education

Department of Education
FREE STATE PROVINCE

# CONTROL TEST

## GRADE 11

# PHYSICAL SCIENCES

## NOVEMBER 2021

## MARKS: 150

## TIME: 3 HOURS

**This paper consists of 12 pages and three information sheets.**

## INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of 11 questions. Answer ALL 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 sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable pocket 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 where applicable.

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

12. Write neatly and legibly.

## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1–1.10) in your ANSWER BOOK.

1.1 Which one of the following is an example of a scalar quantity?

A Mass

B Force

C Velocity

D Acceleration (2)

1.2 Forces $F_1$ = 12 N and $F_2$ = 23 N act on the same object. Which one of the following CANNOT be the resultant of the two forces?

A 11 N

B 20 N

C 35 N

D 40 N (2)

1.3 Mosidinyana from Sehlajaneng village in Monontsha, QwaQwa has a weight *w* while on the surface of the earth. What will be his weight in terms of *w* on the surface of another planet that has HALF the mass of Earth and a radius TWICE that of Earth?

A $\frac{1}{8}w$

B $\frac{1}{4}w$

C $\frac{1}{2}w$

D $w$ (2)

1.4 A bus and a car travel in opposite directions on the same road and collide head-on. The damage to the car is much more severe than the damage to the bus. The bystanders say that the force of the bus on the car has been more than the force of the car on the bus. Nthabiseng says they are wrong because of ...

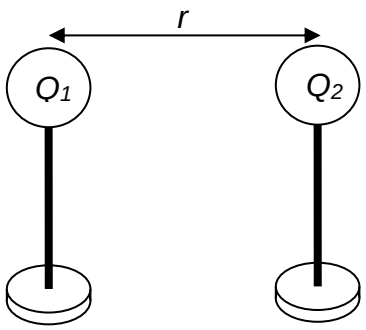
A Newton's first law of motion.

B Newton's third law of motion.

C Newton's second law of motion.

D Newton's law of universal gravitation. (2)

1.5 The centres of two small, identical, metal spheres are a distance *r* apart. They carry charges of $Q_1$ and $Q_2$ as shown in the diagram. Each sphere exerts an electrostatic force of magnitude *F* on the other.




The distance between the centres is now HALVED and the charge on $Q_1$ is DOUBLED. What is the magnitude of the NEW force that the one sphere exerts on the other?

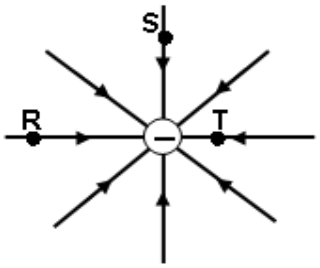
A F

B 2F

C 4F

D 8F (2)

1.6 The diagram represents the electric field pattern around a negative point charge. **R**, **S** and **T** are points at different distances from the negative point charge.




The magnitude of the electric field of the point charge is ...

A greatest at point **R**.

B greatest at point **S**.

C greatest at point **T**.

D the same at points **R**, **S** and **T**. (2)

1.7 Which one of the following is the unit of for the *rate of flow of charge*?

A volt

B watt

C ampere

D coulomb (2)

1.8 Which one of the following correctly defines a covalent bond?

A A molecule that contains two atoms.

B A bond made of different molecules.

C A neutral group of atoms joined together.

D A bond that forms by the sharing of electrons between atoms. (2)

1.9 Which one of the following helps to identify the specific INTERMOLECULAR FORCE that exists between molecules?

A Density

B Solubility

C Bond type

D Molecular polarity (2)

1.10 Consider the following UNBALANCED chemical equation:

$$A\ell + FeO \rightarrow Fe + A\ell_2O_3$$

How many moles of aluminium are needed to react completely with 1,2 moles of FeO?

A 0,8

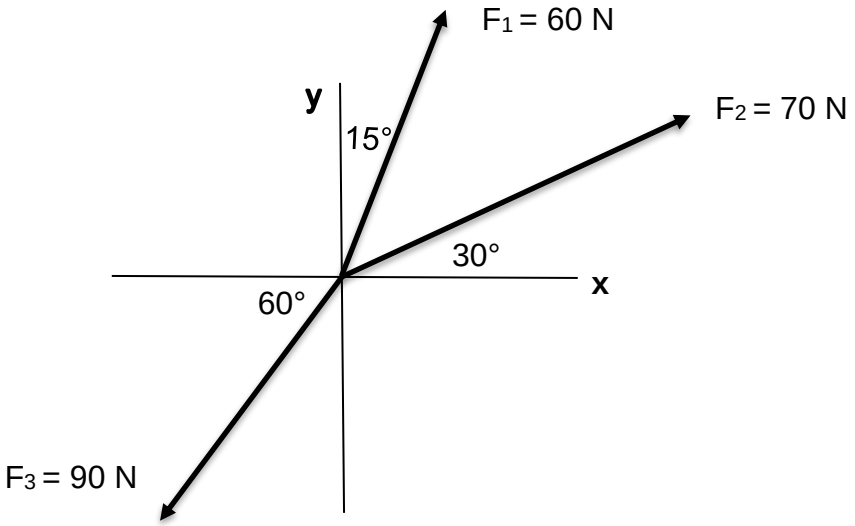
B 1,2

C 1,6

D 2,4 (2)
**[20]**

## QUESTION 2

Three forces, $F_1$, $F_2$ and $F_3$, with magnitudes of 60 N, 70 N and 90 N respectively act simultaneously at a point at the origin of the Cartesian plane as shown in the diagram. The forces are NOT drawn to scale.

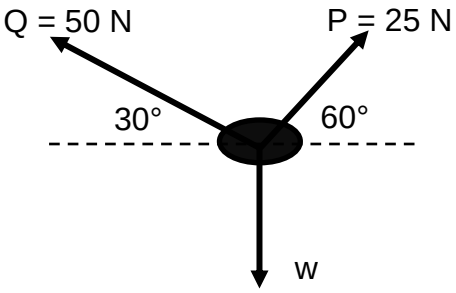



2.1 Define the term *resultant* of forces in words. (2)

2.2 Determine the MAGNITUDE and DIRECTION of the resultant force using a CALCULATION. The direction must be expressed as an angle relative to the positive x-axis. (7)
**[9]**

## QUESTION 3

A body of an UNKNOWN mass is held stationary by THREE forces, **P**, **Q** and **w**, in the vertical plane as shown in the diagram. The forces are in EQUILIBRIUM. **P** and **Q** make angles of 60° and 30° respectively with the horizontal.




3.1 Refer to the statement above and explain what is meant by "the forces are in equilibrium". (1)

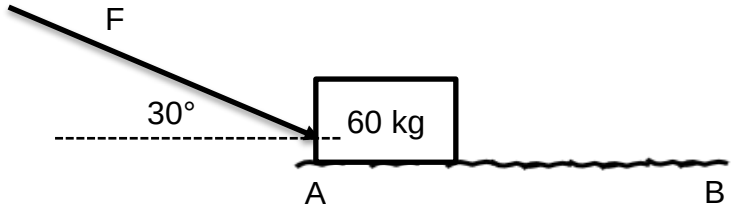
3.2 Calculate the following:

3.2.1 Sum of the magnitude of the VERTICAL components of forces **Q** and **P** (3)

3.2.2 Mass of the body in equilibrium (3)
**[7]**

## QUESTION 4

A 60 kg box is pushed along a rough, horizontal surface **AB** with a constant force *F*. The box moves to the right at a CONSTANT VELOCITY. The coefficient of kinetic friction ($\mu_k$) between the surface and the box is 0,3.




4.1 State *Newton's first law of motion* in words. (2)

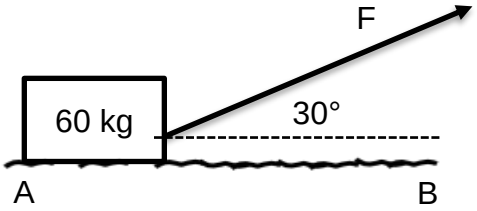
4.2 Draw a free-body diagram to show ALL the forces acting on the 60 kg box. (4)

4.3 Calculate the MAGNITUDE of the following:

4.3.1 *F* (6)

4.3.2 Kinetic frictional force on the box (3)

The same constant force, *F*, is now applied to the block over the same rough, horizontal surface as before, but in the direction shown below.




4.4 Will the velocity of the block INCREASE, DECREASE or REMAIN THE SAME? Explain your answer. (4)
**[19]**

## QUESTION 5

5.1 Give one word/phrase for the following:

5.1.1 The force, perpendicular to the surface, exerted by the surface on an object in contact with it. (1)

5.1.2 The REACTION force of the force that the earth exerts on a table. (1)

5.1.3 Forces that exist between two objects even if they DO NOT touch each other. (1)

5.2 A hiker, mass 65 kg, climbs to the peak of Mount Kilimanjaro which is 5 895 m high.

5.2.1 State Newton's law of universal gravitation. (2)

5.2.2 Calculate the DIFFERENCE in the weight of the hiker while on the surface of the earth and when he is at the peak of the mountain. (7)

**[12]**

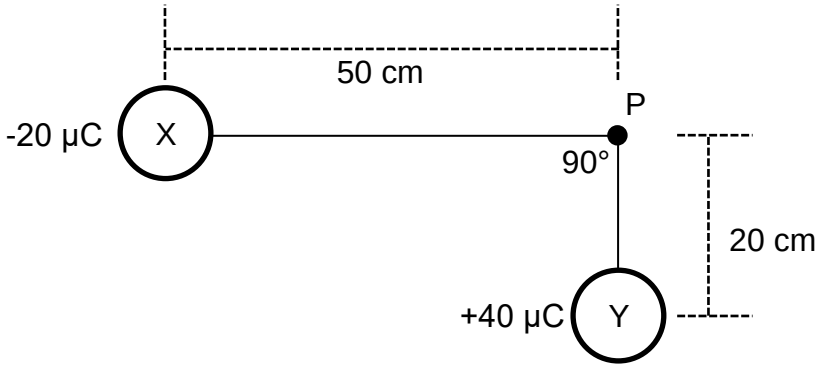
**QUESTION 6**

6.1 Two small, oppositely charged, identical, metal spheres, **X** and **Y**, on insulated stands, are placed as shown below with their centres 50 cm apart. The charge on **X** is -20 µC and the charge on **Y** is +40 µC.


6.1.1 Write down Coulomb's law in words. (2)

6.1.2 Calculate the magnitude of the electrostatic force that charge **X** exerts on charge **Y**. (4)

6.2 The same spheres are now re-arranged and placed at a 90° angle with respect to point **P** as shown below. The distances from the centres of the spheres to point **P** are shown in the diagram.




Calculate the magnitude of the NET electric field at point **P** due to spheres **X** and **Y**. (6)

**[12]**

## QUESTION 7

7.1 Conventional current is flowing perpendicular OUT of the page TOWARDS you. A magnetic field exists around the straight conductor and two of your friends draw the following magnetic field patterns for this situation.

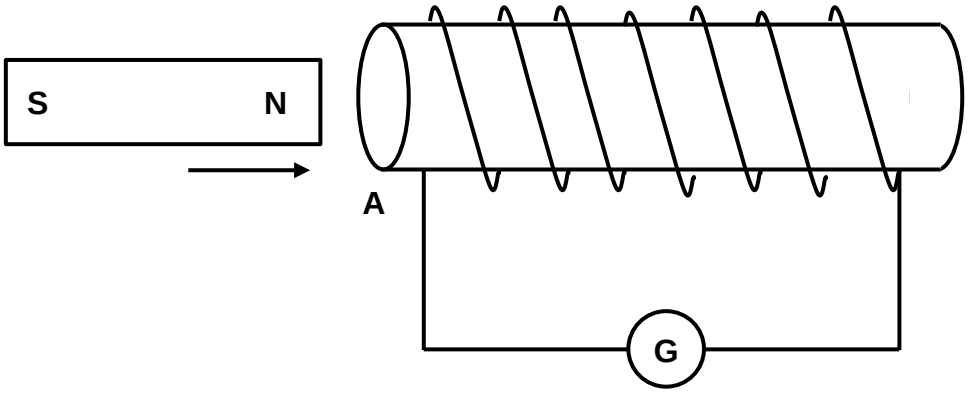
Diagram X

Diagram Y

7.1.1 Which hand must be used to determine the direction of the magnetic field? (1)

7.1.2 Which diagram, **X** or **Y**, is correct? (2)

7.2 A bar magnet is brought near a solenoid (coil) as shown in the diagram below.




7.2.1 Why does the galvanometer needle deflect as the magnet is brought closer to side **A** of the solenoid? (2)

7.2.2 Which rule can be used to predict the direction of the induced current in the solenoid? (1)

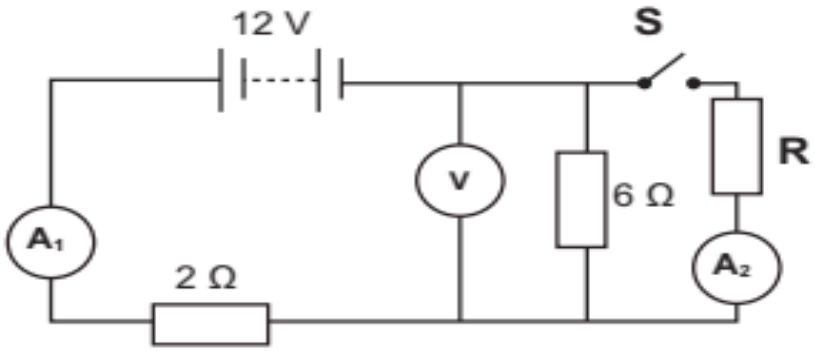
7.2.3 State Faraday's law in words. (2)

7.2.4 State THREE ways in which the deflection of the galvanometer can be increased. (3)
**[11]**

## QUESTION 8

8.1 A geyser is labelled 3 500 W. The price of electricity is R1,20 per kWh. Calculate the cost of the electricity to use this geyser for four hours. (4)

8.2 In the circuit diagram below the battery has negligible resistance.




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

With switch **S** OPEN, determine the reading on:

8.2.2 Ammeter $A_1$ (3)

8.2.3 Voltmeter V (2)

8.3 Switch **S** is now CLOSED and the reading on voltmeter **V** decreases. Calculate the resistance of resistor **R** if the reading on $\mathbf{A_1}$ is THREE times that of $\mathbf{A_2}$. (4)
**[15]**

## QUESTION 9

9.1 Molecules such as $NH_3$ and $H_2O$ have LONE pairs.

9.1.1 Define the term *lone pair*. (2)

9.1.2 Write down the NAME or FORMULA of the molecule that has ONE lone pair. (2)

9.1.3 Write down the SHAPE of EACH molecule. (2)

9.1.4 Draw the Lewis structure of EACH molecule. (4)

9.2 The bond energies of different bonds are given in the table below.

| Bond | Bond energy (kJ) |
|---|---|
| H-H | 432 |
| O=O | 494 |
| $O-H^-$ | 459 |

9.2.1 Define the term *bond energy*. (2)

9.2.2 Give a reason why the bond energy of $O_2$ is more than that of $OH^-$. (1)

9.2.3 Write down three factors that affect the strength of a chemical bond between two atoms. (3)
**[16]**

**QUESTION 10**

The boiling points of compounds **A** to **D** are given in the table below.

| Compound | | Boiling point (°C) |
|---|---|---|
| **A** | $CH_4$ | -161,6 |
| **B** | $H_2O$ | 100 |
| **C** | HI | -35,4 |
| **D** | HCℓ | -85,1 |

10.1 Define the term *boiling point*. (2)

10.2 In what phase is compound **D** at 25°C? (2)

10.3 Explain the difference in the boiling points of compounds:

10.3.1 **A** and **B** (4)

10.3.2 **C** and **D** (4)

10.4 How does the vapour pressure of compound **B** compare to that of compound **C**? Write down only HIGHER THAN, LOWER THAN or THE SAME. Give a reason for your answer. (2)
**[14]**

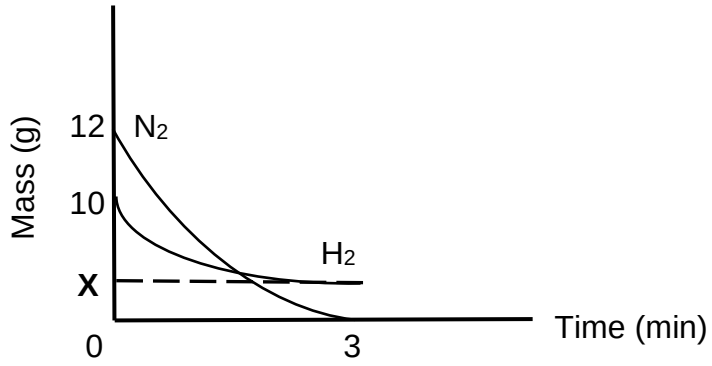
 

## QUESTION 11

Consider the following balanced, chemical equation for the reaction between nitrogen gas ($N_2$) and hydrogen gas ($H_2$) to form ammonia gas ($NH_3$).

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

A grade 11 learner uses 12 g of $N_2(g)$ and 10 g of $H_2(g)$ to determine the LIMITING REACTANT. The learner draws the following graph from the results:




11.1 Define the term *limiting reactant*. (2)

11.2 Which one of $N_2$ or $H_2$ is the limiting reactant in this reaction? Give a reason for your answer by referring to info in the graph. (3)

11.3 Calculate the mass of $NH_3$ produced after three minutes. (5)

11.4 Calculate the magnitude of **X** after three minutes. (5)
**[15]**

**GRAND TOTAL: 150**

# DATA FOR PHYSICAL SCIENCES GRADE 11 (PHYSICS)
# *GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11 (FISIKA)*

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

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Acceleration due to gravity<br>*Swaartekragversnelling* | g | 9,8 $m \cdot s^{-2}$ |
| Universal gravitational constant<br>*Universele gravitasiekonstante* | G | 6,67 x $10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$ |
| Coulomb's constant<br>*Coulomb se konstante* | k | 9,0 x $10^9$ $N \cdot m^2 \cdot C^{-2}$ |
| Charge on electron<br>*Lading op elektron* | e | -1,6 x $10^{-19}$ C |
| Electron mass<br>*Elektronmassa* | $m_e$ | 9,11 x $10^{-31}$ kg |
| Mass of the earth<br>*Massa van die aarde* | M | 5,98 x $10^{24}$ kg |
| Radius of the earth<br>*Radius van die aarde* | $R_E$ | 6,38 x $10^6$ m |

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

### MOTION/*BEWEGING*

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

### FORCE/*KRAG*

| | |
|---|---|
| $F_{net} = ma$ | $w = mg$ |
| $F = \frac{Gm_1 m_2}{r^2}$ | $g = \frac{GM}{r^2}$ |
| $f_s^{max} = \mu_s N$ $\quad$ $f_s^{maks} = \mu_s N$ | $f_k = \mu_k N$ |

## ELECTROSTATIC/*ELEKTROSTATIKA*

| | |
|---|---|
| $F = \frac{kQ_1Q_2}{r^2}$ | $E = \frac{F}{Q}$ |
| $V = \frac{W}{Q}$ | $E = \frac{kQ}{r^2}$ |
| $n = \frac{Q}{q_e}$ | |

## ELECTRIC CIRCUITS / *ELEKTRIESE STROOMBANE*

| | |
|---|---|
| $R = \frac{V}{I}$ | $I = \frac{Q}{\Delta t}$ |
| $R_s = R_1 + R_2 + \cdots$ | $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$ |
| $W = VQ$<br>$W = VI\Delta t$<br>$W = I^2R\Delta t$<br>$W = \frac{V^2\Delta t}{R}$ | $P = \frac{W}{\Delta t}$<br>$P = VI$<br>$P = I^2R$<br>$P = \frac{V^2}{R}$ |

## DATA FOR PHYSICAL SCIENCES GRADE 11 (CHEMISTRY)
## *GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11 (CHEMIE)*

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

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Avogadro's constant<br>*Avogadro-konstante* | $N_A$ | $6{,}02 \times 10^{23}$ mol$^{-1}$ |

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

| | |
|---|---|
| $n = \frac{m}{M}$ | $n = \frac{N}{N_A}$ |
| $c = \frac{n}{V}$ | $c = \frac{m}{MV}$ |

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