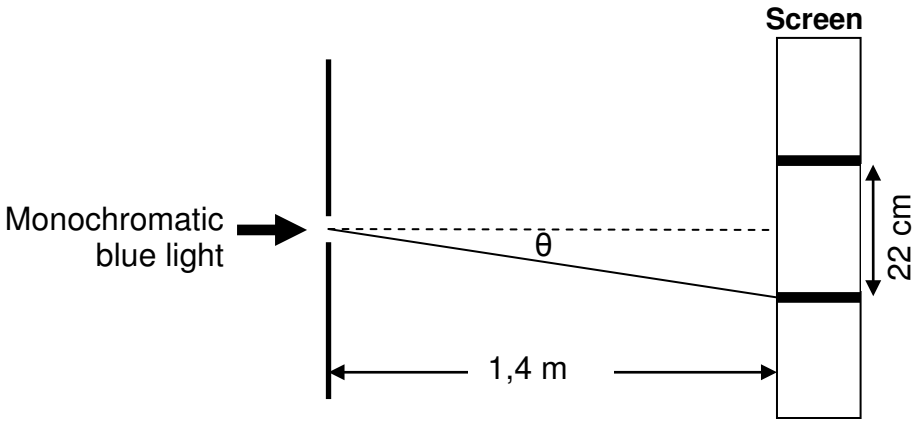
QUESTION 7 (Start on a new page.)

Learners use monochromatic blue light to investigate the difference between an interference pattern and a diffraction pattern.

7.1 Apart from the blue light and a screen, write down the name of ONE item that the learners will need to obtain an interference pattern. (1)

7.2 Briefly describe the interference pattern that will be observed on the screen. (2)

7.3 In one of their experiments they place the screen at a distance of 1,4 m from a single slit and observe a pattern on the screen. The width of the central bright band is measured as 22 cm.



Calculate the:

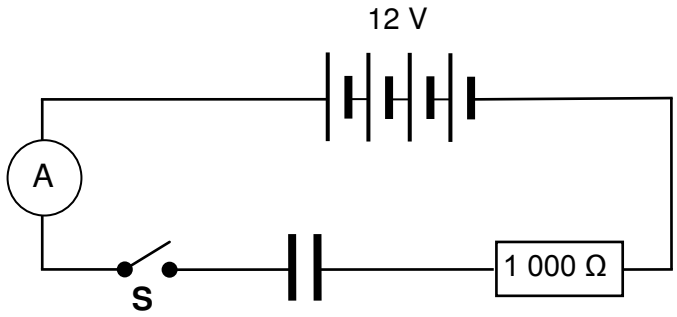
7.3.1 Angle θ at which the first minimum will be observed on the screen (3)

7.3.2 The width of the slit used if the wavelength of the blue light is 470 nm (5)

7.4 The width of the central band INCREASES when the blue light is replaced with monochromatic red light. Explain this observation. (2)
[13]

QUESTION 8 (Start on a new page.)

In the circuit represented below, an uncharged capacitor is connected in series with a 1 000 Ω resistor. The emf of the battery is 12 V. Ignore the internal resistance of the battery and the ammeter.



8.1 Calculate the initial current in the circuit when switch **S** is closed. (3)

8.2 Write down the potential difference across the plates of the capacitor when it is fully charged. (1)

The capacitor has a capacitance of 120 μF and the space between its plates is filled with air.

8.3 Calculate the charge stored on the plates of the capacitor when it is fully charged. (3)

After discharging the capacitor, it is connected in the same circuit to a resistor of HIGHER resistance and switch **S** is closed again.

8.4 How would this change affect each of the following:
(Write down INCREASES, DECREASES or REMAINS THE SAME.)

8.4.1 The initial charging current (1)

8.4.2 The time it takes for the capacitor to become fully charged (1)

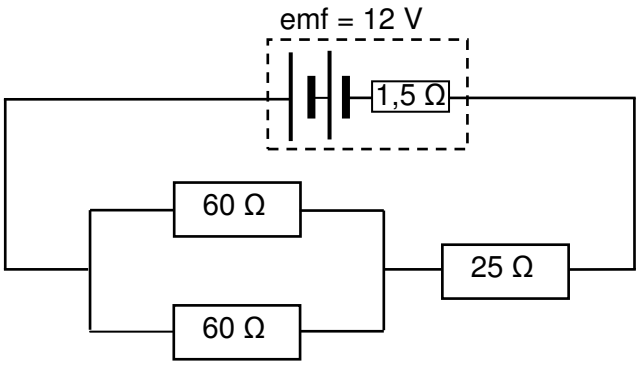
8.5 The two parallel plates of the fully charged capacitor are 12 mm apart.

8.5.1 Sketch the electric field pattern between the parallel plates. (3)

8.5.2 Calculate the magnitude of the electric field at a point midway between the plates. (3)
[15]

QUESTION 9 (Start on a new page.)

9.1 In the circuit represented below, two 60 Ω resistors connected in parallel are connected in series with a 25 Ω resistor. The battery has an emf of 12 V and an internal resistance of 1,5 Ω.



Calculate the:

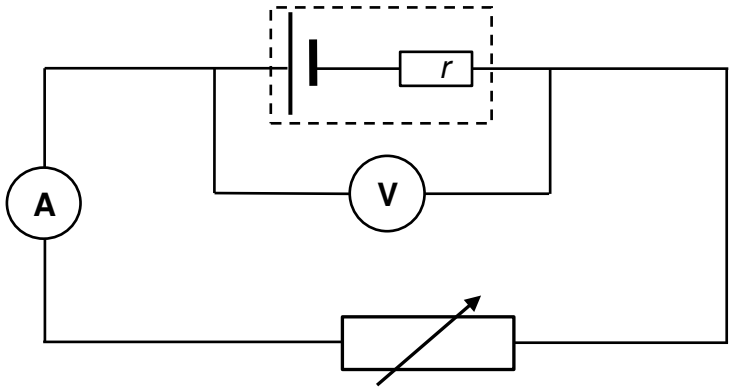
9.1.1 Equivalent resistance of the parallel combination (3)

9.1.2 Total current in the circuit (5)

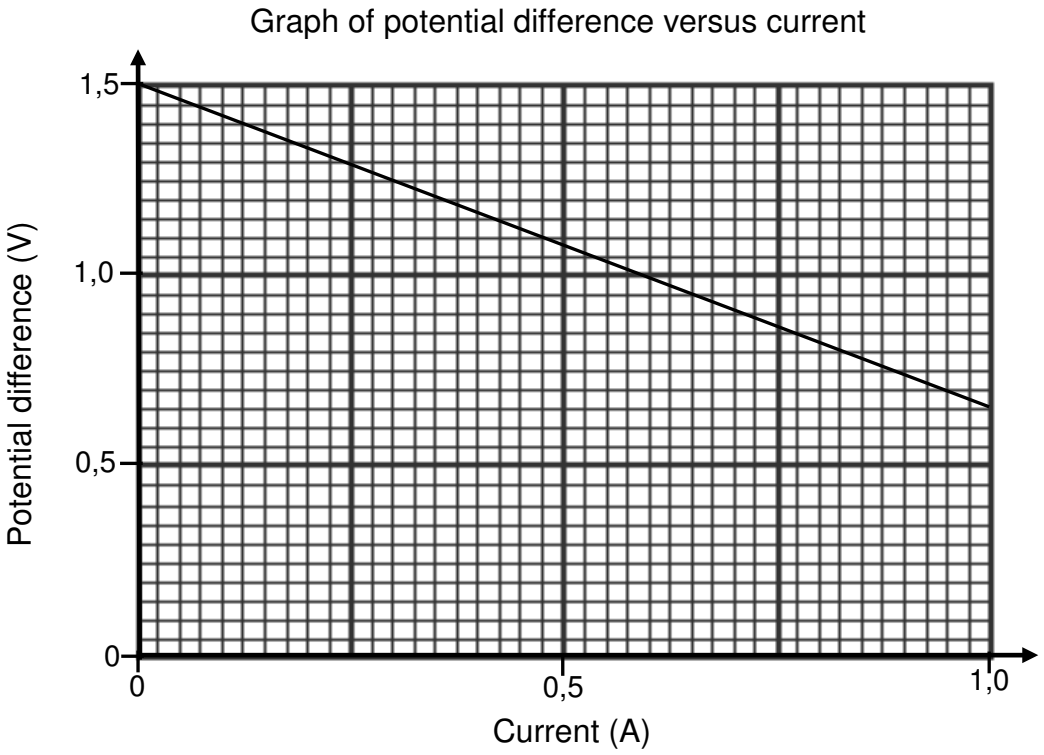
9.1.3 Potential difference across the parallel resistors (3)

9.2 Learners conduct an investigation to determine the emf and internal resistance (*r*) of a battery.

They set up a circuit as shown in the diagram below and measure the potential difference using the voltmeter for different currents in the circuit.



The results obtained are shown in the graph below.



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

9.2.2 Calculate the gradient of the graph. (3)

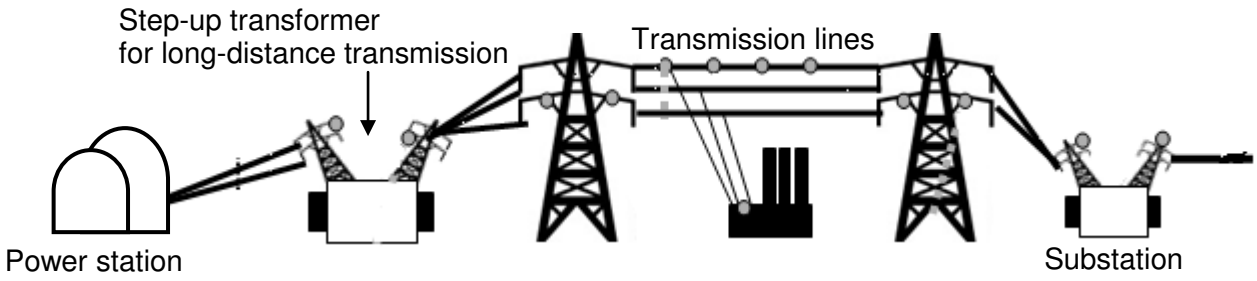
9.2.3 Which physical quantity is represented by the magnitude of the gradient of the graph? (2)

9.2.4 How does the voltmeter reading change as the ammeter reading increases? Write down INCREASES, DECREASES or REMAINS THE SAME. Use the formula emf = $IR + Ir$ to explain the answer. (3)

[20]

QUESTION 10 (Start on a new page.)

The diagram below illustrates how electricity generated at a power station is transmitted to a substation.



10.1 Does the power station use an AC or a DC generator? (1)

10.2 Sketch a graph of the potential difference generated at the power station versus time. (2)

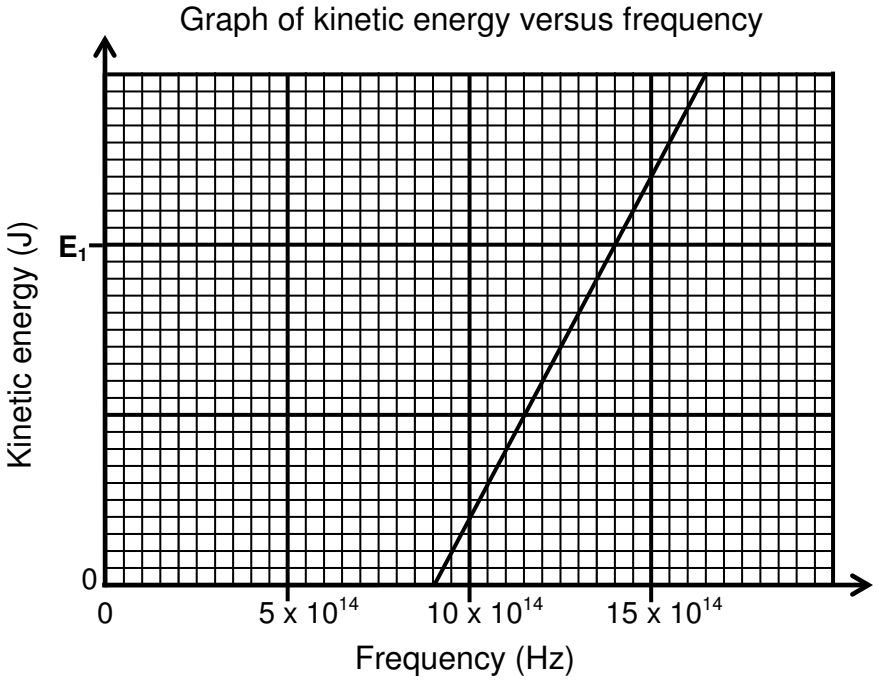
10.3 The average power produced at the power station is $4,45 \times 10^9$ W.

Calculate the rms current in the transmission lines if the power is transmitted at a maximum voltage of 30 000 V. (5)

10.4 Give a reason why electricity should be transmitted at high voltage and low current. (1)
[9]

QUESTION 11 (Start on a new page.)

During an investigation, light of different frequencies is shone onto the metal cathode of a photocell. The kinetic energy of the emitted photoelectrons is measured. The graph below shows the results obtained.



11.1 For this investigation, write down the following:

11.1.1 Dependent variable (1)

11.1.2 Independent variable (1)

11.1.3 Controlled variable (1)

11.2 Define the term *threshold frequency*. (2)

11.3 Use the graph to obtain the threshold frequency of the metal used as cathode in the photocell. (1)

11.4 Calculate the kinetic energy at E_1 shown on the graph. (4)

11.5 How would the kinetic energy calculated in QUESTION 11.4 be affected if light of higher intensity is used? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)
[11]

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 *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^{8}$ $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}$ $J \cdot s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^{9}$ $N \cdot m^{2} \cdot C^{-2}$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg
Permittivity of free space *Permittiwiteit van vry ruimte*	ε_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*

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

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* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ 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* $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ $E = h\frac{c}{\lambda}$
$\sin\theta = \frac{m\lambda}{a}$	$E = W_o + E_k$ where/*waar* $E = hf$ 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 $(\varepsilon) = I(R + r)$ emk $(\varepsilon) = I(R + r)$
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\,\Delta t$
$W = Vq$ $W = VI\,\Delta t$ $W = I^2R\,\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

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 2012

MEMORANDUM

MARKS/*PUNTE*: 150

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

SECTION A

QUESTION 1/*VRAAG 1*

1.1 Frequency/*Frekwensie* ✓ (1)

1.2 Capacitor/*Kapasitor* ✓ (1)

1.3 Split ring commutator ✓
Splitringkommutator (1)

1.4 Photons/*Fotone* ✓ (1)

1.5 Relative velocity/*Relatiewe snelheid* ✓ (1)
[5]

QUESTION 2/*VRAAG 2*

2.1 D ✓✓ (2)

2.2 C ✓✓ (2)

2.3 D ✓✓ (2)

2.4 D ✓✓ (2)

2.5 A ✓✓ (2)

2.6 A ✓✓ (2)

2.7 D ✓✓ (2)

2.8 C ✓✓ (2)

2.9 C ✓✓ (2)

2.10 A ✓✓ (2)
[20]

TOTAL SECTION A/*TOTAAL AFDELING A*: 25

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1 Downward/*afwaarts* ✓ (1)

3.2

3.2.1 **Upwards positive/*Opwaarts positief:***

$v_f = v_i + a\Delta t$ ✓
$= 8$ ✓$+ (-9,8)(4)$ ✓
$= -31,2\ m\cdot s^{-1}$
$\therefore v_f = 31,2\ m\cdot s^{-1}$ ✓

Downwards positive/*Afwaarts positief:*

$v_f = v_i + a\Delta t$✓
$= -8$ ✓$+ (9,8)(4)$ ✓
$\therefore v_f = 31,2\ m\cdot s^{-1}$ ✓ (4)

3.2.2

OPTION 1/*OPSIE 1*

Upwards positive/*Opwaarts positief*:

$\Delta y = v_i\Delta t + \frac{1}{2}a\ \Delta t^2$✓
$= (8)(4)$ ✓ $+ \frac{1}{2}(-9,8)(4)^2$ ✓
$= -46,4$ m

Height of balcony/*Hoogte van balkon:*
$60 - 46,4$ ✓$= 13,6$ m ✓

Downwards positive/*Afwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\ \Delta t^2$✓
$= (-8)(4)$ ✓ $+ \frac{1}{2}(9,8)(4)^2$ ✓
$= 46,4$ m

Height of balcony/*Hoogte van balkon:*
$60 - 46,4$ ✓$= 13,6$ m ✓

OPTION 2/*OPSIE 2*

Upwards positive/*Opwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$= (27,13)$ ✓ (6) ✓$+ \frac{1}{2}(-9,8)(6)^2$✓
$= -13,62$ m

Height of balcony/*Hoogte van balkon:*
$= 13,62$ m ✓

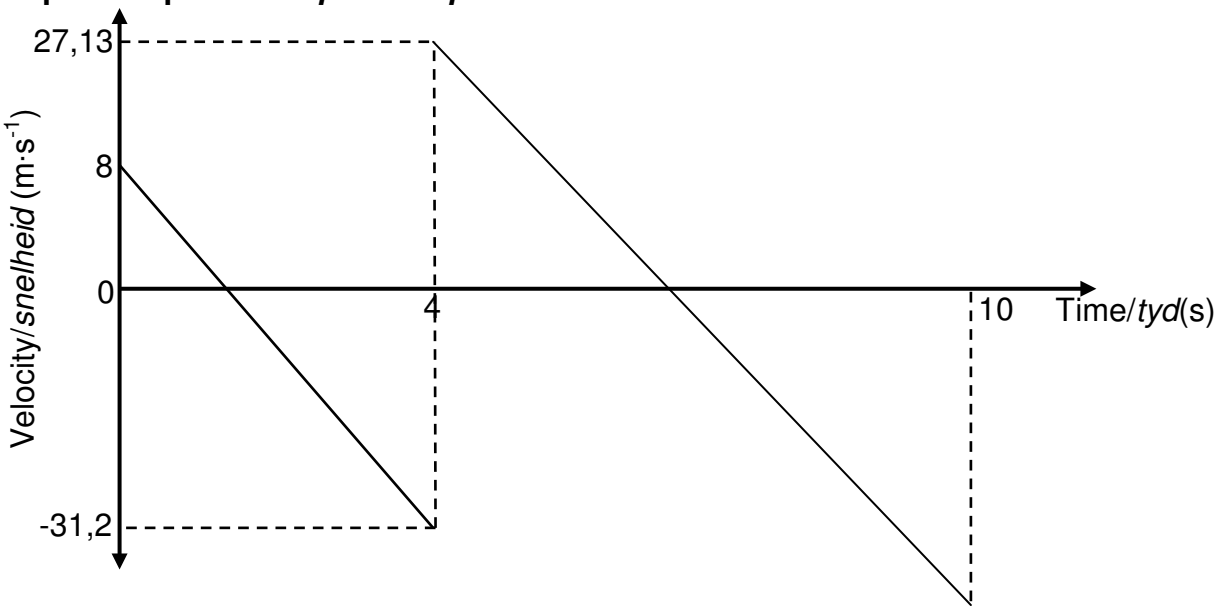
Downwards positive/*Afwaarts positief:*

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$= (-27,13)$ ✓ (6) ✓$+ \frac{1}{2}(9,8)(6)^2$✓
$= 13,62$ m

Height of balcony/*Hoogte van balkon:*
$= 13,62$ m ✓ (5)

3.3 **OPTION 1/*OPSIE 1***

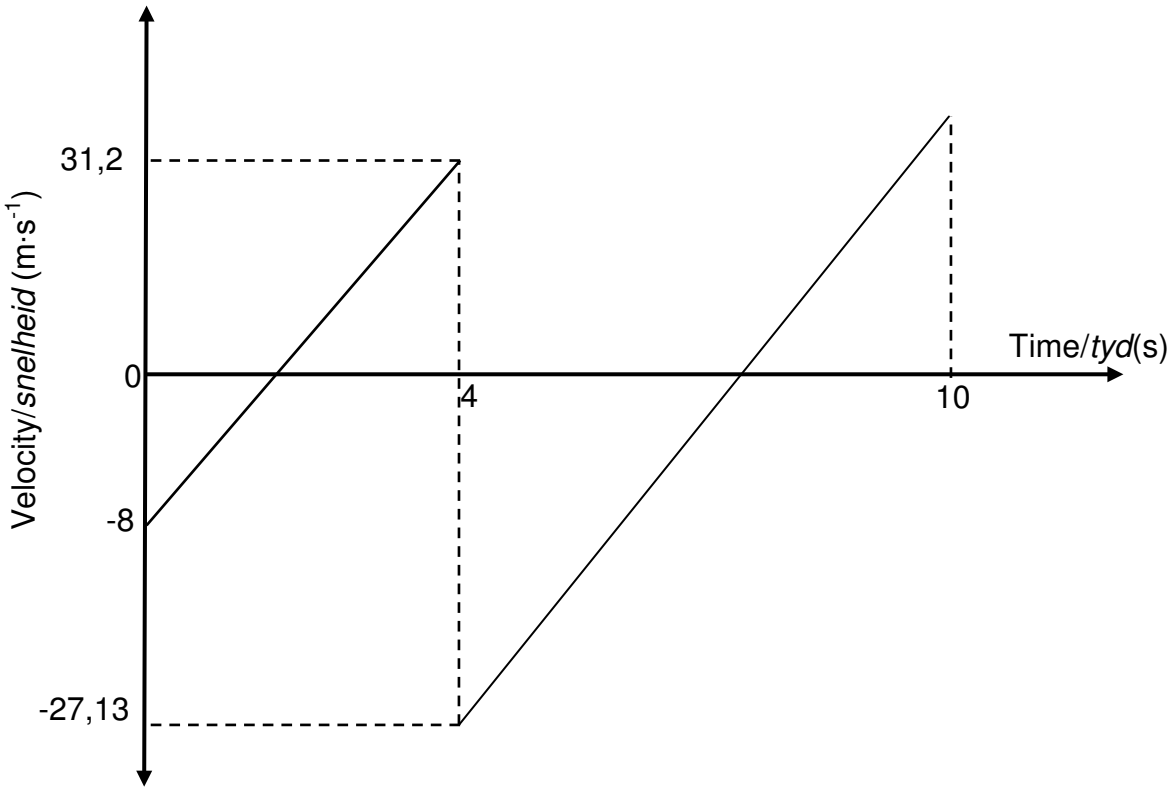
Upwards positive/*Opwaarts positief:*



Criteria for graph/*Kriteria vir grafiek:*	**Marks/ *Punte***
Shape has two parallel lines with a gradient. *Vorm het twee ewewydige lyne met gradient.*	✓
First part of graph starts at v = 8 m·s^{-1} at t = 0 s *Eerste deel van grafiek begin by v = 8 m·s^{-1} by t = 0 s.*	✓
Positive marking from QUESTION 3.2.1: ***Positiewe nasien vanaf VRAAG 3.2.1:*** First part of the graph extends below the x axis until v = -31,2 m·s^{-1} at t = 4 s. *Eerste deel van die grafiek verleng onder x-as tot* v = -31,2 m·s^{-1} by *t = 4 s.*	✓
Graph is discontinuous and object changes direction at 4 s. *Grafiek is nie kontinu nie en voorwerp verander van rigting by 4 s.*	✓
Second part of graph starts at v = 27,13 m·s^{-1} at t = 4 s. *Tweede deel van grafiek begin by v = 27,13 m·s^{-1} by t = 4 s.*	✓
Second part of graph extends below the x axis until t = 10 s. *Tweede deel van grafiek verleng onder x-as tot t =10 s.*	✓

OPTION 2/*OPSIE 2*

Upwards negative/*Opwaarts negatief:*



Criteria for graph/*Kriteria vir grafiek:*	**Marks** ***Punte***
Correct shape as shown (two parallel lines). *Korrekte vorm soos aangetoon (twee ewewydige lyne).*	✓
First part of graph starts at v = -8 m·s^{-1} at t = 0 s *Eerste deel van grafiek begin by v = -8 m·s^{-1} by t = 0 s*	✓
Positive marking from QUESTION 3.2.1. ***Positiewe nasien vanaf VRAAG 3.2.1.*** First part of the graph extends above the x axis until v = 31,2 m·s^{-1} at t = 4 s. *Eerste deel van die grafiek verleng bokant x-as tot* v = 31,2 m·s^{-1} by *t = 4 s.*	✓
Graph is discontinuous and object changes direction at 4 s. *Grafiek is nie kontinu en voorwerp verander van rigting by 4 s.*	✓
Second part of graph starts at v = -27,13 m·s^{-1} at t = 4 s. *Tweede deel van grafiek begin by v = -27,13 m·s^{-1} by t = 4 s.*	✓
Second part of graph extends above the x axis until t = 10 s. *Tweede deel van grafiek verleng bokant x-as tot t = 10 s.*	✓

.

(6)
[16]

QUESTION 4/*VRAAG 4*

4.1 40 m·s^{-1} ✓east/*oos* ✓ (2)

4.2 The <u>total (linear) momentum remains constant</u>/is conserved ✓
in <u>an isolated</u>/a closed system/the absence of external forces/ if the impulse of external forces is zero. ✓

Die <u>totale (linière) momentum bly konstant</u>/behoue ✓
in 'n <u>geïsoleerde sisteem</u>/geslote sisteem/ die afwesigheid van eksterne kragte./ indien die impuls van eksterne kragte nul is.✓ (2)

4.3 **<u>East positive</u>/*<u>Oos positief:</u>***
$\Sigma p_i = \Sigma p_f$ ✓
$m(20)$ ✓$+ 2m(-20)$ ✓ $= (m + 2m)v_f$ ✓
$\therefore v_f = -6{,}67$ m·s^{-1}
$\therefore v_f = 6{,}67$ m·s^{-1} ✓ west /wes ✓
<u>East negative</u>/*<u>Oos negatief:</u>*
$\Sigma p_i = \Sigma p_f$ ✓
$m(-20)$ ✓$+ 2m(+20)$ ✓ $= (m + 2m)v_f$ ✓
$\therefore v_f = 6{,}67$ m·s^{-1} ✓ west /*wes* ✓ (6)

4.4
4.4.1 F✓
Newton's Third Law of motion/*Newton se Derde Bewegingswet* ✓ (2)

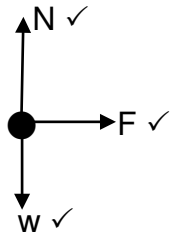
4.4.2 -½ a / ½a ✓
(Same/*Dieselfe* F_{net}), $a \propto \frac{1}{m}$ ✓ (2)

4.4.3 Car driver ✓
(Car - driver system) have <u>greater acceleration</u>. ✓
(Car - driver system) have <u>greater change in velocity /greater Δv</u>.✓

Motorbestuurder ✓
(Motor -bestuurder sisteem) het groter versnelling. ✓
(Motor -bestuurder sisteem) het groter verandering in snelheid / groter <u>Δv</u>.✓ (3)
[17]

QUESTION 5/*VRAAG 5*

5.1



(3)

5.2 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). ✓ (2)

5.3

5.3.1 $W_{net} = \Delta E_k/\Delta K$ ✓ **OR/*OF*** $F_{net}\Delta x\cos\theta = ½ m(v_f^2 - v_i^2)$
$F_{net}(1{,}02)\cos 180° ✓ = ½(1\,200)(0 - 20^2)$ ✓
$F_{net} = 235\,294{,}12$ N ✓ ($2{,}35 \times 10^5$ N)
(4)

5.3.2

OPTION 1 /*OPSIE 1*	**OPTION 2/*OPSIE 1***
$F_{net}\Delta t = m\Delta v$ ✓ $\therefore (-235\,294{,}12)\Delta t$ ✓ $= (1\,200)(0 - 20)$ ✓ $\therefore \Delta t = 0{,}1$ s ✓(0,102 s)	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ 1,02 ✓ $= \left(\frac{20 + 0}{2}\right)\Delta t$ ✓ $\Delta t = 0{,}1$ s✓

(4)
[13]

QUESTION 6/*VRAAG 6*

6.1 Frequency/*Frekwensie* ✓ (1)

6.2 There is relative motion between the bird and the bird watcher. ✓
Daar is relatiewe beweging tussen die voël en die voëlkyker nie. ✓ (1)

6.3 0,2 m ✓ (1)

6.4

6.4.1 $v = f\lambda$ ✓
$340 = f(0{,}2)$ ✓
$\therefore f = 1\,700$ Hz ✓
(3)

6.4.2 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ **OR/*OF*** $f_L = \frac{v}{v - v_s} f_s$ ✓
$\therefore 1\,700$ ✓ $= \frac{340}{340 - v_s}$ ✓ (1 650) ✓
$\therefore v_s = 10$ m·s^{-1} ✓
(5)
[11]

QUESTION 7/*VRAAG 7*

7.1 Double slit/*Dubbelspleet* ✓ (1)

7.2 (Alternate) dark and bright/blue bands. ✓
Bright / blue bands of equal broadness (width). ✓
(Afwissellende) donker en helder/blou bande. ✓
Helder / blou bande van gelyke breedte. ✓ (2)

7.3

7.3.1

$$\tan\theta = \frac{\frac{1}{2}\text{central band}}{\text{screen distance}} \;/\; \frac{\frac{1}{2}\textit{sentraleband}}{\textit{skermafstand}}$$

$$\therefore \tan\theta = \frac{\frac{1}{2}(0{,}22)}{1{,}4} \checkmark\checkmark$$

$$\therefore \theta = 4{,}49° \checkmark$$ (3)

7.3.2

OPTION 1/*OPSIE 1:*	**OPTION 2/*OPSIE 2:***
$\sin\theta = \frac{m\lambda}{a}$ ✓	$\sin\theta = \frac{m\lambda}{a}$ ✓
$\sin 4{,}49 = \frac{(1)(470\times10^{-9})}{a}$ ✓✓	$\sin(-4{,}49°) = \frac{(-1)(470\times10^{-9})}{a}$ ✓✓
$\therefore a = 6\times10^{-6}$ m ✓(6 003,67 nm)	$\therefore a = 6\times10^{-6}$ m ✓ (6 003,67 nm)

(5)

7.4 $\lambda_{\text{red light}} > \lambda_{\text{blue light}}$ ✓
(Degree of) diffraction/sin θ / θ α wavelength (λ) ✓
$\lambda_{\textit{rooilig}} > \lambda_{\textit{bloulig}}$ ✓
Diffraksie α *golflengte* (λ) ✓ (2)

[13]

QUESTION 8/*VRAAG 8*

8.1 $R = \frac{V}{I}$ ✓

$1\,000 = \frac{12}{I}$ ✓

$\therefore I = 0{,}01$ A ✓ (3)

8.2 12 V ✓ (1)

8.3 $C = \frac{Q}{V}$ ✓

$120 \times 10^{-6} = \frac{Q}{12}$ ✓

$\therefore Q = 1{,}44 \times 10^{-3}$ C ✓ (3)

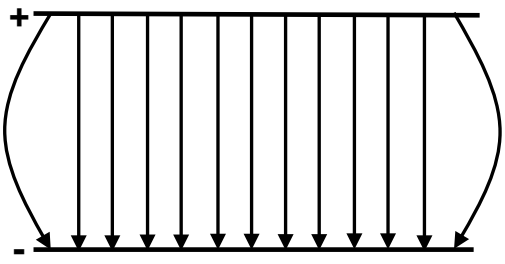
8.4

8.4.1 Decreases/*Verminder* ✓ (1)

8.4.2 Increases/*Vermeerder* ✓ (1)

8.5

8.5.1



Criteria for sketch:/*Kriteria vir skets:*	Marks/ *Punte*
Parallel lines equally spaced. *Parallelle lyne eweredig gespasieer.*	✓
Direction from positive plate towards negative plate.(Polarity of plates must be indicated) *Rigting vanaf positiewe plaat na negatiewe plaat.(Polariteit van plate moet aangedui word)*	✓
Field curved at the ends of the plates. *Veld gekrom aan einde van die plate.*	✓

(3)

8.5.2

$E = \frac{V}{d}$ ✓

$= \frac{12}{12 \times 10^{-3}}$ ✓

$\therefore E = 1\,000$ V·m^{-1} ✓ (3)

[15]

QUESTION 9/*VRAAG 9*

9.1

9.1.1 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓

$= \frac{1}{60} + \frac{1}{60}$ ✓

$\therefore R_p = 30\ \Omega$ ✓ (3)

9.1.2

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2:***
$R_{ext} = 30 + 25 = 55\ \Omega$ ✓	$R_{tot} = (30 + 25)$ ✓$+1,5 = 56,5\ \Omega$
Emf/*emk* = I(R + r) ✓	V = IR✓
$\therefore 12$ ✓$= I(55 + 1,5)$ ✓	12✓ $= I(56,5)$ ✓
$\therefore I = 0,21$ A ✓	$\therefore I = 0,21$ A ✓

(5)

9.1.3

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
V = IR ✓	V = IR ✓
= (0,21)(30) ✓	= (0,105)(60) ✓
= 6,3 V ✓	= 6,3 V ✓

(3)

9.2

9.2.1 1,5 V ✓ (1)

9.2.2 gradient/m $= \frac{\Delta V}{\Delta I}$

$= \frac{0,65 - 1,5}{1,0 - 0}$ ✓✓

$= -0,85\ \Omega$ ✓ (3)

9.2.3 Internal resistance ✓✓
Interne weerstand (2)

9.2.4 Decreases/*Verminder* ✓

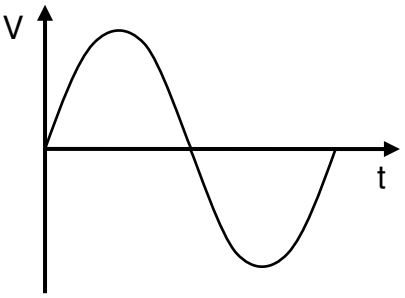
When I increases/*Wanneer I toeneem:*
"Lost volts"/ Ir increases./*"Verlore volts"/Ir neem toe.* ✓
V_{ext} = emf – Ir decreases. ✓/V_{ext} = *emk – Ir neem af.* (3)

[20]

QUESTION 10/*VRAAG 10*

10.1 AC /*WS* ✓ (1)

10.2



Criteria for graph/*Kriteria vir grafiek:*	**Marks *Punte***
Correct shape as shown; accept more than one cycle. *Korrekte vorm soos aangetoon; aanvaar meer as een siklus.*	✓✓
If no/wrong labels: minus 1 mark *Indien geen/verkeerde byskifte: minus 1 punt*	

(2)

10.3

OPTION 1/*OPSIE 1*

$V_{rms/wgk} = \frac{V_{max/\ maks}}{\sqrt{2}}$ ✓

$= \frac{30 \times 10^3}{\sqrt{2}}$ ✓

$= 2{,}12 \times 10^4$ V

$P_{ave} = V_{rms}I_{rms}/P_{gem.} = V_{wgk}I_{wgk}$ ✓

$4{,}45 \times 10^9$ ✓ $= (2{,}12 \times 10^4)I_{rms/wgk}$

$\therefore I_{rms/wgk} = 2{,}10 \times 10^5$ A ✓

OPTION 2 / *OPSIE 2*

$P_{ave} = V_{rms}I_{rms}/P_{gem.} = V_{wgk}I_{wgk}$

$P_{ave/gem.} = \frac{V_{max}I_{rms}}{\sqrt{2}} / \frac{V_{maks}I_{wgk}}{\sqrt{2}}$ ✓✓

$4{,}45 \times 10^9$ ✓ $= \frac{(30 \times 10^3)I_{rms/wgk}}{\sqrt{2}}$ ✓

$\therefore I_{rms/wgk} = 2{,}10 \times 10^5$ A ✓

(5)

10.4 Less loss in (electrical) energy (as heat). ✓
Minder verlies aan (elektriese) energie (as hitte). ✓ (1)

[9]

QUESTION 11/*VRAAG 11*

11.1

11.1.1 Kinetic energy /*Kinetiese energie* (E_k)✓ (1)

11.1.2 Frequency /*Frekwensie*✓(f) (1)

11.1.3 (Type of) metal✓
(Soort) metaal ✓ (1)

11.2 The minimum frequency needed to emit electrons ✓
from (the surface of) a metal. ✓
Die minimum frekwensie benodig om elektrone vry te stel vanaf (die oppervlak van) 'n metaal. (2)

11.3 9×10^{14} Hz ✓ (1)

11.4

$E = W_0 + E_k$
$hf = hf_0 + E_k$ } ✓ Any one /*Enige een*

$(6,63 \times 10^{-34})(14 \times 10^{14})$ ✓ $= (6,63 \times 10^{-34})(9 \times 10^{14})$ ✓ $+ E_k$

$\therefore E_k = 3,32 \times 10^{-19}$ J ✓ $(3,31 \times 10^{-19}$ J) (4)

11.5 Remains the same/*Bly dieselfde* ✓ (1)
[11]

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 2012

MARKS: 150

TIME: 3 hours

This question paper consists of 14 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 propan-2-one belongs (1)

1.2 The IUPAC name of the alkene with two carbon atoms (1)

1.3 The minimum energy needed for a chemical reaction to occur (1)

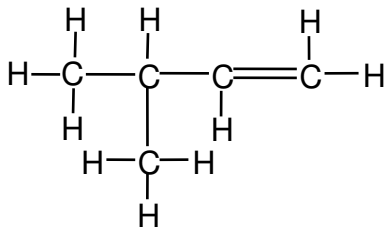
1.4 The general name used for a substance that increases the rate of a reaction without being consumed in the reaction (1)

1.5 The chemical name of brine (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 Consider the organic compound represented below.



The compound is ...

A saturated and branched.

B unsaturated and branched.

C saturated and straight-chained.

D unsaturated and straight-chained. (2)

2.2 A structural isomer of butane is ...

A propane.

B 2-methylbutane.

C 2-methylpropane.

D 2,2-dimethylpropane. (2)

2.3 The alcohols form a homologous series. This means that alcohols have ...

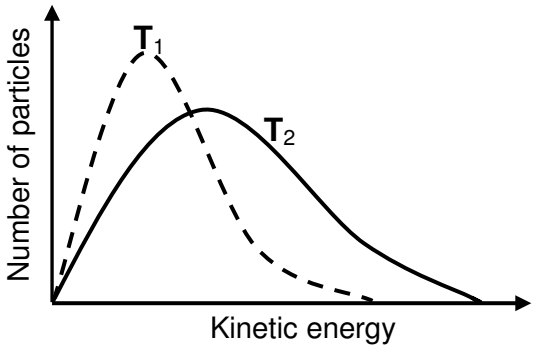
A similar chemical properties.

B similar physical properties.

C the same molecular formula.

D the same structural formula. (2)

2.4 The energy distribution diagrams for particles in a fixed mass of gas at two different temperatures, T_1 and T_2, are shown below.



Which ONE of the following is the correct interpretation of the diagrams as the temperature of the gas changes from $\mathbf{T_1}$ to $\mathbf{T_2}$?

	Activation energy (E_A)	**Number of effective collisions**
A	Remains the same	Increases
B	Decreases	Decreases
C	Decreases	Increases
D	Remains the same	Decreases

(2)

2.5 The expression for the equilibrium constant (K_C) of a hypothetical reaction is given as follows:

$$K_C = \frac{[D]^2[C]}{[A]^3}$$

Which ONE of the following equations for a reaction at equilibrium matches the above expression?

A $3A(s) \rightleftharpoons C(g) + 2D(g)$

B $3A(\ell) \rightleftharpoons C(aq) + 2D(aq)$

C $3A(aq) + B(s) \rightleftharpoons C(g) + D_2(g)$

D $3A(aq) + B(s) \rightleftharpoons C(aq) + 2D(aq)$ (2)

2.6 The reaction represented by the balanced equation below reaches equilibrium in a closed container.

$$2NO_2(g) \rightleftharpoons N_2O_4(g) \qquad \Delta H < 0$$

Which ONE of the following changes will INCREASE the yield of $N_2O_4(g)$?

A Add a catalyst.

B Remove NO_2 gas from the container.

C Increase the temperature of the system.

D Decrease the temperature of the system. (2)

2.7 In a redox reaction, an oxidising agent is ...

A reduced because it loses electrons.

B reduced because it gains electrons.

C oxidised because it loses electrons.

D oxidised because it gains electrons. (2)

2.8 In a galvanic (voltaic) cell, electrons move from the ...

A anode to the cathode through the salt bridge.

B cathode to the anode through the salt bridge.

C anode to the cathode in the external circuit.

D cathode to the anode in the external circuit. (2)

2.9 During the extraction of aluminium from aluminium oxide, cryolite is added to ...

A increase the yield of aluminium.

B decrease the yield of aluminium.

C increase the melting point of aluminium oxide.

D decrease the melting point of aluminium oxide. (2)

2.10 Which ONE of the following is a primary nutrient needed by plants?

A N

B C

C Mg

D Na (2)

[20]

TOTAL SECTION A: 25

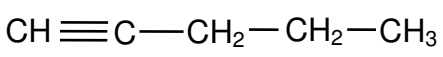
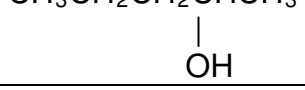
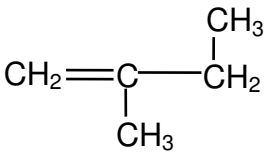
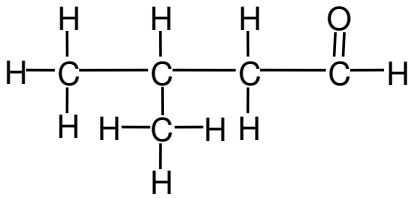
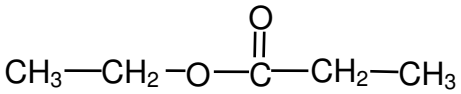
SECTION B

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 your 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**	Pentanoic acid
E		**F**	

3.1 Write down the letter(s) that represent(s) each of the following:
(A compound may be used more than once.)

3.1.1 An alkyne (1)

3.1.2 Two compounds that are structural isomers (2)

3.1.3 A compound containing a carboxyl group (1)

3.1.4 An aldehyde (1)

3.1.5 An alcohol (1)

3.2 Write down the:

3.2.1 IUPAC name of compound **C** (2)

3.2.2 Structural formula of compound **D** (2)

3.3 Compound **F** is prepared in the laboratory.

3.3.1 How can one quickly establish whether compound **F** is indeed being formed? (1)

3.3.2 Write down the IUPAC name of the alcohol needed to prepare compound **F**. (2)

3.3.3 Write down the IUPAC name of compound **F**. (2)
[15]

QUESTION 4 (Start on a new page.)

During a practical investigation the boiling points of the first six straight-chain ALKANES were determined and the results were recorded in the table below.

ALKANE	MOLECULAR FORMULA	BOILING POINT (°C)
Methane	CH_4	−164
Ethane	C_2H_6	−89
Propane	C_3H_8	−42
Butane	C_4H_{10}	−0,5
Pentane	C_5H_{12}	36
Hexane	C_6H_{14}	69

4.1 Write down the:

4.1.1 Most important use of the alkanes in the above table (1)

4.1.2 General formula of the alkanes (1)

Refer to the table to answer QUESTION 4.2 and QUESTION 4.3 below.

4.2 For this investigation, write down the following:

4.2.1 Dependent variable (1)

4.2.2 Independent variable (1)

4.2.3 Conclusion that can be drawn from the above results (2)

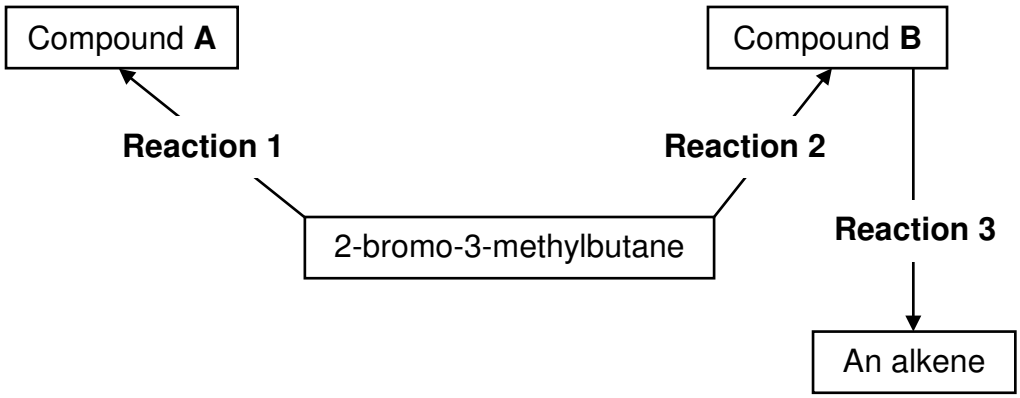
4.3 Write down the NAME of an alkane that is a liquid at 25 °C. (1)

4.4 Alkanes burn readily in oxygen. Write down a balanced equation, using molecular formulae, for the combustion of propane in excess oxygen. (3)

4.5 Will the boiling points of the structural isomers of hexane be HIGHER THAN, LOWER THAN or EQUAL TO that of hexane? Refer to MOLECULAR STRUCTURE, INTERMOLECULAR FORCES and ENERGY NEEDED to explain the answer. (4)
[14]

QUESTION 5 (Start on a new page.)

The flow diagram below shows how three organic compounds can be prepared from 2-bromo-3-methylbutane.



5.1 Write down the:

5.1.1 Homologous series to which 2-bromo-3-methylbutane belongs (1)

5.1.2 Structural formula of 2-bromo-3-methylbutane (2)

5.2 **Reaction 2** takes place in the presence of a dilute sodium hydroxide solution.

Write down the:

5.2.1 Name of the type of reaction which takes place (1)

5.2.2 Structural formula of compound **B** (2)

5.3 **Reaction 1** takes place in the presence of concentrated sodium hydroxide.

Write down:

5.3.1 Another reaction condition needed for this reaction (1)

5.3.2 The name of the type of reaction which takes place (1)

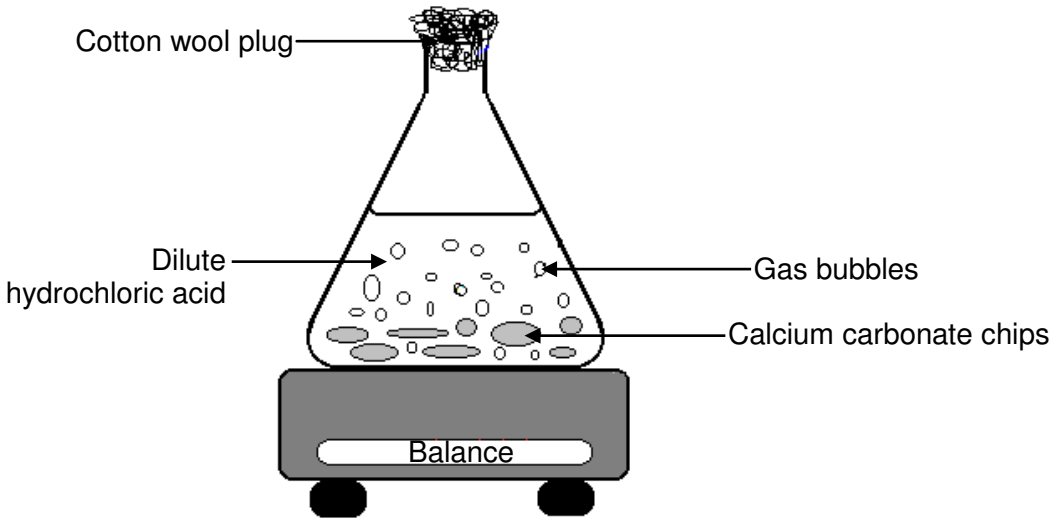
5.3.3 The structural formula of compound **A**, the major product formed (2)

5.4 **Reaction 3** takes place when compound **B** is heated in the presence of concentrated sulphuric acid. Write down the IUPAC name of the major product formed. (2)
[12]

QUESTION 6 (Start on a new page.)

Calcium carbonate chips are added to an excess dilute hydrochloric acid solution in a flask placed on a balance as illustrated below. The cotton wool plug in the mouth of the flask prevents spillage of reactants and products, but simultaneously allows the formed gas to escape. The balanced equation for the reaction that takes place is:

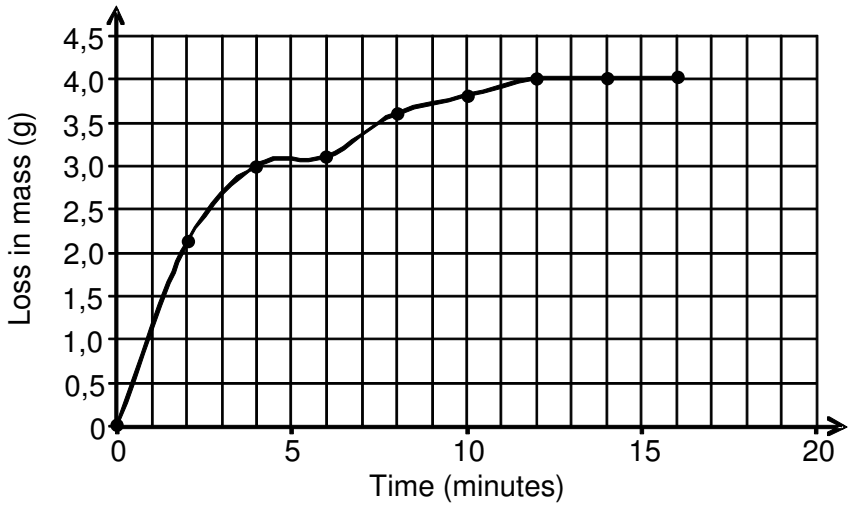
$$CaCO_3(s) + 2HC\ell(aq) \rightarrow CaC\ell_2(aq) + CO_2(g) + H_2O(\ell)$$



6.1 Write down the NAME of the gas that escapes through the cotton wool plug while the reaction takes place. (1)

The loss in mass of the flask and its contents is recorded in intervals of 2 minutes. The results obtained are shown in the graph below.

Graph of loss in mass versus time



6.2 From the graph, write down the following:

6.2.1 The coordinates of the point that represents results that were measured incorrectly (1)

6.2.2 How long (in minutes) the reaction lasts (1)

6.2.3 How long (in minutes) it takes 75% (three quarters) of the reaction to occur (1)

6.3 The experiment is now repeated using hydrochloric acid of a higher concentration. It is found that the rate of the reaction INCREASES. Use the collision theory to explain this observation. (2)

6.4 How would a higher concentration of hydrochloric acid affect the following: (Write down only INCREASES, DECREASES or REMAINS THE SAME.)

6.4.1 Loss in mass per unit time (1)

6.4.2 Total loss in mass (1)

6.4.3 Time for the reaction to reach completion (1)

6.5 Apart from concentration and temperature changes, write down TWO other changes that can be made to increase the rate of this reaction. (2)

6.6 Calculate the mass of calcium carbonate used when the reaction is completed. Assume that all the gas that was formed, escaped from the flask. (5)
[16]

QUESTION 7 (Start on a new page.)

A hypothetical reaction is represented by the balanced equation below.

$$A(g) + 2B(g) \rightleftharpoons 2C(g)$$

Initially 3 moles of A(g) and 6 moles of B(g) are mixed in a 5 dm^3 sealed container. When the reaction reaches equilibrium at 25 °C, it is found that 4 moles of B(g) is present.

7.1 Define the term *chemical equilibrium.* (2)

7.2 Show by calculation that the equilibrium concentration of C(g) is 0,4 $mol \cdot dm^{-3}$. (3)

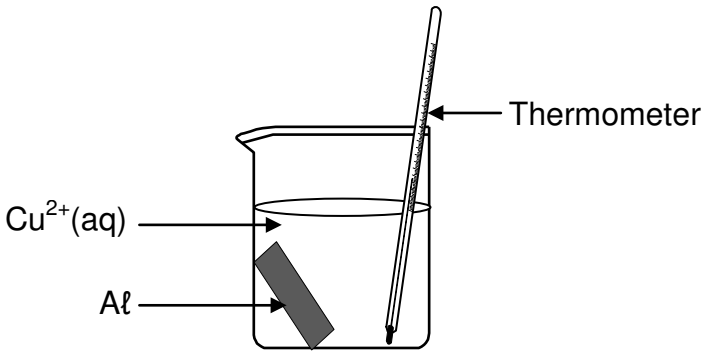
7.3 How will an increase in pressure, by decreasing the volume of the container, influence the amount of C(g) in the container at 25 °C?
Write down INCREASES, DECREASES or REMAINS THE SAME. Explain the answer. (3)

7.4 The initial number of moles of B(g) is now increased while the initial number of moles of A(g) remains constant at 25 °C

Calculate the number of moles of B(g) that must be ADDED to the original amount (6 mol) so that the concentration of C(g) is 0,8 $mol \cdot dm^{-3}$ at equilibrium. The equilibrium constant (K_C) for this reaction at 25 °C is 0,625. (9)
[17]

QUESTION 8 (Start on a new page.)

8.1 A strip of aluminium is placed in a beaker containing a blue solution of a copper(II) salt. After a while the solution becomes colourless.

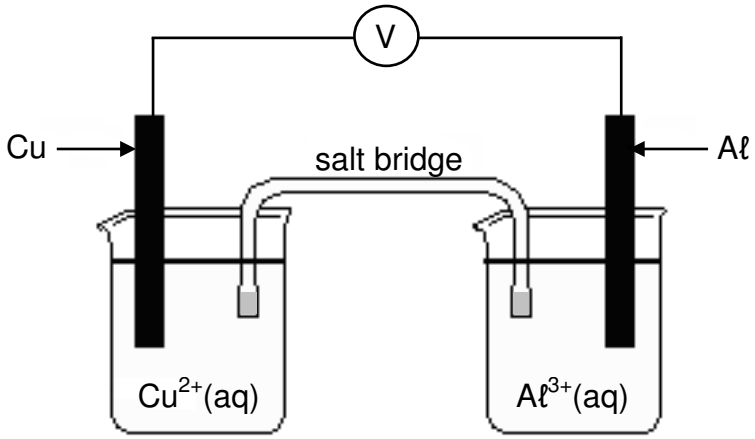


8.1.1 How would the reading on the thermometer change as the reaction proceeds? Write down INCREASES, DECREASES or REMAINS THE SAME. Give a reason for the answer. (2)

8.1.2 Refer to the reducing ability of aluminium to explain why the solution becomes colourless. (2)

8.1.3 Write down the balanced net IONIC equation for the reaction that takes place. (3)

8.2 The electrochemical cell shown below functions at standard conditions.



8.2.1 Which electrode (Cu or Aℓ) is the anode? (1)

8.2.2 Write down the cell notation for this cell. (3)

8.2.3 Calculate the emf of this cell. (4)

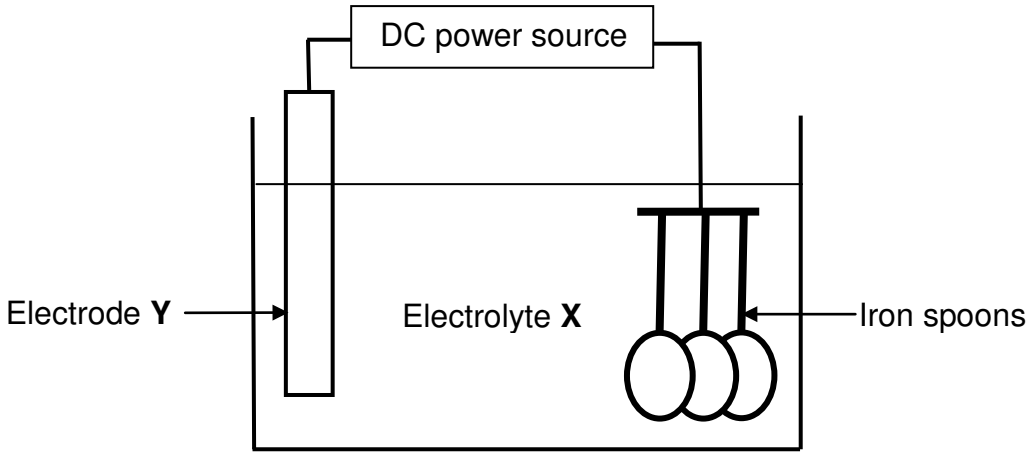
The salt bridge is now removed.

8.2.4 What will the reading on the voltmeter be? Give a reason for your answer. (2)

[17]

QUESTION 9 (Start on a new page.)

The simplified diagram below shows an electrolytic cell used at an electroplating company to coat iron spoons with silver.



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

9.2 Direct current (DC) is used in this process. Give a reason why alternating current (AC) is NOT used. (1)

9.3 Which type of reaction (OXIDATION or REDUCTION) takes place at the spoons? (1)

9.4 Write down the:

9.4.1 Equation for the half-reaction that takes place at electrode **Y** (2)

9.4.2 NAME or FORMULA of electrolyte **X** (1)

9.5 Give a reason why the concentration of electrolyte **X** remains constant during electroplating. (2)

9.6 Apart from the income generated, write down ONE major reason why the company electroplates the spoons. (1)

9.7 Write down the TWO major expenses for the company during the process. (2)
[11]

QUESTION 10 (Start on a new page.)

The following half-reactions take place when a non-rechargeable alkaline cell is in use:

$$Zn(s) + 2OH^-(aq) \rightarrow ZnO(s) + H_2O(\ell) + 2e^- \quad \ldots\ldots\ldots\ldots(1)$$

$$MnO_2(s) + 2H_2O(\ell) + 2e^- \rightarrow Mn(OH)_2(s) + 2OH^-(aq) \quad \ldots\ldots(2)$$

10.1 Write down the general name used for non-rechargeable cells. (1)

10.2 Which ONE of the above equations (**1** or **2**) represents the half-reaction that takes place at the cathode? Give a reason for your answer. (2)

10.3 Give a reason why the cell 'dies' after delivering current for a while. (1)

10.4 The emf of the alkaline cell is 1,5 V. The maximum electrical work that can be done by this cell is 3×10^4 J.

Calculate the:

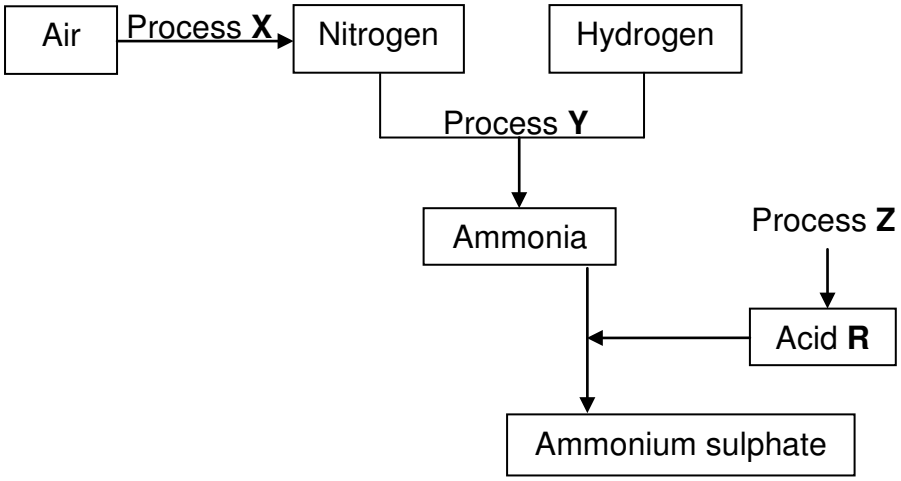
10.4.1 Cell capacity of this cell in A·h (4)

10.4.2 Maximum constant current that this cell can deliver for 20 hours (3)

[11]

QUESTION 11 (Start on a new page.)

11.1 The flow diagram below represents processes used in the fertiliser industry.



Write down:

11.1.1 The name of industrial process **X** (1)

11.1.2 A balanced equation for process **Y** (3)

11.1.3 The name of industrial process **Z** (1)

11.1.4 A balanced equation for the preparation of ammonium sulphate using acid **R** (3)

11.1.5 The name of the type of reaction taking place in QUESTION 11.1.4. (1)

11.2 Ammonium nitrate is one of the most common compounds used as fertiliser.

11.2.1 Write down the NAME or FORMULA of the acid needed to prepare ammonium nitrate from ammonia. (1)

11.2.2 Write down TWO properties of ammonium nitrate that make it suitable for use as a fertiliser. (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 *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}$ C

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

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

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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 **H** 1																	**He** 4
1,0 **Li** 7	1,5 **Be** 9											2,0 **B** 11	2,5 **C** 12	3,0 **N** 14	3,5 **O** 16	4,0 **F** 19	**Ne** 20
0,9 **Na** 23	1,2 **Mg** 24											1,5 **Aℓ** 27	1,8 **Si** 28	2,1 **P** 31	2,5 **S** 32	3,0 **Cℓ** 35,5	**Ar** 40
0,8 **K** 39	1,0 **Ca** 40	1,3 **Sc** 45	1,5 **Ti** 48	1,6 **V** 51	1,6 **Cr** 52	1,5 **Mn** 55	1,8 **Fe** 56	1,8 **Co** 59	1,8 **Ni** 59	1,9 **Cu** 63,5	1,6 **Zn** 65	1,6 **Ga** 70	1,8 **Ge** 73	2,0 **As** 75	2,4 **Se** 79	2,8 **Br** 80	**Kr** 84
0,8 **Rb** 86	1,0 **Sr** 88	1,2 **Y** 89	1,4 **Zr** 91	**Nb** 92	1,8 **Mo** 96	1,9 **Tc**	2,2 **Ru** 101	2,2 **Rh** 103	2,2 **Pd** 106	1,9 **Ag** 108	1,7 **Cd** 112	1,7 **In** 115	1,8 **Sn** 119	1,9 **Sb** 122	2,1 **Te** 128	2,5 **I** 127	**Xe** 131
0,7 **Cs** 133	0,9 **Ba** 137	**La** 139	1,6 **Hf** 179	**Ta** 181	**W** 184	**Re** 186	**Os** 190	**Ir** 192	**Pt** 195	**Au** 197	**Hg** 201	1,8 **Tℓ** 204	1,8 **Pb** 207	1,9 **Bi** 209	2,0 **Po**	2,5 **At**	**Rn**
0,7 **Fr**	0,9 **Ra** 226	**Ac**															

Ce 140	**Pr** 141	**Nd** 144	**Pm**	**Sm** 150	**Eu** 152	**Gd** 157	**Tb** 159	**Dy** 163	**Ho** 165	**Er** 167	**Tm** 169	**Yb** 173	**Lu** 175
Th 232	**Pa**	**U** 238	**Np**	**Pu**	**Am**	**Cm**	**Bk**	**Cf**	**Es**	**Fm**	**Md**	**No**	**Lr**

KEY/*SLEUTEL*

Atomic number *Atoomgetal*

Electronegativity *Elektronegatiwiteit*

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 2012

MEMORANDUM

MARKS/*PUNTE*: 150

This memorandum consists of 11 pages.
Hierdie memorandum bestaan uit 11 bladsye.

SECTION A/*AFDELING A*

QUESTION 1/*VRAAG 1*

1.1 Ketones/*Ketone* ✓ (1)

1.2 Ethene/*Eteen* ✓ (1)

1.3 Activation (energy)/*Aktiverings(energie)* ✓ (1)

1.4 Catalyst/*katalistor* ✓ (1)

1.5 (saturated) sodium chloride solution ✓
(versadigde) natriumchloried oplossing (1)
[5]

QUESTION 2/*VRAAG 2*

2.1 B ✓✓ (2)

2.2 C ✓✓ (2)

2.3 A ✓✓ (2)

2.4 A ✓✓ (2)

2.5 D ✓✓ (2)

2.6 D ✓✓ (2)

2.7 B ✓✓ (2)

2.8 C ✓✓ (2)

2.9 D ✓✓ (2)

2.10 A ✓✓ (2)
[20]

TOTAL SECTION A/*TOTAAL AFDELING A*: 25

SECTION B/*AFDELING B*

QUESTION 3/*VRAAG 3*

3.1

3.1.1 A ✓ (1)

3.1.2 D & F ✓✓ (2)

3.1.3 D ✓ (1)

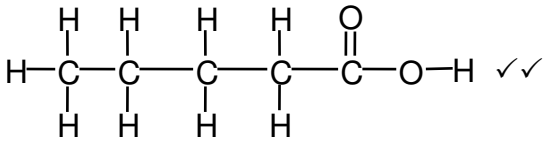
3.1.4 E ✓ (1)

3.1.5 B ✓ (1)

3.2

3.2.1 2-methyl✓but-1-ene ✓
2-metiel✓ but-1-een ✓ (2)

3.2.2



✓✓ (2)

3.3

3.3.1 Pleasant odour ✓
Aangename geur (1)

3.3.2 Ethanol ✓✓
Etanol (2)

3.3.3 Ethyl propanoate ✓✓
Etielpropanoaat (2)

[15]

QUESTION 4/*VRAAG 4*

4.1

4.1.1 Fuels ✓
Brandstowwe ✓ (1)

4.1.2 C_nH_{2n+2} ✓ (1)

4.2

4.2.1 Boiling point/*Kookpunt* ✓ (1)

4.2.2 Chain length/Molecular size/Molecular mass ✓
Kettinglengte/Molekulêre grootte/Molekulêre massa (1)

4.2.3

Criteria for conclusion/*Kriteria vir gevolgtrekking*:	**Mark/*Punt***
Dependent and independent variables correctly identified. *Afhanklike en onafhanklike veranderlikes korrek geï dentifiseer.*	✓
Relationship between the independent and dependent variables correctly stated. Verwantskap tussen die *afhanklike en onafhanklike veranderlikes korrek genoem.*	✓

Examples/*Voorbeelde*:

- Boiling point increases with increase in chain length/molecular size/molecular mass.
  Kookpunt neem toe met toename in kettinglengte/molekulêre grootte/molekulêre massa.
- Boiling point decreases with decrease in chain length/ molecular size/molecular mass.
  Kookpunt neem af met afname in kettinglengte/molekulêre grootte/molekulêre massa.
- Boiling point is proportional to chain length/molecular size/molecular mass.
  Kookpunt is eweredig aan kettinglengte/molekulêre grootte/molekulêre massa .

(2)

4.3 Pentane/*Pentaan* ✓

OR/*OF*

Hexane/*Heksaan* ✓ (1)

4.4 $C_3H_8 + 5O_2$ ✓→ $3CO_2 + 4H_2O$ ✓ bal ✓ (3)

4.5 Lower than ✓

- **Structure:**
  Isomers have more branching/ more compact or spherical molecules / smaller surface areas over which the intermolecular forces act. ✓
- **Intermolecular forces:**
  Weaker intermolecular forces/less intermolecular forces ✓
- **Energy:**
  Less energy needed to overcome intermolecular forces. ✓

Kleiner as ✓

- ***Struktuur*:**
  Isomere *meer vertak/Molekule meer kompak of sferies./ Kleiner oppervlaktes waaroor intermolekulêre kragte werk.* ✓
- ***Intermolekulêre* kragte**
  Swakker intermolekulêre kragte/ minder intermolekulêre kragte ✓
- ***Energie*:**
  Die minder energie benodig om intermolekulêre kragte te oorkom. ✓

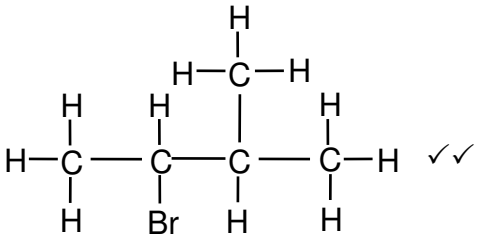
(4)
[14]

QUESTION 5/*VRAAG 5*

5.1

5.1.1 Haloalkanes /*Haloalkane* ✓ (1)

5.1.2



✓✓ (2)

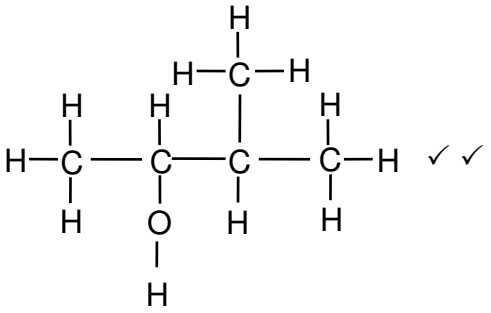
5.2

5.2.1 Substitution/*Substitusie* ✓

OR/*OF*

Hydrolysis/*Hidrolise* ✓ (1)

5.2.2



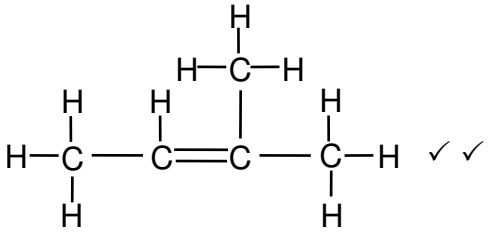
✓ ✓ (2)

5.3

5.3.1 Heat strongly ✓
Verhit sterk (1)

5.3.2 Elimination/dehydrohalogenation/dehydrobromination ✓
Eliminasie/dehidrohalogenering/dehidrobrominering ✓ (1)

5.3.3



✓ ✓ (2)

5.4 2-methylbut-2-ene ✓✓
2-metielbut-2-een (2)

[12]

QUESTION 6/*VRAAG 6*

6.1 Carbon dioxide ✓
Koolstofdioksied/koolsuurgas (1)

6.2

6.2.1 (6 ; 3,1) ✓ (1)

6.2.2 12 minutes/*minute* ✓ (1)

6.2.3. 4 minutes/*minute* ✓ (1)

6.3 More particles per unit volume ✓
More effective collisions per unit time/second. ✓
Meer deeltjies per eenheids volume deeltjies.
Meer effektiewe botsings per eenheids tyd/sekonde. (2)

6.4

6.4.1 Increases/*Vermeerder* ✓ (1)

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

6.4.3 Decreases/*Neem af* ✓ (1)

6.5
- Add a catalyst/*Voeg 'n katalisator by* ✓
- Increase surface area of calcium carbonate./Use calcium carbonate powder./Crush calcium carbonate chips. ✓
Verhoog die oppervlakarea van kalsiumkarbonaat./Gebruik kalsiumkarbonaatpoeier./Maak die kalsiumkarbonaatstukkies fyn. (2)

6.6
$$n(CO_2) = \frac{m}{M} \checkmark$$
$$= \frac{4}{44} \checkmark$$
$$= 0{,}09 \text{ mol}$$
$$n(CaCO_3) = n(CO_2) = 0{,}09 \text{ mol}$$
$$m(CaCO_3) = nM$$
$$= (0{,}09) \checkmark (100) \checkmark$$
$$= 9 \text{ g} \checkmark$$
(5)
[16]

QUESTION 7/*VRAAG 7*

7.1 The stage in a chemical reaction when the rate of forward reaction equals the rate of reverse reaction. ✓✓
Die stadium in 'n chemiese reaksie wanneer die tempo van die voorwaartse reaksie is gelyk aan die tempo van die terugwaarste reaksie. ✓✓
(2)

7.2 n(B)reacted/*gereageer* = 6 – 4 = 2 mol ✓
n(C)formed/*gevorm* = n(B)reacted/*gereageer*
= 2 mol ✓
$c(C) = \frac{n}{V} = \frac{2}{5}$ ✓ = 0,4 mol·dm^{-3}
(3)

7.3 Increases ✓
- 3 mol/volumes (of gas) produces 2 mol/volumes (of gas)./The reaction which produces the smaller number of moles/volume is favoured. ✓
- Forward reaction is favoured. ✓

Vermeerder ✓
- *3 mol/volumes (gas) produseer 2 mol/volumes (gas)./Die reaksie wat die kleiner getal mol /volume vorm, word bevoordeel.*
- *Voorwaartse reaksie word bevoordeel.*

(3)

7.4 **OPTION 1/*OPSIE 1***
Use *x* as the total initial amount of B(g) that must be used.
Gebruik x as die totale aanvanklike hoeveelheid B(g) wat gebruik moet word.

	A	B	C
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	3	x	0
Change (mol) *Verandering (mol)*	-2	-4	+4
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	1	x – 4 ✓	4 ✓
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{1}{5} = 0,2$	$\frac{x-4}{5}$	0,8

ratio ✓ *verhouding*

Divide by/*gedeel deur* 5 ✓

$K_C = \frac{[C]^2}{[A][B]^2}$ ✓

$\therefore 0,625$ ✓ $= \frac{(0,8)^2}{(0,2)(\frac{x-4}{5})^2}$ ✓

$\therefore x = 15,3$ mol

$\therefore$ n(B) added = 15,3 – 6 ✓
= 9,3 (mol) ✓

No K_C expression, correct substitution/*Geen K_c-uitdrukking*, korrekte substitusie: Max./*Maks.* 8/9

Wrong K_C expression/*Verkeerde K_c-uitdrukking*: Max./*Maks.* 6/9

OPTION 2/*OPSIE 2*

Use *x* as amount to be added to the amount of B(g) present initially i.e. 6 mol of B(g).
Gebruik x as die hoeveelheid wat by die hoeveelheid van B(g) wat aanvanklik teenwoordig was gevoeg moet word d.i. 6 mol B(g).

	A	B	C
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	3	x + 6 ✓	0
Change (mol) *Verandering (mol)*	-2	-4	+4
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	1	x + 2 ✓	4 ✓
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{1}{5} = 0,2$	$\frac{x+2}{5}$	0,8

ratio ✓
verhouding

Divide by/*gedeel deur* 5

$$K_C = \frac{[C]^2}{[A][B]^2} \checkmark$$

$$\therefore 0,625 \checkmark = \frac{(0,8)^2}{(0,2)(\frac{x+2}{5})^2} \checkmark$$

$$\therefore x = 9,31 \text{ (mol)} \checkmark$$

OPTION 3/*OPSIE 3*

Use *x* as amount to be added to the amount of B(g) present after first equilibrium was established i.e. 4 mol of B(g).
Gebruik x as die hoeveelheid wat by die hoeveelheid van B(g) wat teenwoordig is nadat die eerste ewewig ingestel is, gevoeg moet word d.i. 4 mol B(g).

	A	B	C
Initial quantity (mol) *Aanvangshoeveelheid (mol)*	2	x + 4 ✓	2
Change (mol) *Verandering (mol)*	-1	-2	+2
Quantity at equilibrium (mol)/ *Hoeveelheid by ewewig (mol)*	1	x + 2 ✓	4 ✓
Equilibrium concentration (mol·dm^{-3}) *Ewewigskonsentrasie (mol·dm^{-3})*	$\frac{1}{5} = 0,2$	$\frac{x+2}{5}$	0,8

ratio ✓
verhouding

Divide by /*gedeel deur* 5✓

$$K_C = \frac{[C]^2}{[A][B]^2} \checkmark$$

$$\therefore 0,625 \checkmark = \frac{(0,8)^2}{(0,2)(\frac{x+2}{5})^2} \checkmark$$

$$\therefore x = 9,31 \text{ (mol)} \checkmark$$

(9)
[17]

QUESTION 8/*VRAAG 8*

8.1

8.1.1 Increases ✓
The reaction is exothermic./Energy (or heat) is released /ΔH < 0.✓

Vermeerder
Die reaksie is eksotermies./Energie (of hitte) word vrygestel/ΔH < 0. (2)

8.1.2 Aluminium is a strong reducing agent/stronger reducing agent ✓ than copper and will reduce the copper(II) ions to copper. ✓

Aluminium is 'n sterk reduseermiddel / sterker reduseermiddel ✓ as koper en sal die koper(II)-ione reduseer na koper. ✓ (2)

8.1.3 $2A\ell(s) + 3Cu^{2+}(aq)\checkmark \rightarrow 2A\ell^{3+}(aq) + 3Cu(s)\checkmark$ bal. ✓ (3)

8.2

8.2.1 Aℓ/Aluminium ✓ (1)

8.2.2 $A\ell(s) \mid A\ell^{3+}(1\ mol{\cdot}dm^{-3}) \checkmark \parallel Cu^{2+}(1\ mol{\cdot}dm^{-3}) \checkmark \mid Cu(s)$ (3)

8.2.3 $E^{o}_{cell} = E^{o}_{cathode} - E^{o}_{anode}$ ✓
$= 0,34$ ✓$- (-1, 66)$ ✓
$E^{o}_{cell} = 2,(00)V$ ✓ (4)

8.2.4 0 (V)/zero/*nul* ✓
The circuit is open. ✓
Die stroombaan is oop (2)
[17]

QUESTION 9/*VRAAG 9*

9.1 Electrical energy to chemical energy. ✓
Elektriese energie na chemiese energie ✓ (1)

9.2 The polarity of the electrodes must remain constant during plating. ✓
Die polariteit van die elektrodes moet konstant bly tydens elektroplatering. (1)

9.3 Reduction/*Reduksie* ✓ (1)

9.4
9.4.1 $Ag \rightarrow Ag^+ + e^-$ ✓✓ (2)

9.4.2 Silver nitrate/*Silwernitraat*/$AgNO_3$✓

OR/*OF*
Silver ethanoate/silver acetate/*Silweretanoaat/silwerasetaat* ✓
$CH_3COOAg/AgC_2H_3O_2/AgCH_3CO_2$ (1)

9.5 Rate of oxidation is equal to the rate of reduction. ✓✓
Tempo van oksidasie is gelyk aan die tempo van reduksie. (2)

9.6 **Protection/*Beskerming***
Protects it from rusting / corrosion./*Beskerm dit teen roes/korrosie.* ✓

OR/OF
Appearance/*Voorkoms*
Improve appearance of spoons. / *Verbeter voorkoms van die lepels.* (1)

9.7 Cost of electricity/ *Koste van elektrisiteit.* ✓
Cost of silver/ *Koste van silwer* ✓ (2)
[11]

QUESTION 10/*VRAAG 10*

10.1 Primary (cells)/*Primêre (selle)* ✓ (1)

10.2 (Equation/*Vergelyking*) 2 ✓
Reduction takes place (at the cathode)./*Reduksie vind (by die katode) plaas.*✓ (2)

10.3 **ANY ONE/*ENIGE EEN*:**
- The cell reaction reaches equilibrium. ✓
  Die selreaksie bereik ewewig. ✓
- The rates of the forward and reverse reactions become equal. ✓
  Die tempo van die voorwaartse en terugwaartse reaksies is gelyk. ✓
- Substances reach their equilibrium concentrations. ✓
  Stowwe bereik hul ewewigskonsentrasies.

(1)

10.4

10.4.1 $W = qV$ ✓
$\therefore 3 \times 10^4 = q(1,5)$ ✓
$\therefore q = 2 \times 10^4$ (C)
Cell capacity/*Selkapasiteit* = $\frac{2 \times 10^4}{3600}$ ✓ = 5,56 A·h ✓ (4)

10.4.2

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
$q = I\Delta t$ ✓	$q = I\Delta t$ ✓
$\therefore 2 \times 10^4 = I(20)(3600)$ ✓	$\therefore 5,56 = I(20)$ ✓
$\therefore I = 0,28$ A ✓	$\therefore I = 0,28$ A ✓

(3)
[11]

QUESTION 11/*VRAAG 11*

11.1

11.1.1 Fractional distillation (of liquid air) ✓
Fraksionele distillasie (van vloeibare lug) ✓ (1)

11.1.2 $N_2 + 3H_2$ ✓$\rightleftharpoons 2NH_3$ ✓ bal. ✓ (3)

11.1.3 Contact (process)/*Kontak(proses)* ✓ (1)

11.1.4 $H_2SO_4 + 2NH_3$ ✓$\rightarrow (NH_4)_2SO_4$ ✓ bal. ✓ (3)

11.1.5 Neutralisation/Acid-base reaction ✓
Neutralisasie/Suur-basisreaksie ✓ (1)

11.2

11.2.1 Nitric acid/HNO_3/ hydrogen nitrate /*salpetersuur/ waterstofnitraat* ✓ (1)

11.2.2
- Contains (a high percentage of) nitrogen/N/primary nutrient. ✓
  Bevat (*'n hoë persentasie) stikstof/N/primêre voedingstof.* (2)
- High solubility /*Hoë oplosbaarheid* ✓ **[12]**

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