



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

AMAJUBA DISTRICT

GRADE 11

PHYSICAL SCIENCES: PHYSICS (P1)

MARCH 2023

MARKS: 50

TIME: 1 hour

Stanmorephysics

This question paper consists of 7 pages and 1 data sheets.

INSTRUCTIONS AND INFORMATION

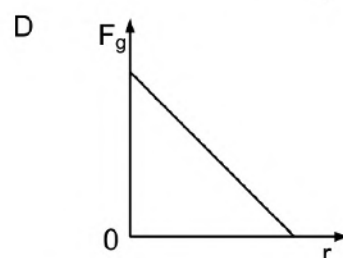
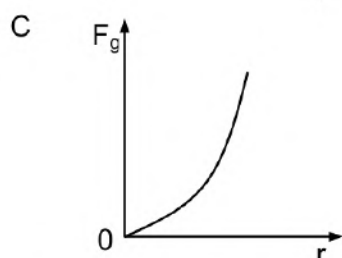
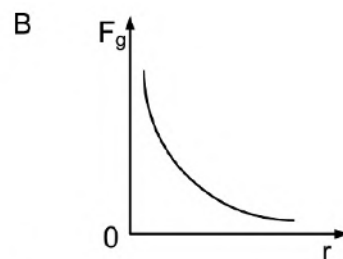
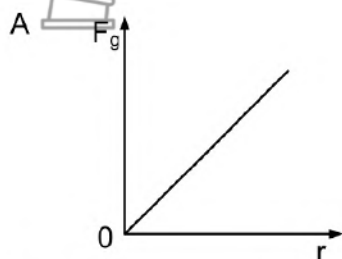
1. This question paper consists of 3 questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You are advised to use the attached **DATA SHEETS**.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, et cetera where required.
10. Write neatly and legibly.



QUESTION 1

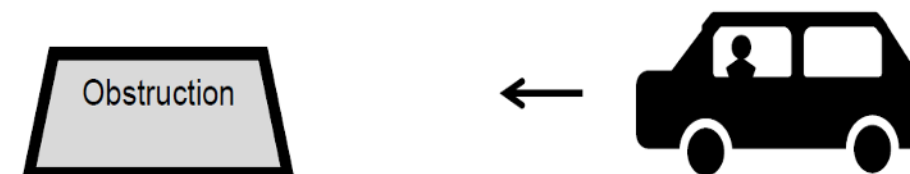
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.3) in the ANSWER BOOK, for example 1.4 E.

1.1 Which of the following graphs best illustrates the relationship between the gravitational force (F_g) and the distance (r) between the centres of two particles?



(2)

1.2 A car is travelling along a road. The driver has his seat belt on. The driver sees an obstruction in the road ahead and suddenly applies the brakes.



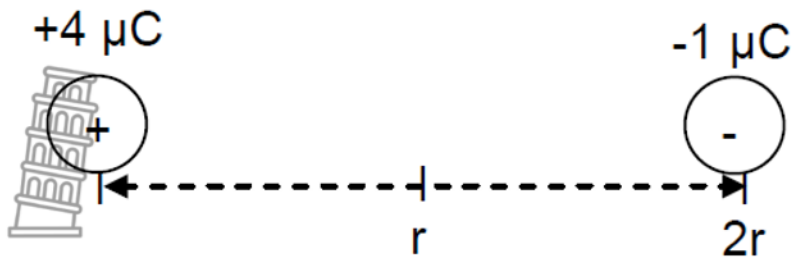
An action-reaction pair is the force of the seat belt on the driver and the force of the ...

- A. Driver on the seat.
- B. Wheels on the road.
- C. Driver on the seat belt.
- D. Seat belt on the seat.



(2)

- 1.3 A negative charge of $-1 \mu\text{C}$, which is free to move, is placed at a distance $2r$ from a positive charge of $+4 \mu\text{C}$.



Which ONE of the following statements regarding the $-1 \mu\text{C}$ charge, when it is at distance r , is CORRECT?

The electrostatic force experienced by the $-1 \mu\text{C}$ charge will ...

- A. Remain the same.
- B. Be halved.
- C. Be doubled.
- D. Increase four times.

(2)
[6]

QUESTION 2

The acceleration due to gravity on planet X is $6,7 \text{ m}\cdot\text{s}^{-2}$. The radius of this planet is a third ($\frac{1}{3}$) of the radius of Earth.

- 2.1 Explain the difference between *weight* and *mass*. (4)
- 2.2 Calculate the *mass* of planet X. (4)
- 2.3 Determine the *factor* by which the weight of an object on planet X will differ from the weight of the same object on Earth. (2)



Two satellites orbiting the Earth are situated on opposite sides of the Earth. Satellite A has a mass of 5 800 kg and Satellite B has a mass of 4 500 kg. Satellite A is at a height of 30 000 km above the surface of the Earth.



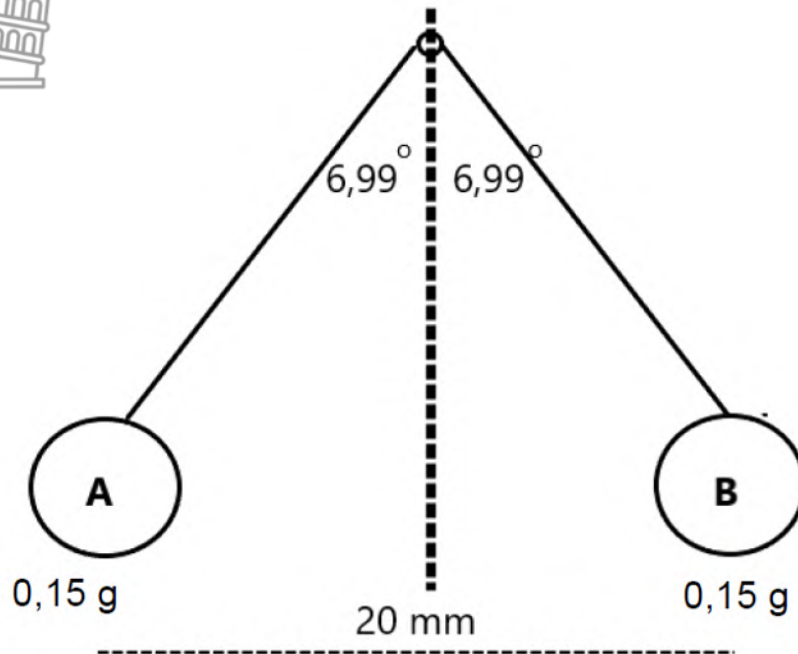
- 2.4 State **Newton's Universal Gravitational Law** in words. (2)
- 2.5 Explain the term **weightlessness**. (2)
- 2.6 Calculate the force between the Earth and Satellite A. (4)
- 2.7 What distance above the surface of the Earth should Satellite B be to experience the *same* force towards the Earth as Satellite A? (4)

Choose from: **GREATER THAN, LESS THAN** or **EQUAL TO** the distance above the Earth. **Explain how you arrived at the answer.** (4)
[22]



QUESTION 3

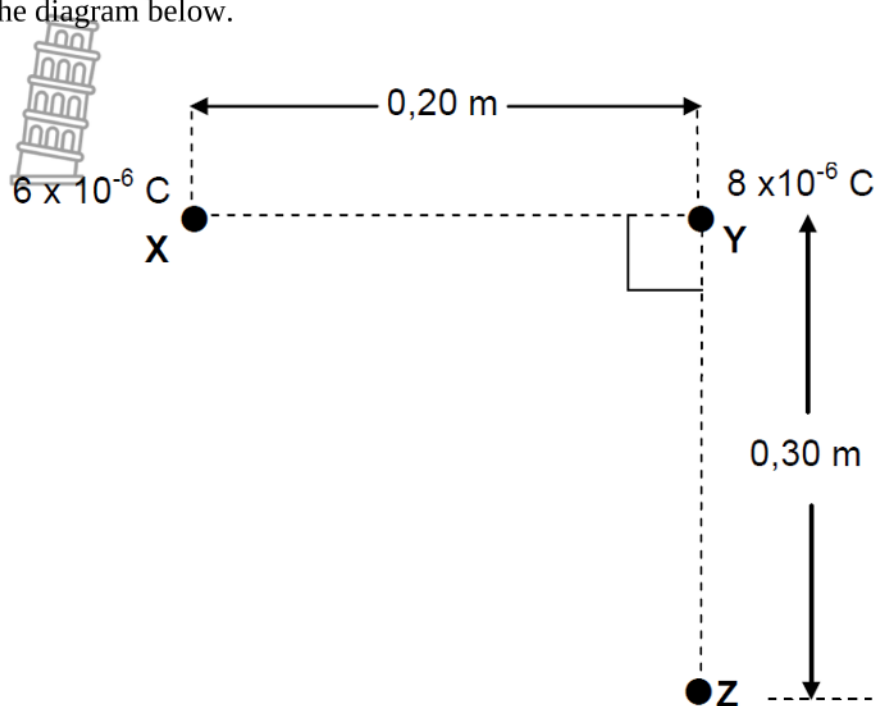
Two identical negatively charged spheres, **A** and **B**, both with a mass 0,15 g, hang from the same point by thin, inextensible strings (mass of the strings can be ignored). The electrostatic force between the spheres causes them to move **20 mm** apart. The angle between one of the silk threads and the vertical is **6,99°**.



- 3.1 Define **Coulomb's law** in words. (2)
- 3.2 Draw a **free body diagram** of all the forces acting on sphere **A**. (3)
- 3.3 Use your answer to **QUESTION 3.2** to calculate the magnitude of the force to the left on **A**. (4)
- 3.4 State **Newton's third law** of motion in words. (2)
- 3.5 Calculate the charge on both Q_A and Q_B . (4)



THREE small spheres, **X**, **Y** and **Z**, carrying charges of $+6 \times 10^{-6} \text{ C}$ and $+8 \times 10^{-6} \text{ C}$ respectively, are placed 0,20 m apart in air. A third sphere, **Z**, of **unknown negative** charge, is placed at a distance of 0,30 m below sphere **Y**, in such a way that the line joining the charged spheres **X** and **Y** is perpendicular to the line joining the charged spheres **Y** and **Z**, as shown in the diagram below.



3.6 Draw a **vector diagram** showing the directions of the electrostatic forces and the net force experienced by charged sphere **Y** due to the presence of charged spheres **X** and **Z** respectively. (3)

3.7 The magnitude of the **net electrostatic force** experienced by charged sphere **Y** is 15,20 N and the magnitude of electrostatic force experience by charged sphere **X** is 10,8 N. Calculate the charge on sphere **Z**. (4)

[22]

TOTAL MARKS: 50



PHYSICS:

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8 \text{ m}\cdot\text{s}^{-2}$
Universal gravitational constant	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Radius of the Earth	R_E	$6,4 \times 10^6 \text{ m}$
Mass of the Earth	M_E	$5,98 \times 10^{24} \text{ kg}$

FORCE

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G \frac{m_1 m_2}{d^2}$ or $F = G \frac{m_1 m_2}{r^2}$	$g = G \frac{M}{d^2}$ or $g = G \frac{M}{r^2}$

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1 Q_2}{r^2}$ ($k = 9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$)	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ ($k = 9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$)	$n = \frac{Q}{e}$





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MEMORANDUM

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This memorandum consists of 5 pages



QUESTION 1

- 1.1 B✓✓ (2)
- 1.2 C✓✓ (2)
- 1.3 D✓✓ (2)
- 
- [6]

QUESTION 2

- 2.1 Weight is the gravitational force exerted on an object by the earth. ✓✓
- Mass is the amount of matter in a body. ✓✓ (4)

2.2

$$g = \frac{GM}{r^2} \quad \checkmark$$
$$6,7 = \frac{6,67 \times 10^{-11} M}{\left(\frac{1}{3} \times 6,38 \times 10^6\right)^2} \quad \checkmark$$
$$M = 4,54 \times 10^{23} \text{ kg} \quad \checkmark$$

(4)

2.3

$$\frac{9,8}{6,7} = 1,46 \quad \checkmark \text{ times smaller on planet X than on Earth} \quad \checkmark$$

(2)

2.4 Every body in the universe attracts every other body with a force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between their centres. ✓ (2)

2.5 Weightlessness is the sensation experienced when all contact forces are removed. ✓✓ (2)



2.6

$$F = G \frac{M_E m}{r^2} \quad \checkmark$$

$$= 6,67 \times 10^{-11} \times \frac{(5,98 \times 10^{24})(5800) \checkmark}{[6,38 \times 10^6 + 30 \times 10^6]^2 \checkmark}$$

$$= 1747,95 \text{ N} \checkmark$$

(4)

2.7

Greater than \checkmark

the mass is greater \checkmark

and for the same force \checkmark the distance must also be greater \checkmark

(because the product of the masses is directly proportional to the square of the distance between the centres.)

OPTION 2

POSITIVE MARKING FROM 2.6

Greater than \checkmark

$$F = G \frac{m_1 m_2}{R^2}$$

$$1747,95 = 6,67 \times 10^{-11} \times \frac{(5,98 \times 10^{24})(4500)}{R^2}$$

$$F = \frac{G m_1 m_2}{r^2} \checkmark$$

$$R = 3,20 \times 10^7 \text{ m}$$

Distance above the surface of the Earth

$$D = 3,20 \times 10^7 - 6,38 \times 10^6 \checkmark$$

$$D = 2,57 \times 10^7 \text{ m} \checkmark \quad (\text{or } 25664630,12 \text{ m})$$

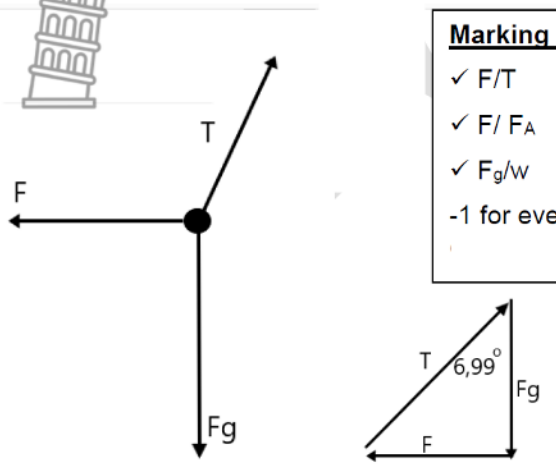
(4)
[22]



QUESTION 3

3.1 The magnitude of the electrostatic force exerted by two point charges (Q1 and Q2) on each other is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them. ✓✓ (2)

3.2



Marking guidelines/Nasiennriglyne:

- ✓ F/T
- ✓ F/ F_A
- ✓ F_g/w
- 1 for every extra force added.

(3)

3.3

$$F_g = m \times g$$

$$= 0,15 \div 1\,000 \times 9,8 \quad \checkmark$$

$$= 1,47 \times 10^{-3} \text{ N}$$

Marking guidelines

- ✓ F_g substitution.
- ✓ Formula
- ✓ Substitution tanθ
- ✓ Final answer.

$$\tan \theta = \frac{F}{F_g}$$

$$F = F_g \times \tan 6,99^\circ \quad \checkmark$$

$$= 1,47 \times 10^{-3} \times \tan 6,99^\circ \quad \checkmark$$

$$= 1,8 \times 10^{-4} \text{ N} \quad \checkmark$$

(4)

3.4 When object **A** exerts a force on object **B**, object **B** SIMULTANEOUSLY exerts an oppositely directed force of equal magnitude on object **A**. ✓✓

3.5

$$F = \frac{kQ_1Q_2}{r^2} \quad \checkmark$$

$$1,8 \times 10^{-4} = \frac{(9 \times 10^9)Q^2}{(20 \div 1\,000)^2} \quad \checkmark$$

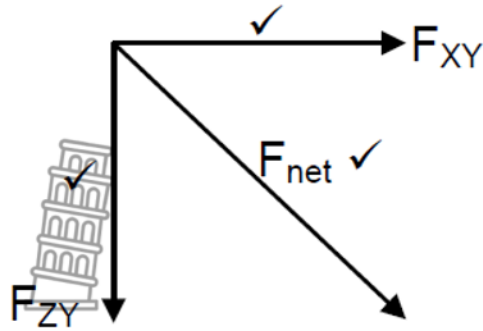
$$= -2 \times 10^{-8} \text{ C} \quad \checkmark$$

Marking guidelines

- ✓ Formula/Formule
- ✓ Substitution F
- ✓ Substitution/
- ✓ Final answer

(4)

3.6



(3)

3.7

OPTION 1

$$F_{\text{net}}^2 = F_{\text{XY}}^2 + F_{\text{ZY}}^2$$

$$15,20^2 = 10,8^2 + F_{\text{ZY}}^2$$

$$F_{\text{ZY}} = 10,696 \text{ N}$$

$$F_{\text{ZY}} = k \frac{Q_Z Q_Y}{r^2}$$

$$10,696 \checkmark = 9 \times 10^9 \times \frac{8 \times 10^{-6} \times Q_Z \checkmark}{(0,30)^2}$$

$$Q_Z = 1,34 \times 10^{-5} \text{ C} \checkmark$$

OPTION 2

$$\cos \theta = \frac{10,8}{15,2}$$

$$\theta = 44,72^\circ$$

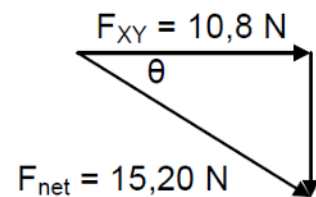
$$\sin 44,72 = \frac{F_{\text{ZY}}}{15,2} \checkmark \quad \text{OR/OF} \quad \tan 44,72 = \frac{F_{\text{ZY}}}{F_{\text{XY}}}$$

$$F_{\text{ZY}} = 10,696 \text{ N}$$

$$F_{\text{ZY}} = k \frac{Q_Z Q_Y}{r^2}$$

$$10,696 \checkmark = 9 \times 10^9 \times \frac{8 \times 10^{-6} \times Q_Z \checkmark}{(0,30)^2}$$

$$Q_Z = 1,34 \times 10^{-5} \text{ C} \checkmark$$



(4)

[22]

TOTAL MARKS 50