higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE

(First Paper)

NQF LEVEL 3

(10021003)

21 November 2019 (X-Paper)
09:00–12:00

REQUIREMENTS: Graph paper

Scientific calculators may be used.

This question paper consists of 9 pages, 1 data sheet and 1 formula sheet.

Copyright reserved

TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Read ALL the questions carefully.
2. Answer ALL the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Start each section on a NEW page.
5. Write neatly and legibly.

Copyright reserved

SECTION A

QUESTION 1

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

1.1 The distance it takes for a wave to repeat itself

1.2 The law according to which the acceleration of an object is directly proportional to the resultant force acting on it and inversely proportional to the object's mass

1.3 The amount by which a machine increases or multiplies the force that you exert on it

1.4 A device used to increase or decrease current and voltage

1.5 A device that protects components by breaking the circuit if too much current flows through it

(5 × 1) **[5]**

QUESTION 2

Choose a word from COLUMN B that matches a description in COLUMN A. Write only the letter (A–J) next to the question number (2.1–2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	Sound waves that are reflected by hard objects and travel back to the original source	A	no acceleration
		B	magnetism
2.2	Tendency of an object to maintain a state of rest or to maintain a constant speed along a straight line	C	pitch
		D	capacitor
2.3	Ability of a device to store charge	E	echo
2.4	Region in space where a force is exerted on a charged particle	F	inertia
		G	capacitance
2.5	Moving away at the same speed	H	electric field
		I	accelerating fast
		J	displacements

(5 × 1) **[5]**

Copyright reserved

QUESTION 3

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (3.1–3.5) in the ANSWER BOOK.

3.1 A concave lens can be used to correct the vision of a far-sighted person.

3.2 For motion in a straight line at the turning point the velocity is at minimum and acceleration is at maximum.

3.3 A solenoid is a device that changes the voltage of a circuit.

3.4 Sound waves can travel in a vacuum with a speed of 340m.s^{-1}.

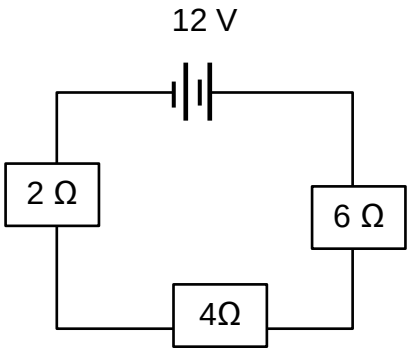
3.5 The frictional force act by opposing the net-force between two surfaces which are in contact.

(5 × 2) **[10]**

QUESTION 4

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (4.1–4.5) in the ANSWER BOOK.

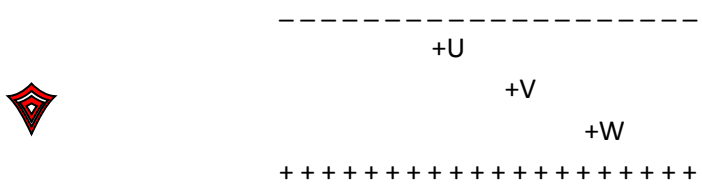
4.1 The diagram below indicates three resistors connected in series. The current drawn from the battery is:



A 6 A
B 3 A
C 2 A
D 1 A

Copyright reserved

4.2 A charged particle is placed at different positions between oppositely charged parallel plates as shown in the diagram.



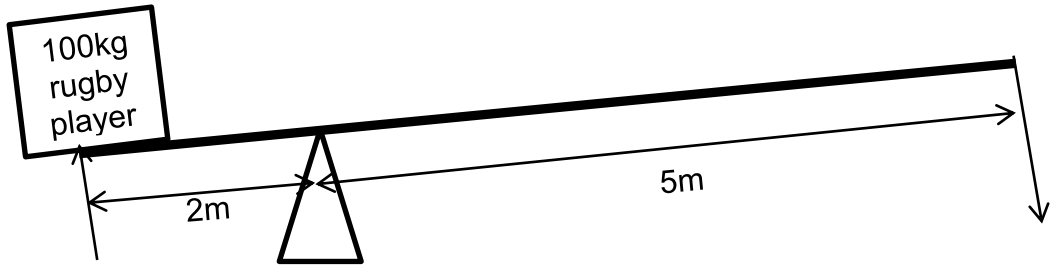
At which point will the electric force be greatest on the charge?

A U
B V
C U, V and W
D U and W

4.3 When an object is placed between a focal point and the convex lens, the image formed will be …

A	Real	enlarged	inverted
B	Real	reduced	inverted
C	Virtual	enlarged	upright
D	Virtual	enlarged	inverted

4.4 A strong 100 kg rugby player has to be lifted by a 7m long bar, as shown in the diagram below. A light-weight 40 kg Makgale argues that he can sit on the bar on the other side of the pivot point and lift the player.



For Makgale to lift this giant, he must sit …

A 2m from the pivot
B 4m from the pivot
C 3m from the pivot
D At the end of the bar

4.5 When an object moves at constant velocity:

A $v_f = 0$
B $v_i = 0$
C $a = 0$
D $s = 0$

(5 × 3) **[15]**

TOTAL SECTION A: 35

Copyright reserved

SECTION B

QUESTION 5

5.1 Name ONE instrument you would use to measure:

5.1.1 Your body temperature

5.1.2 Length of your trouser

5.1.3 Weight of your book

(3 × 1) (3)

5.2 Express the following quantities from the prefix form to relevant units.
For example 10^3 g = kg

5.2.1 10^{-6} m

5.2.2 $10^{-3}\ell$

(2 × 1) (2)
[5]

QUESTION 6

6.1 A bus starts from rest at a station and accelerates at a rate of 2 m/s^2 for 15 s. It then travels at a constant speed for 45 s and slows down at a rate of 5 m/s^{-2} until it comes to a stop.

6.1.1 What is the speed of the bus after 15 s? (3)

6.1.2 60 s after leaving the station, the bus starts to slow down.

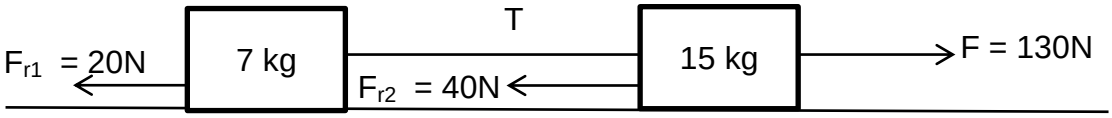
How much time does the bus take to slow down? (3)

6.1.3 Using graph paper, draw a velocity-time graph for the motion of the bus. Indicate ALL details on the graph. (6)

6.1.4 From the graph, determine the distance covered by the bus. (Do NOT use equations of motion.) (5)

Copyright reserved

6.2 The diagram below indicates a 7 kg box being pulled by a rope (T) connected to a 15 kg box. Both boxes are then pulled by a horizontal force (F) of 130 N. The frictional force on the 7 kg box is 20 N and the frictional force on the 15 kg box is 40 N.



Use the diagram above to help you to answer the questions.

6.2.1 State Newton's second law of motion. (2)

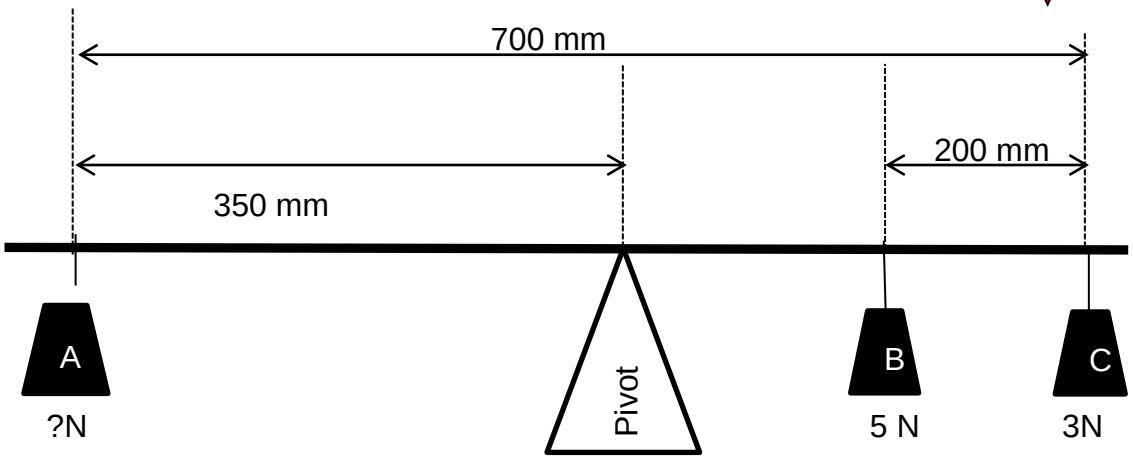
6.2.2 Calculate the acceleration of the system. (7)

6.2.3 Find the tension (T) in the rope between the boxes. (3)

[29]

QUESTION 7

7.1 In the sketch below, a number of forces are in balance.



7.1.1 State the second condition of equilibrium with parallel forces. (2)

7.1.2 Calculate the clockwise moment of the system. (4)

7.1.3 Calculate the mass of object A in grams. (7)

7.2 A tyre of a sports car with a mass of 2 500 kg has to be changed. The vehicle is raised by a jack that has a pitch of 0,4 cm and a 25 cm handle.

7.2.1 What is the ideal mechanical advantage of the jack? (2)

7.2.2 Calculate the resistance (load) that can be lifted if an effort force of 150N is applied. (2)

7.2.3 Calculate the actual mechanical advantage if the efficiency is 20%. (2)

7.2.4 Calculate the actual effort that is needed to lift the vehicle. (3)

[22]

Copyright reserved

QUESTION 8

8.1 Draw a neat diagram indicating the path of a parallel light beam through a convex lens. (3)

8.2 Use the diagram you have drawn above in QUESTION 8.1 to help you to explain the following terms:

8.2.1 Principal axis

8.2.2 Optical centre

8.2.3 Principal focus

8.2.4 Focal length

(4 × 2) (8)

8.3 A convex lens has a focal length of 30mm. An object, 20 mm high, is placed on the principal axis 45 mm from the optical centre of the lens.

8.3.1 Draw an accurate ray diagram to show how the image is formed by this lens. (6)

8.3.2 Determine the size of the image formed from the diagram. (2)

8.3.3 Determine the distance of the image from the lens. (2)

[21]

QUESTION 9

9.1 State Coulomb's law. (2)

9.2 Predict what will happen to the force between two identically charged objects if …

9.2.1 one of the object's charge is doubled.

9.2.2 the charge applied to the two objects is doubled.

9.2.3 the distance between the charged objects is doubled.

9.2.4 the distance between the charged objects is halved.

(4 × 1) (4)

9.3 The potential difference between two parts of a thunderstorm is 10^6 V.

9.3.1 Define the potential difference. (2)

9.3.2 Calculate the amount of energy given up during the passage of 10 C of charge. (3)

Copyright reserved

9.4 The following questions are based on the following symbols:



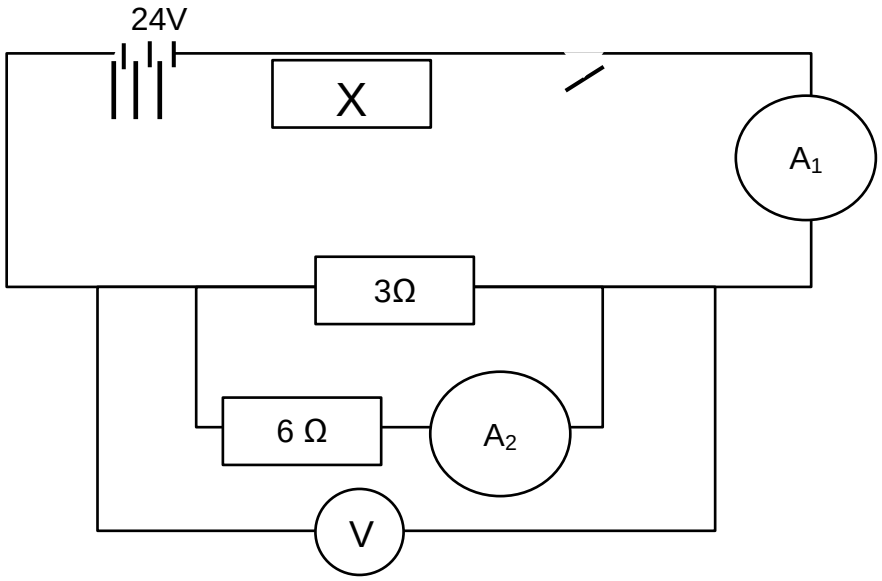
9.4.1 What do these symbols represent? (2)

9.4.2 Draw the magnetic field around each conductor whose current flows into the paper and out of the paper. (4)

9.4.3 Describe the effect these magnetic fields will have on each other. (1)

[18]

QUESTION 10



A battery of EMF 24V and zero internal resistance is connected in a circuit as shown in the diagram above. A current of 2A registers on ammeter A_1 when the switch is closed:

10.1 Calculate the total resistance of the parallel resistors. (3)

10.2 Calculate the resistance of resistor X. (5)

10.3 Calculate the reading on the voltmeter. (3)

10.4 Calculate the reading on the ammeter A_2. (3)

10.5 State the value of the current flowing through the 3 Ω resistor. (2)

10.6 If the 3Ω resistor is removed from the circuit, will the reading on ammeter A_1 INCREASE/DECREASE or REMAIN THE SAME. Explain. (4)

[20]

TOTAL SECTION B: 115
GRAND TOTAL: 150

Copyright reserved

DATA FOR PHYSICAL SCIENCE LEVEL 3

PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8\ m.s^{-2}$
Speed of light in a vacuum	c	$3,0 \times 10^{8}\ m.s^{-1}$
Planck's constant	h	$6,63 \times 10^{9}\ J.s$
Coulomb's constant	k	$9,0 \times 10^{9}\ N.m2.C^{-2}$
Charge of an electron	e	$-1,6 \times 10^{-19}\ C$
Electron mass	m_e	$9,11 \times 10^{-31}$
Permittivity of free space	0ε	$8,85 \times 10^{-12}\ F.m^{-1}$

Copyright reserved

TABLE 2: FORMULAE

MECHANICS

$v = u + at$	$F = \frac{Gm_1m_2}{r^2}$
$v^2 = u^2 + 2as$	$E_P = mgh$
$s = ut + \frac{1}{2}at^2$	$MA = \frac{load}{effort}$
$F = mg$	$VR = \frac{S_E}{S_R}$
$F = ma$	$W = F \times s$
$\tau = \perp F.s$	$Efficiency = \frac{MA}{VR}$
$E_k = \frac{1}{2}mv^2$	

WAVES, SOUND AND LIGHT

$v = f\lambda$
$T = \frac{1}{f}$

MAGNETISM AND ELECTRICITY

$R_T = R_1 + R_2 + R_3 + \cdots$	$Q = It$
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$	$E = IR + Ir$
$V = IR$	$V = \frac{W}{Q}$
$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{F}{q}$
$E = \frac{kq}{r^2}$	$E = \frac{V}{d}$
$C = \frac{\epsilon_0 A}{d}$	$P = VI$
$C = \frac{Q}{V}$	$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$
$U = \frac{kQ_1Q_2}{r}$	

Copyright reserved