basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CHEMISTRY (P2)

NOVEMBER 2019

MARKS: 150

TIME: 2 hours

This question paper consists of 13 pages and 2 data sheets.

Copyright reserved

INSTRUCTIONS AND INFORMATION

1. Write your name and class (e.g. 10A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc. where required.
12. Write neatly and legibly.

Copyright reserved

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1 Nitrogen gas is an example of a/an …

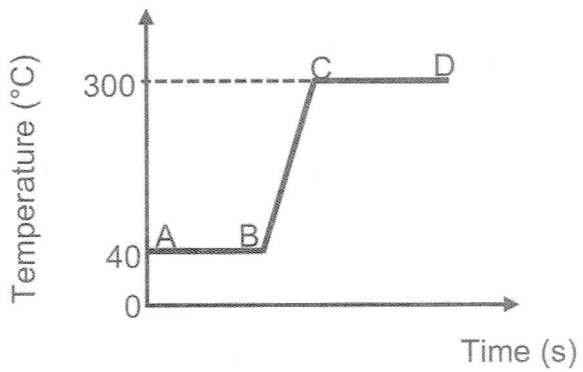
A element.

B compound.

C heterogeneous mixture.

D homogeneous mixture. (2)

1.2 The heating curve, not drawn to scale, of a compound is shown below.



During which section(s) on the curve will the potential energy of the compound INCREASE?

A BC only

B CD only

C AB and CD

D AB, BC and CD (2)

1.3 Elements in the periodic table are arranged in order of increasing …

A mass number.

B number of protons.

C number of neutrons.

D number of nucleons. (2)

1.4 Avogadro's number is equal to the number of …

A atoms in 1 mole CO.

B atoms in 1 mole Br_2.

C molecules in 1 mole Au.

D molecules in 1 mole N_2. (2)

1.5 The unbalanced equation for a chemical reaction is shown below.

$$CH_4 + O_2 \rightarrow CO_2 + H_2O$$

Which ONE of the following represents the coefficients of reactants and products in the BALANCED equation?

	CH_4	O_2	CO_2	H_2O
A	2	1	2	1
B	1	1	2	2
C	1	2	1	2
D	2	2	1	1

(2)

1.6 A covalent bond forms …

A between metal and non-metal atoms.

B through electron transfer.

C through sharing of electrons.

D between positive and negative ions. (2)

1.7 The reaction between hydrogen chloride (HCℓ) and sodium hydroxide (NaOH) is an example of a/an … reaction.

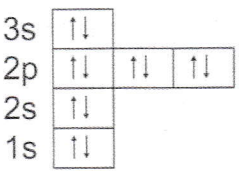
A redox

B acid-base

C precipitation

D gas forming (2)

1.8 Consider the Aufbau diagram of an element below.



The element is a/an …

A halogen.

B noble gas.

C alkali metal.

D alkaline-earth metal. (2)

1.9 Which ONE of the following equations represents a precipitation reaction?

A $NaOH + HC\ell \rightarrow NaC\ell + H_2O$

B $NaC\ell + HNO_3 \rightarrow NaNO_3 + HC\ell$

C $NaC\ell + AgNO_3 \rightarrow AgC\ell + NaNO_3$

D $Na_2CO_3 + 2HC\ell \rightarrow 2NaC\ell + CO_2 + H_2O$ (2)

1.10 The air surrounding the Earth is the …

A biosphere.

B lithosphere.

C atmosphere.

D hydrosphere. (2)
[20]

QUESTION 2 (Start on a new page.)

Most elements found on Earth are metals. All metals have a metallic structure.

2.1 For a metallic structure, write down the:

2.1.1 Type of particles present (2)

2.1.2 Type of chemical bond formed between particles (1)

2.2 In which region on the periodic table are metals found? Choose from LEFT or RIGHT. (1)

2.3 Write down the SYMBOL of a metal which is a liquid at room temperature. (1)

2.4 To prevent iron from rusting it is often mixed with other metals, e.g. stainless steel is a mixture of iron, chromium and nickel.

2.4.1 Is stainless steel a HOMOGENEOUS or HETEROGENEOUS mixture? Give a reason for the answer. (2)

2.4.2 Rusting is the formation of iron(III) oxide. Write down the FORMULA of iron(III) oxide. (1)

2.5 The physical properties of two substances, **A** and **B**, are shown in the table below.

SUBSTANCES	DENSITY ($g \cdot cm^{-3}$)	ELECTRICAL CONDUCTIVITY	THERMAL CONDUCTIVITY
A	4,94	Poor	Poor
B	7,87	Good	Good

2.5.1 Which ONE of the substances, **A** or **B**, has the smaller mass to volume ratio? Give a reason for the answer. (2)

2.5.2 Explain the difference between *electrical conductivity* and *thermal conductivity*. (2)

2.5.3 Which ONE of the substances, **A** or **B**, is a metal? Give a reason for the answer. (2)

[14]

QUESTION 3 (Start on a new page.)

3.1 The three isotopes of magnesium are Mg-24, Mg-25 and Mg-26. The percentage abundance of the three isotopes is 80%, 10% and 10% respectively.

3.1.1 Define the term *isotope.* (2)

3.1.2 Calculate the relative atomic mass of magnesium. (4)

3.1.3 The number of protons and electrons, the mass number and the atomic number of Mg-24 and its ion are shown in the table below.

Some of these values in the table have been omitted. Write down the letters **(a–e)** in the ANSWER BOOK and next to each letter the number omitted.

	NUMBER OF PROTONS	NUMBER OF ELECTRONS	MASS NUMBER	ATOMIC NUMBER
Mg	12	**(a)**	24	**(b)**
Mg^{2+}	**(c)**	**(d)**	**(e)**	12

(5)

3.2 The sp notation of an unknown element **X** is shown below.

$$1s^2 2s^2 2p^6 3s^2 3p^5$$

For element **X**, write down the:

3.2.1 Number of valence electrons (1)

3.2.2 Period where this element is found on the periodic table (1)

3.2.3 Highest energy level in which electrons occur (1)

3.2.4 Symbol (1)

Magnesium combines with element **X** to form a compound.

3.2.5 Write down the type of bond that forms between magnesium and element **X**. (1)

3.2.6 Draw the Aufbau diagram for the MAGNESIUM ION. (2)

3.2.7 Draw Lewis dot diagrams to show the bond formation between magnesium and element **X**. (4)

[22]

QUESTION 4 (Start on a new page.)

A section of the periodic table is shown below. Imaginary symbols are used to represent some of the elements.

	1	2										13	14	15	16	17	18
1																	L
2		E													G	J	
3												D		M			
4	A												H				

4.1 Write down the IMAGINARY SYMBOL, as shown above, of the element that:

4.1.1 Is a halogen (1)

4.1.2 Will form a cation with a charge of +2 (1)

4.1.3 Has the largest atomic radius (1)

4.1.4 Has the highest electronegativity (1)

4.1.5 Is a metalloid (1)

4.1.6 Is a noble gas (1)

4.1.7 Will form a diatomic molecule (1)

4.1.8 Has three valence electrons (1)

4.2 The first ionisation energy of element **A** is 400 $kJ \cdot mol^{-1}$.

4.2.1 Define the term *first ionisation energy*. (2)

4.2.2 The first ionisation energy of element **A** can be represented by the following incomplete equation:

$$\mathbf{A}(g) + 400\ kJ \cdot mol^{-1} \rightarrow \ldots + \ldots$$

Copy the equation above into the ANSWER BOOK and complete it. (2)

4.3 Atoms of element **J** release the most energy when gaining electrons to form negative ions.

Write down ONE word or term for the underlined phrase. (1)

4.4 Write down the formula of the compound formed when:

4.4.1 **D** combines with **G** (2)

4.4.2 **A** combines with **J** (2)

[17]

QUESTION 5 (Start on a new page.)

Consider the compound $A\ell_2(SO_4)_3$.

5.1 Write down the NAME of the compound above. (1)

5.2 Define the term *molar mass*. (2)

5.3 Calculate the following for $A\ell_2(SO_4)_3$:

5.3.1 Its molar mass (2)

5.3.2 Its percentage composition (3)

5.3.3 The number of moles present in 85,5 g (3)

5.3.4 The number of aluminium atoms present in 85,5 g (3)

5.4 Particles of $A\ell_2(SO_4)_3$ are bonded in a crystal lattice.

Write down the following for this crystal lattice:

5.4.1 The name (1)

5.4.2 The particles of which it consists (2)

5.4.3 TWO physical properties (2)

5.5 500 g of $A\ell_2(SO_4)_3$ is dissolved in 2 dm^3 water.

5.5.1 Define the term *concentration*. (2)

5.5.2 Calculate the concentration of the solution. (4)
[25]

QUESTION 6 (Start on a new page.)

6.1 The first step in the extraction of zinc from zinc sulphide (ZnS) is the combustion of ZnS in oxygen. The balanced equation for the reaction is:

$$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g) + \text{energy}$$

6.1.1 Is the reaction above EXOTHERMIC or ENDOTHERMIC? Give a reason for the answer. (2)

Oxygen gas consists of oxygen molecules.

6.1.2 Define the term *molecule*. (2)

6.1.3 Draw the Lewis dot diagram of the oxygen molecule (O_2). (2)

During the reaction above, 7 g ZnS reacts completely with oxygen gas.

Calculate the:

6.1.4 Number of moles of ZnS that has reacted (3)

6.1.5 Mass O_2 needed (3)

6.1.6 Volume of $SO_2(g)$ produced at STP (4)

6.2 Consider the incomplete equation for the chemical reaction below.

$$Zn(s) + H_2SO_4(aq) \rightarrow \mathbf{X} + H_2(g)$$

6.2.1 Write down the NAME of the acid in the equation above. (1)

6.2.2 Write down the FORMULA of product **X**. (2)

6.2.3 Name the type of reaction illustrated above. Choose from ACID-BASE REACTION, PRECIPITATION REACTION or REDOX REACTION. Explain the answer. (3)

6.2.4 Briefly describe a test that can be used to verify the formation of hydrogen gas during the reaction above. (2)

[24]

QUESTION 7 (Start on a new page.)

7.1 The relationship between conductivity and the concentration of ions in two electrolytes, $NaC\ell(aq)$ and $CaC\ell_2(aq)$, of the SAME concentration are investigated.

7.1.1 Define the term *electrolyte*. (2)

7.1.2 Is the water molecule POLAR or NON-POLAR? Give a reason for the answer. (2)

7.1.3 For this investigation, write down the:

(a) Independent variable (1)

(b) Dependant variable (1)

The $NaC\ell(aq)$ is added dropwise to distilled water in a beaker and the conductivity of the solution is measured after the addition of each drop. The experiment is repeated for the $CaC\ell_2(aq)$. The results obtained are shown in the table below.

NUMBER OF DROPS	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Conductivity of $NaC\ell(aq)$ (mA)	0,18	0,34	0,55	0,74	0,92	1,10	1,29	1,47
Conductivity of $CaC\ell_2(aq)$ (mA)	0,18	0,55	0,91	1,29	1,47	1,84	2,21	2,21

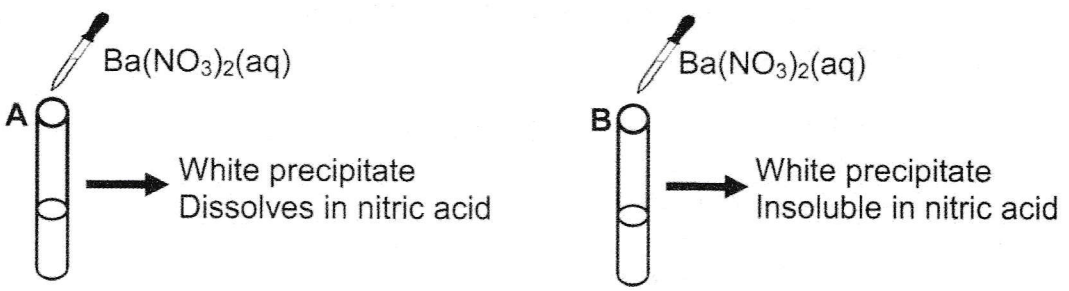
7.1.4 Write down a balanced equation for the dissociation of $NaC\ell(s)$ in water. (3)

7.1.5 Which electrolyte, $NaC\ell(aq)$ or $CaC\ell_2(aq)$, has the higher conductivity? Give a reason for the answer. (2)

Copyright reserved

7.2 A learner is supplied with two unlabelled bottles containing potassium salts. She knows that one bottle contains a SULPHATE and the other a CARBONATE.

To distinguish between the two salts she adds a few drops of barium nitrate, $Ba(NO_3)_2(aq)$, to a solution of each salt in two separate test tubes, **A** and **B**, as shown below.



The learner finds that a white precipitate forms in each test tube. After the addition of nitric acid, the precipitate in test tube **A** dissolves to release a gas, while the precipitate in test tube **B** remains.

Write down the:

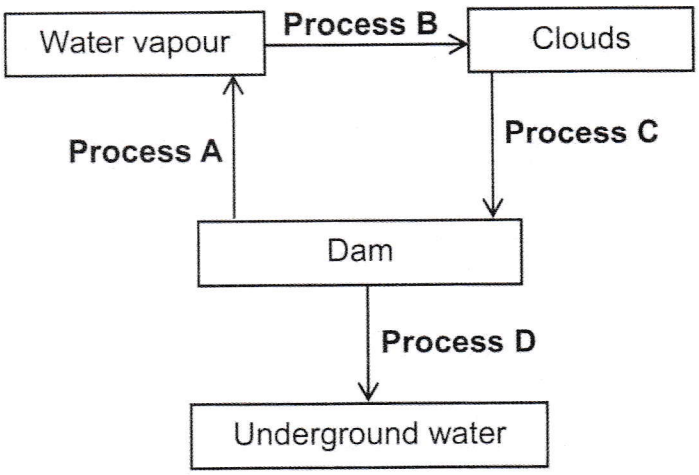
7.2.1 FORMULA of the POTASSIUM SALT in test tube **A** (2)

7.2.2 FORMULA of the precipitate that forms in test tube **B** (2)

7.2.3 Balanced equation for the reaction that explains why the precipitate dissolves in test tube **A** after the addition of nitric acid (3)
[18]

QUESTION 8 (Start on a new page.)

The simplified diagram below represents the water cycle. Condensation and evaporation are two of the processes in the water cycle.



8.1 Define the term:

8.1.1 Condensation (2)

8.1.2 Evaporation (2)

8.2 Write down the name of:

8.2.1 Process **A** (1)

8.2.2 Process **B** (1)

8.2.3 Process **C** (1)

8.2.4 Process **D** (1)

8.3 Describe the term *hydrosphere* with reference to the different phases present. (2)
[10]

TOTAL: 150

Copyright reserved

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
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
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/*OF* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

Copyright reserved

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
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

29
1,9 Cu
63,5

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

Copyright reserved

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES: PHYSICS (P1)

NOVEMBER 2019

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 2 data sheets.

Copyright reserved

INSTRUCTIONS AND INFORMATION

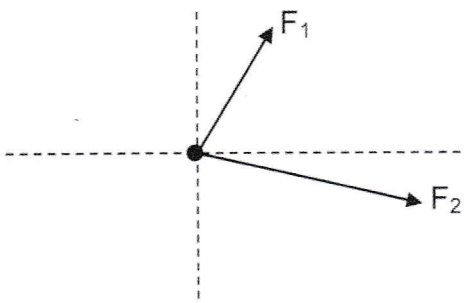
1. Write your name and class (e.g. 11A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc. where required.
12. Write neatly and legibly.

Copyright reserved

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

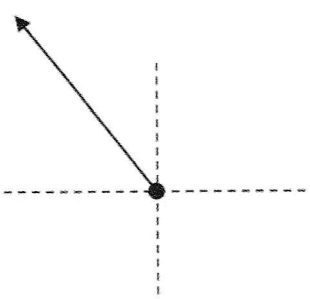
Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1 Two forces, F_1 and F_2, act simultaneously at a point in the directions as shown in the sketch below.

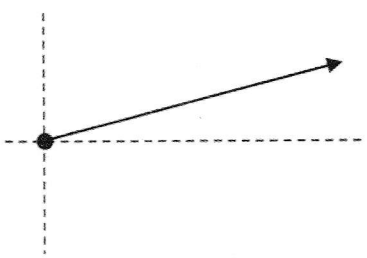


Which ONE of the following represents the resultant of the two forces?

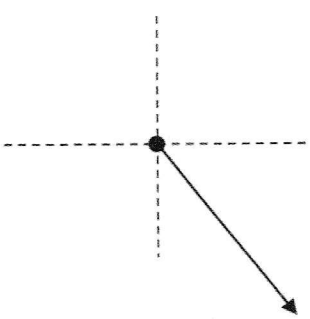
A



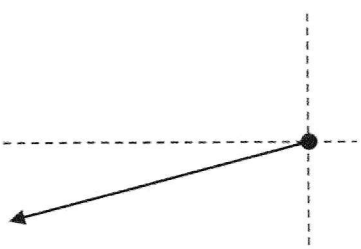
B



C



D



(2)

1.2 Which ONE of the following statements regarding inertia of an object is CORRECT?

The inertia of an object …

A is greater if its mass is smaller.

B increases as the applied force on the object increases.

C is the resistance to any change in its state of motion.

D increases as the frictional force on the object increases.

1.3 Which ONE of the following statements regarding the frictional force acting on an object is CORRECT?

The frictional force is …

A directly proportional to the normal force.

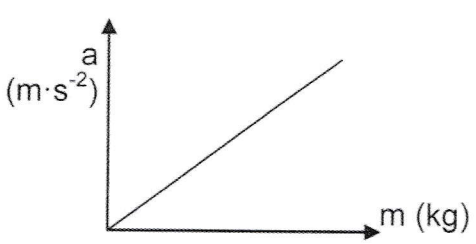
B dependent on the velocity of the motion.

C independent of the type of surface.

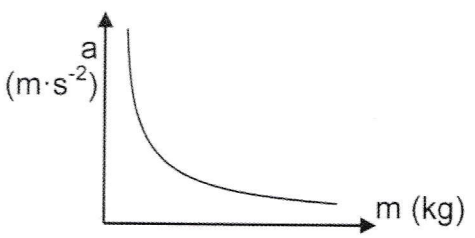
D equal to the weight of the object. (2)

1.4 Which ONE of the following graphs represents the relationship between acceleration and mass of an object if a constant net force acts on it?

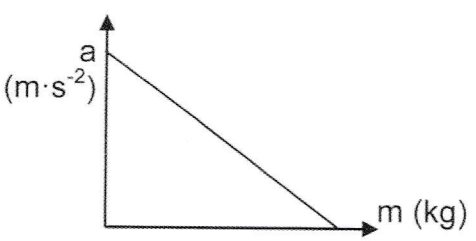
A



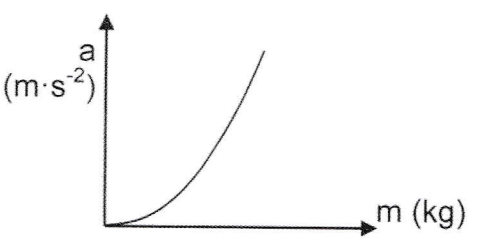
B



C



D



(2)

1.5 According to Newton's Third Law of Motion, the reaction force to the weight of a book lying on a table is the …

A normal force.

B force of the book on Earth.

C force of Earth on the book.

D force of the book on the table. (2)

1.6 The measure of the refractive power of a medium is called the …

A refractive index.

B optical density.

C refraction.

D speed of light in the medium.

1.7 A central bright band is observed when light of wavelength **λ** travels through a slit of width **w**.

Light of wavelength **2λ** is now used. A central bright band of the SAME broadness will be produced if the slit width used is …

A w

B ½w

C ¼w

D 2w (2)

1.8 The electric field at a point is defined as …

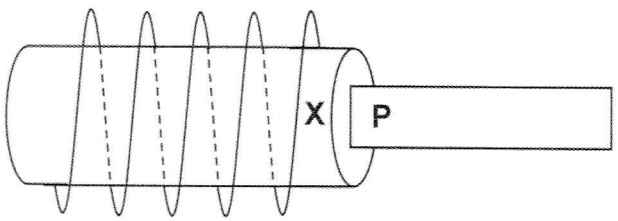
A the region in space where an electric charge experiences an electrostatic force.

B the electrostatic force per unit positive charge.

C directly proportional to the product of the charges.

D the direction that a negative test charge would move. (2)

1.9 The diagram below shows a coil and a magnet with a pole, **P**. A magnetic field is induced in the coil due to the motion of the magnet.

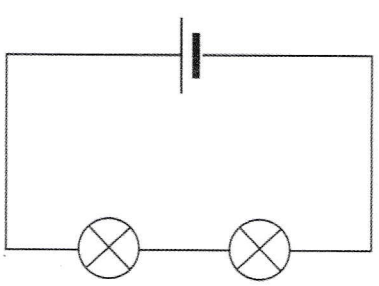


Which ONE of the following combinations will result in an induced magnetic field with a NORTH POLE at point **X**?

	DIRECTION OF MOTION OF MAGNET	POLARITY OF P
A	Into the coil	North
B	Up and down inside the coil	North
C	Into the coil	South
D	Up and down inside the coil	South

(2)

1.10 The cell in the circuit below delivers a potential difference of 1,5 V. The bulbs are identical and the current in the circuit is 0,2 A.



The energy, in joule, transferred by ONE of the bulbs in one minute is …

A 1,5 × 0,2 × 1

B 1,5 × 0,2 × 60

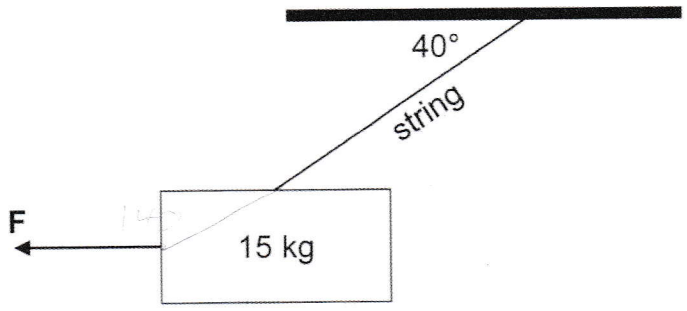
C 0,75 × 0,2 × 1

D 0,75 × 0,2 × 60

(2)
[20]

QUESTION 2 (Start on a new page.)

A billboard, mass 15 kg, is suspended from a roof by means of a light inextensible string. Force **F** pulls the billboard sideways, as shown in the diagram below.



When the angle between the roof and the string is 40°, a closed vector diagram is obtained for all the forces acting on the billboard.

2.1 What deduction can be made when the forces acting on an object forms a closed vector diagram? (2)

2.2 Calculate the weight of the billboard. (2)

2.3 Draw a labelled closed vector diagram of ALL the forces acting on the billboard. Indicate the value of ONE of the angles. (4)

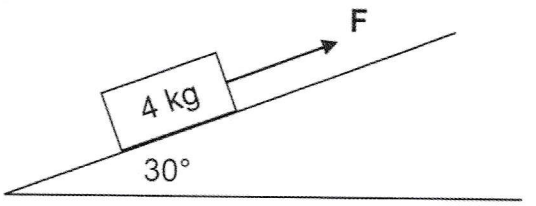
2.4 Calculate the tension in the string. (2)

2.5 The magnitude of force **F** is equal to the magnitude of the horizontal component of the tension in the string.

Give a reason why these two forces are NOT considered to be an action-reaction pair according to Newton's Third Law. (1)
[11]

QUESTION 3 (Start on a new page.)

A 4 kg block is pulled up along a frictionless incline by a constant force **F** acting parallel to the incline, as shown below. The incline makes an angle of 30° with the horizontal. The block moves at CONSTANT VELOCITY.



3.1 State *Newton's First Law of Motion* in words. (2)

3.2 Draw a labelled free-body diagram showing all the forces acting on the block. (3)

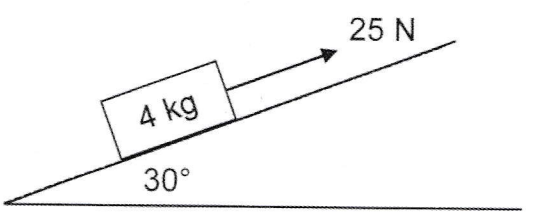
3.3 Calculate the magnitude of:

3.3.1 The perpendicular component of the weight of the block (3)

3.3.2 Force **F** (3)

The same block is now pulled up along a rough incline by a constant force of 25 N acting parallel to the incline, as shown below. The incline makes an angle of 30° with the horizontal.

The acceleration of the block is now 0,2 $m \cdot s^{-2}$ upwards along the incline.

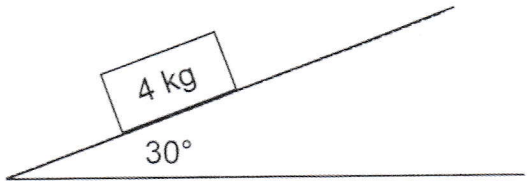


3.4 Calculate the:

3.4.1 Magnitude of the kinetic frictional force acting on the block (4)

3.4.2 Coefficient of kinetic friction between the block and the surface of the incline (3)

The force of 25 N acting on the block on the rough incline is now removed, as shown below.



3.5 How will EACH of the following quantities change in MAGNITUDE and DIRECTION?

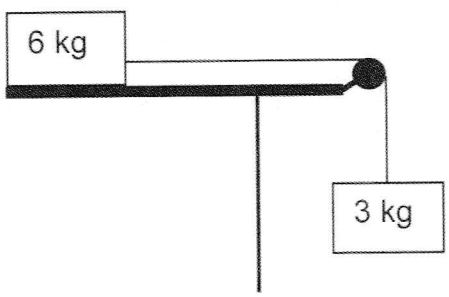
3.5.1 Weight of the block (2)

3.5.2 Acceleration of the block (2)

3.5.3 Kinetic frictional force acting on the block (2)
[24]

QUESTION 4 (Start on a new page.)

A 6 kg block, held at rest on a rough horizontal table, is connected to another block of mass 3 kg by a light inextensible string passing over a frictionless pulley. The 3 kg block hangs vertically, as shown in the diagram below.



When the 6 kg block is released, it accelerates to the right and experiences a kinetic frictional force of 24 N. Ignore the effects of air friction.

4.1 State *Newton's Second Law of Motion* in words. (2)

4.2 Draw a labelled free-body diagram showing ALL the forces acting on the 6 kg block. (4)

4.3 Calculate the magnitude of the acceleration of the 3 kg block. (6)

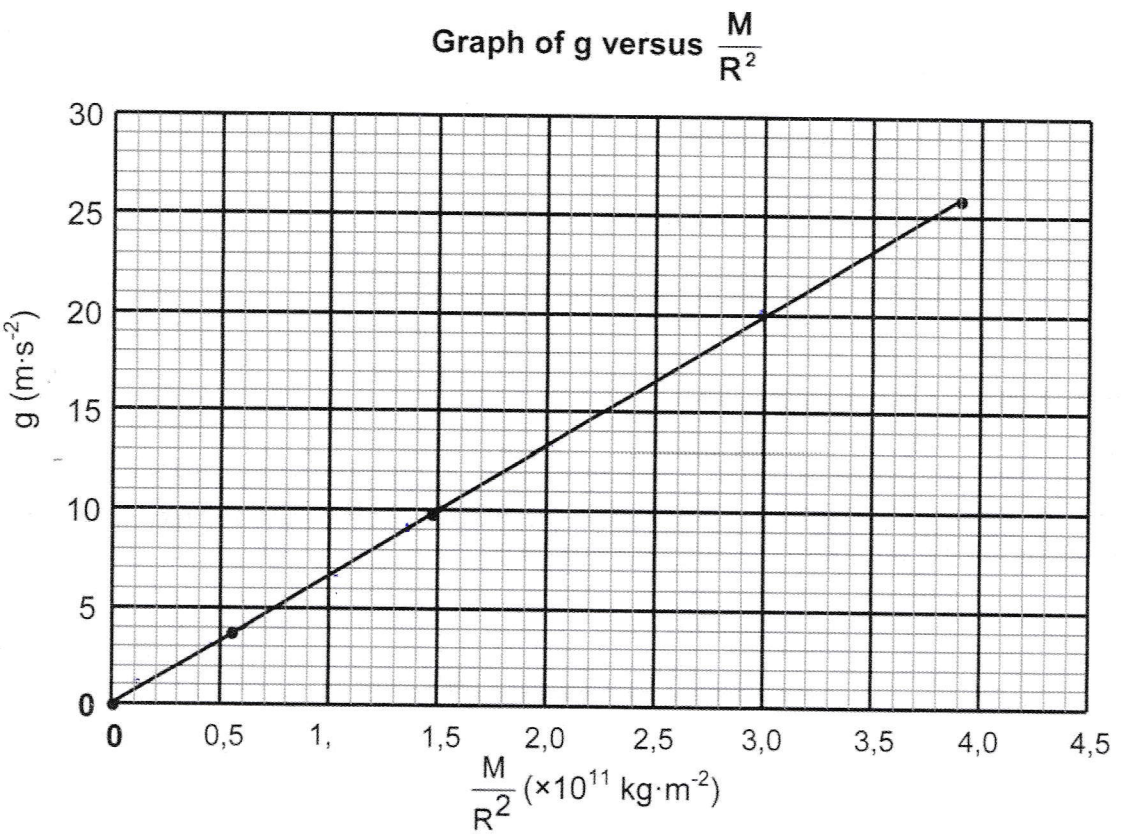
4.4 Explain the following statement:

The acceleration of an object is 0,6 $m \cdot s^{-2}$. (2)
[14]

QUESTION 5 (Start on a new page.)

The relationship between gravitational acceleration and the ratio of the mass to the square of the radius ($\frac{M}{R^2}$) of different planets are investigated.

The graph below is obtained from the data collected.



5.1 What relationship between g and $\frac{M}{R^2}$ can be deduced from the graph? (1)

5.2 Calculate the gradient of the graph. (3)

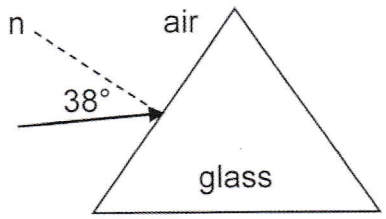
5.3 Which physical constant is represented by the gradient of the graph? (1)

5.4 The gravitational acceleration on Uranus is 9 m·s^{-2}. Use the graph to determine the $\frac{M}{R^2}$ value for Uranus. (2)

5.5 Calculate the mass of Uranus if the radius is 2,54 × 10^7 m. (2)
[9]

QUESTION 6 (Start on a new page.)

A light ray is incident on a glass prism. The angle of incidence is 38°, as shown below. The refractive index of glass is 1,5 and that of air is 1.

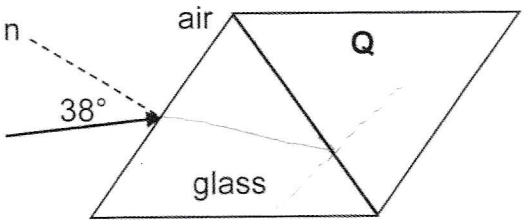


6.1 Define the term *angle of refraction*. (2)

6.2 Calculate the angle of refraction inside the glass prism. (3)

6.3 Redraw the glass prism in the ANSWER BOOK. Complete the path of the light ray inside the prism and label the angle of refraction. (2)

A second prism, **Q**, of unknown material, is now placed next to the glass prism, as shown in the diagram below.



The light ray travels from the glass prism and enters prism **Q** at an angle of incidence of 36°. The angle of refraction inside prism **Q** is 41°.

6.4 Calculate the refractive index of prism **Q**. (2)

6.5 How does the speed of light in the glass prism compare to the speed of light in prism **Q**? Write only GREATER THAN, SMALLER THAN or REMAINS THE SAME. (1)

6.6 Explain the answer to QUESTION 6.5 by referring to the refractive indices of the materials. (2)

The critical angle for the glass prism **Q** boundary is 63,3°. The angle of incidence when the light ray travels from the glass prism to prism **Q** is increased to 65°.

6.7 Define the term *critical angle*. (2)

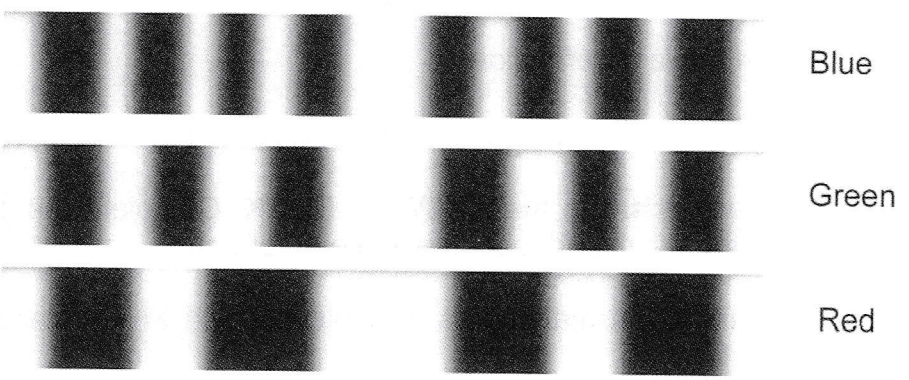
6.8 What observation will be made? Briefly explain the answer. (3)
[17]

QUESTION 7 (Start on a new page.)

An experiment is set up to determine the relationship between the DEGREE OF DIFFRACTION and WAVELENGTH of light. Blue light is passed through a single slit and the pattern formed is observed.

The experiment is now repeated with green light and then with red light. The distance between the light source and the slit remains constant during the investigation.

The patterns obtained are shown in the diagram below.



7.1 Define the term *wave front.* (2)

7.2 What nature of light is demonstrated by diffraction? (1)

7.3 For this experiment, write down:

7.3.1 ONE controlled variable (1)

7.3.2 The independent variable (1)

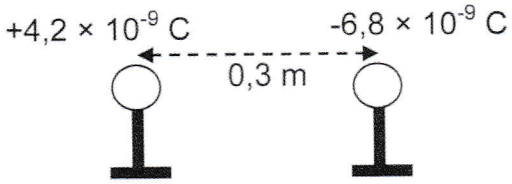
7.4 Fully explain the difference in the patterns observed. (4)

7.5 The experiment with red light is now repeated using a NARROWER slit.

How will the broadness of the central band be affected? Write only INCREASES, DECREASES or REMAINS THE SAME. Give a reason for the answer. (2)
[11]

QUESTION 8 (Start on a new page.)

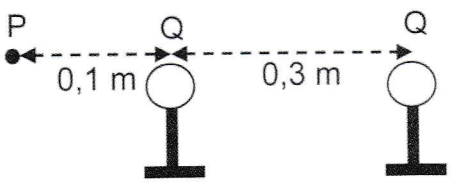
Two small identical metal spheres on insulated stands carry charges of $+4,2 \times 10^{-9}$ C and $-6,8 \times 10^{-9}$ C respectively. They are placed at a distance of 0,3 m apart.



8.1 State *Coulomb's law* in words. (2)

8.2 Calculate the magnitude of the electrostatic force that the one charge exerts on the other. (3)

The two spheres are allowed to touch and are then returned to their original positions.



8.3 Calculate the new charge **Q** on EACH sphere. (3)

8.4 Draw the electric field pattern between the two charged spheres. (2)

8.5 Calculate the magnitude of the net electric field at point **P** situated at 0,1 m to the left of the spheres, as shown in the diagram above. (5)
[15]

QUESTION 9 (Start on a new page.)

A coil with 200 windings and a surface area of $2,8 \times 10^{-3}$ m is rotated at constant speed in a constant magnetic field of 2,5 T. An emf of 3,5 V is induced in the coil.

9.1 Consider the following statement: The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in the magnetic flux linkage with the conductor.

Name the law represented by the above statement. (1)

9.2 Calculate the:

9.2.1 Change in magnetic flux if the angle of the coil relative to the magnetic field changes from 0° to 90° (3)

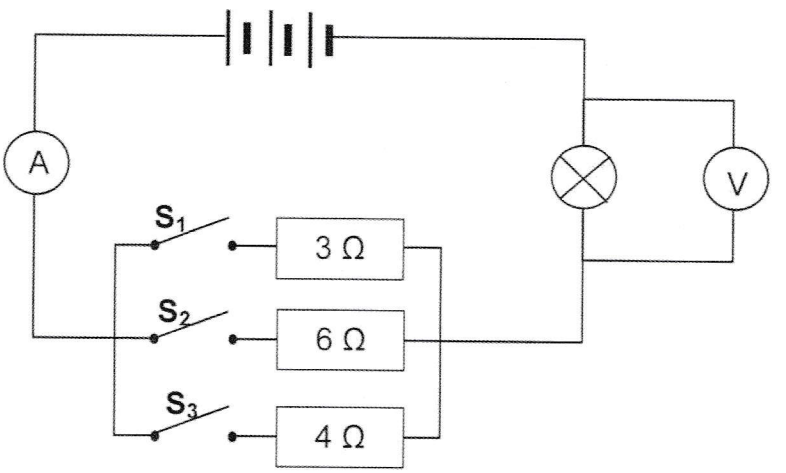
9.2.2 Time it takes the coil to rotate from 0° to 90° (3)

9.3 By what factor will the induced emf change if a coil with 100 windings is used under the same conditions? Give a reason for the answer. (2)
[9]

Copyright reserved

QUESTION 10 (Start on a new page.)

Three resistors, of resistances 3 Ω, 4 Ω and 6 Ω, and a bulb are connected in a circuit, as shown below. Initially all the switches, S_1, S_2 and S_3, are open. The internal resistance of the battery and the resistance of the connecting wires may be ignored.



10.1 State *Ohm's law* in words. (2)

Switch S_1 is now closed and the voltmeter and ammeter readings are recorded. The voltmeter and ammeter readings, when both switch S_1 and switch S_2 are closed, are then recorded, as well as the readings when all three switches, S_1, S_2 and S_3, are closed.

The results obtained are shown in the table below.

SWITCHES CLOSED	VOLTMETER READING (V)	AMMETER READING (A)
S_1	4,8	2,4
S_1 and S_2	6	3
S_1, S_2 and S_3	7,2	3,6

10.2 Explain the increase in the ammeter reading as more switches are closed. (2)

10.3 Calculate the:

10.3.1 Resistance of the bulb (3)

10.3.2 Potential difference of the battery (4)

10.4 Define the term *power*. (2)

10.5 Calculate the power dissipated in the 6 Ω resistor when ONLY SWITCHES S_1 and S_2 are closed. (4)

10.6 How will the BRIGHTNESS of the bulb be affected as more switches in the circuit are closed? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

10.7 Explain the answer to QUESTION 10.6. (2)

[20]

TOTAL: 150

Copyright reserved

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
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 $m \cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6,67 \times 10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$
Radius of Earth *Straal van die Aarde*	R_E	$6,38 \times 10^6$ m
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9$ $N \cdot m^2 \cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8$ $m \cdot s^{-1}$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg
Mass of Earth *Massa van die Aarde*	M_E	$5,98 \times 10^{24}$ kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$
$v_f^{\ 2} = v_i^{\ 2} + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$\mu_s = \frac{f_{s(max/\ maks)}}{N}$
$\mu_k = \frac{f_k}{N}$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{v}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$n = \frac{Q}{e}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots$	$R = r_1 + r_2 + r_3 + \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

Copyright reserved