higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE

(First paper)

NQF LEVEL 3

(10021003)

27 November 2023 (X-paper)
09:00–12:00

REQUIREMENTS: **Graph paper must be supplied**
ANSWER SHEET

Nonprogrammable calculators and drawing instruments may be used.

This question paper consists of 15 pages,
1 information sheet and a formula sheet of 2 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
SUBJECT
NQF LEVEL
TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Start each section on a new page.
5. Use only a blue or black pen.
6. Show all steps in calculations
7 Round off all answers to TWO decimals
8 Write and draw all diagrams neatly and legibly.

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SECTION A

QUESTION 1

Give the word or phrase for the definition provided. Write only the answer next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 The product of the distance from one point, to the point of application of the force and the component of the force, perpendicular to the line of the distance.

1.2 A property of matter that resists a sudden change in motion.

1.3 An eye condition for people who can only see far objects.

1.4 The law is used to find the direction of the current and magnetic field in a solenoid.

1.5 The amount of energy required to carry a charge from one point to another.

(5 × 1) **[5]**

QUESTION 2

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

COLUMN A		COLUMN B	
2.1	The image formed by a concave lens	A	scalar
2.2	Constant velocity	B	$a = 0\ m.s^{-2}$
2.3	Net force	C	$kg\ m.s^{-2}$
2.4	Series resistor	D	diminished and enlarged
2.5	A physical quantity that has magnitude only	E	diminished and erect
		F	potential divider
		G	amplitude
		H	acceleration

(5 × 1) **[5]**

QUESTION 3

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

3.1 200 $km.h^{-1}$ is equal to 55,56 $m.s^{-1}$

3.2 Airbags in modern cars provide more safety during an accident by increasing the time of impact.

3.3 Sound is a transverse wave.

3.4 The frequency of sound represents the loudness.

3.5 Lighting is not related to electrical charges, it has everything to do with witchcraft.

(5 × 2) **[10]**

QUESTION 4

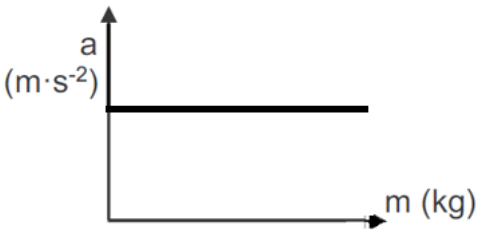
Various options are given as possible answers to the following questions. Choose the correct answer and write only the letter (A–D) next to the question number (4.1–4.5) in the ANSWER BOOK.

4.1 Which ONE of the following quantities is an example of a scalar quantity?

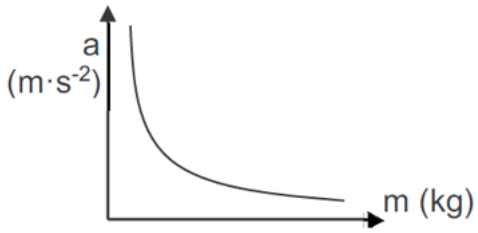
A Velocity
B Displacement
C Force
D Mass

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

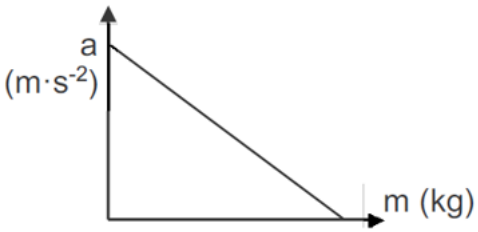
A



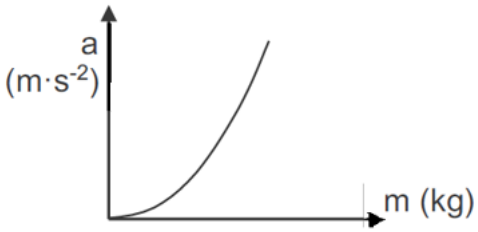
B



C

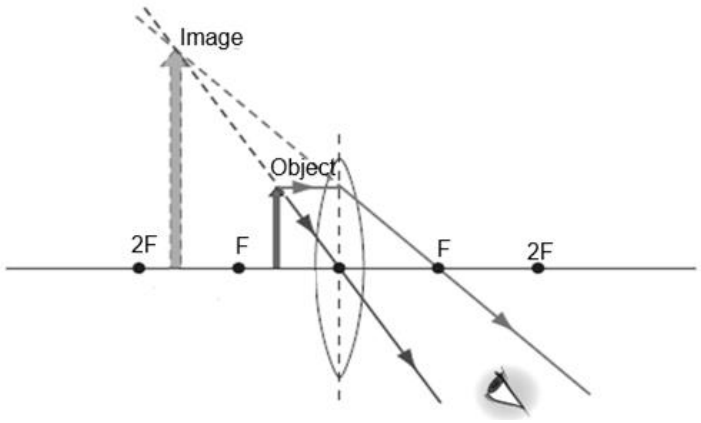


D

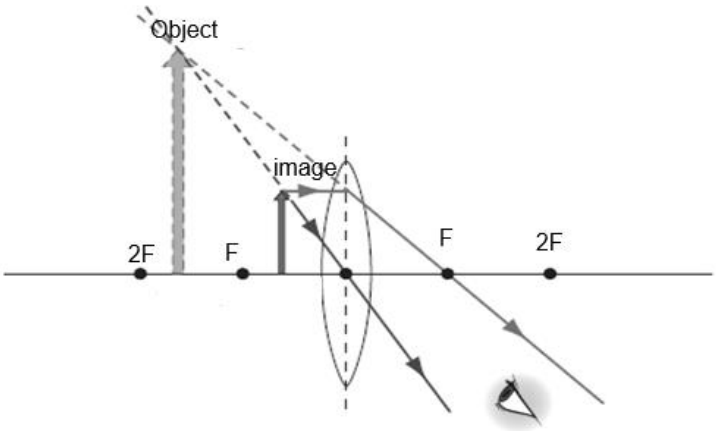


4.3 Which ONE of the diagrams below correctly shows image formation through a thin convex lens:

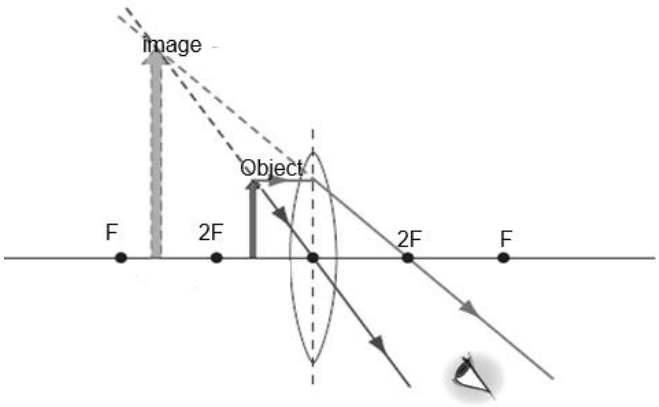
A



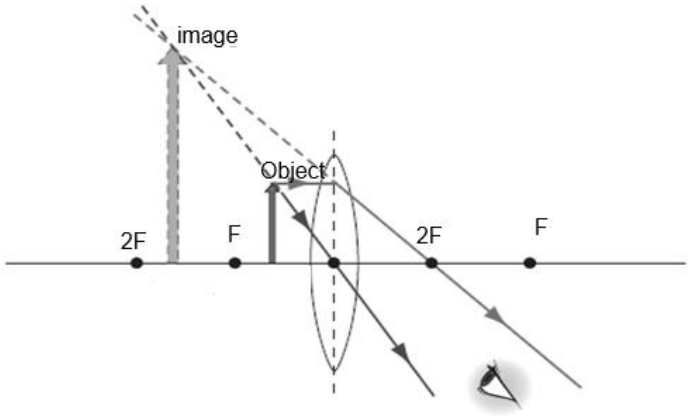
B



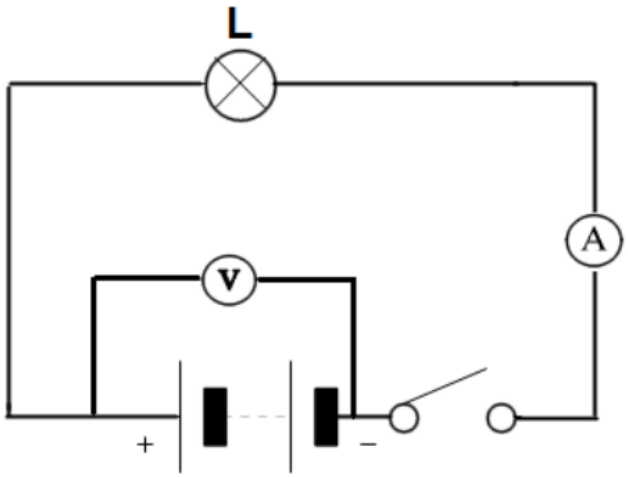
C



D

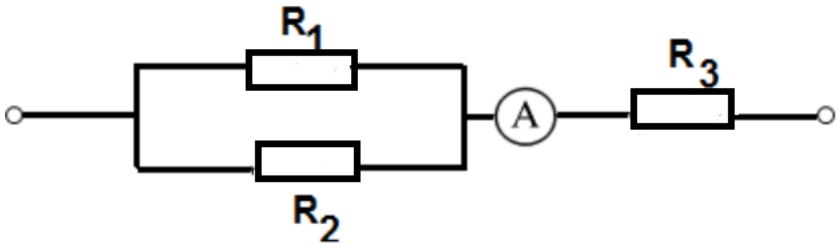


4.4 When the switch in the circuit presented by the diagram below is open, the voltmeter reading represents the …



A Terminal voltage
B EMF
C Current
D Resistance

4.5 Two resistors R1 = 6 Ω and R2 = 12 Ω are connected in parallel to each other and in series to R3 = 2 Ω.



What is the relationship between the current and the potential difference in R_1 and R_2 respectively?

A R_1 has more current than R_2 but they both have the same potential difference
B R_2 has more current than R_1 but they both have the same potential difference
C R_1 has more potential difference than R_2 but they both have the same current
D R_2 has more potential difference than R_1 but they both have the same current

(5 × 3) **[15]**

TOTAL SECTION A: 35

SECTION B

QUESTION 5

Olympic champion Wayde van Niekerk claimed a commanding victory in his first men's 400m race of the 2022 track season at the Stars and Stripes Classic meeting in Atlanta, Georgia, on Saturday 2 July 2022. He completed his first lap (round) in 25 seconds.



[Source: *olympics.com/en/news*]

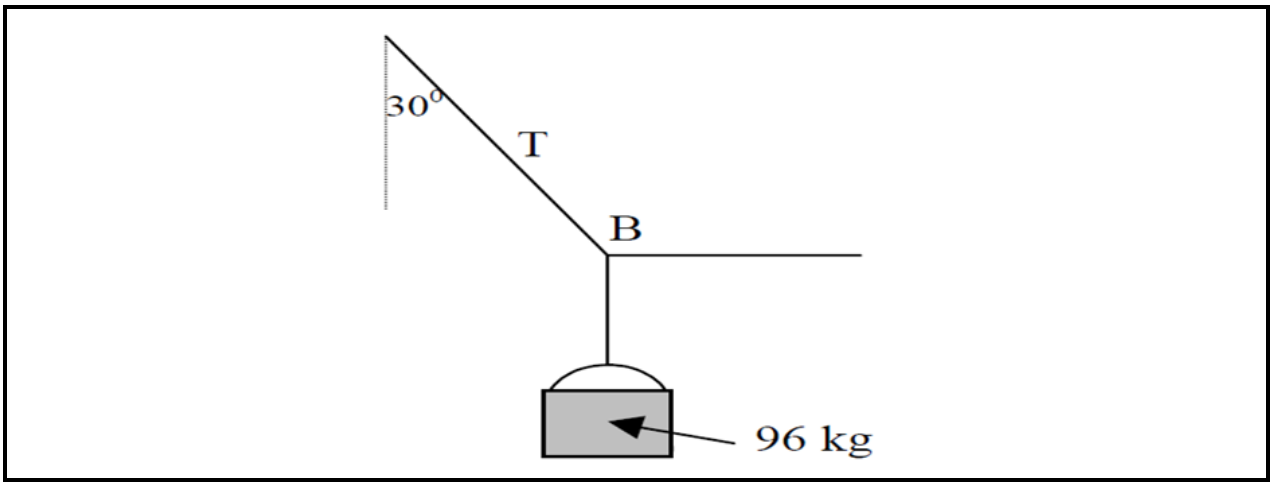
5.1 Calculate the average speed at which Wayde ran. (3)

5.2 Calculate Wayde's average acceleration from when he started the race until he finished just before he stopped. (3)
[6]

QUESTION 6

A bricklayer on top of a building runs short of bricks. He lowers a bucket on a cable to a worker on a truck. The worker pulls the bucket horizontally to the right to bring it close to the truck.

The worker holds the bucket stationary so that it makes an angle of 30^0 to the vertical (as shown in the diagram below). Another worker then fills the bucket with bricks until the total mass of the bucket is 96 kg.



6.1 Are all the forces acting on the bucket in equilibrium or not? (1)

6.2 What does it mean to say that forces acting on an object are in equilibrium? (2)

6.3 Draw a labelled vector diagram showing all forces acting on the bucket and angles (3)

6.4 Calculate the …

6.4.1 the horizontal force exerted on the bucket by the worker, to hold it in place. (4)

6.4.2 the tension in cable T. (4)

[14]

QUESTION 7

7.1 A person is riding a skateboard as shown below.

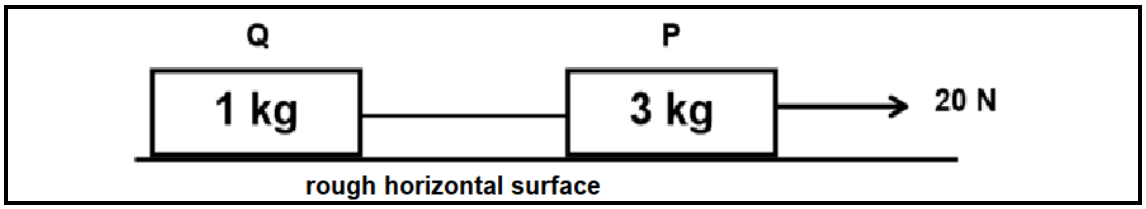


[Source: *www.adobe stock.com*]

7.1.1 What will happen if the skateboard rider hit something (like a curb) with the front wheels? (2)

7.1.2 Which of Newton's laws explains the answer in QUESTION 7.1.1? (1)

7.2 The diagram below shows a 3 kg block connected to a 1 kg block by a light inextensible string. A constant horizontal force of 20 N pulls the system along a rough horizontal surface. The frictional force between the blocks P is 2 N and that between Q and the surface is 1 N respectively.



7.2.1 State Newton's second law of motion in words. (2)

7.2.2 Draw a labelled force diagram showing ALL *forces* acting on the 3 kg block. (4)

Calculate:

7.2.3 The magnitude of the acceleration of the 3 kg block (6)

7.2.4 The magnitude of the tension in the string between the boxes. (3)

7.2.5 The rope between the boxes breaks whilst the same 20 N force doesn't change.

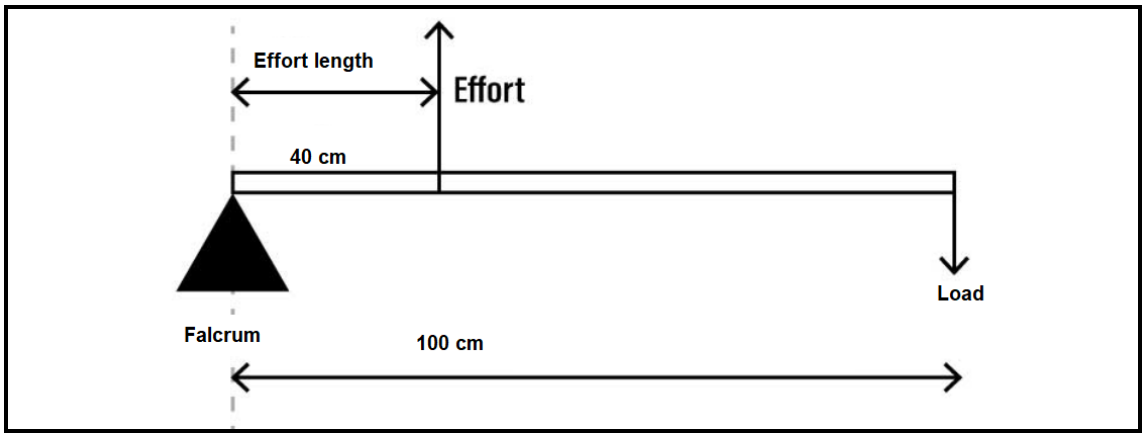
Draw a graph (not according to scale) to show the relationship between the acceleration and the mass of the 3 kg box. (4)

[22]

QUESTION 8

8.1 Explain the term *mechanical advantage*. (2)

8.2 A lever of length 100 cm has an effort force of 15 N at a distance of 40 cm from the fulcrum at one end.



8.2.1 What class of the lever is shown in the diagram in QUESTION 8.2 above? (1)

Calculate the …

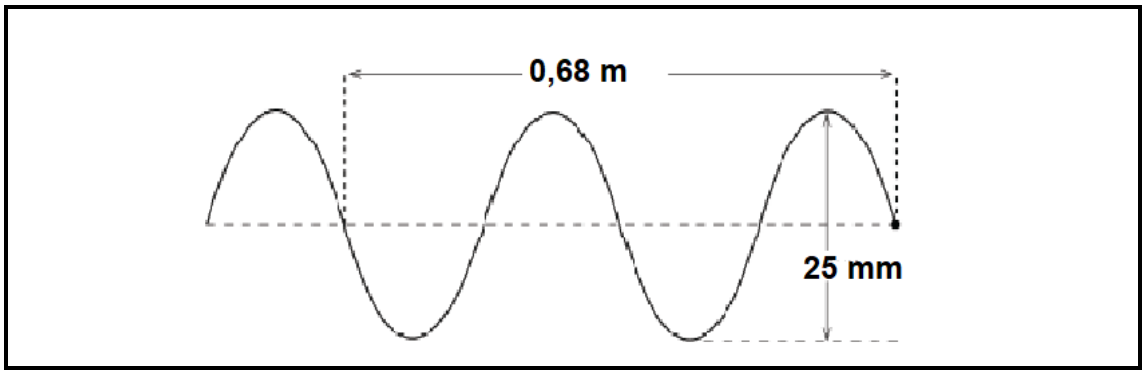
8.2.2 the mechanical advantage of the lever (4)

8.2.3 load force that can be applied at the other end of the lever, 100 cm from the fulcrum. (4)

[11]

QUESTION 9

9.1 Study the graph below and answer the questions that follow. Each particle in the wave shown above completes one vibration (oscillation) in 0,4 s.



Calculate the …

9.1.1 The time it will take eight wavelengths to pass a specific point in the medium. (2)

9.1.2 The amplitude of this wave. (2)

9.1.3 The wavelength of this wave. (2)

9.1.4 The frequency of the wave. (3)

9.1.5 The speed of the wave. (3)

9.2 Define the term '*amplitude*.' (2)

[14]

QUESTION 10

After the age of 40 most people have to be close to an object for them to see it clearly



[Source: *www.google.com*]

10.1 To correct this, doctors recommend glasses with lenses that can allow them to see objects that are near.

10.1.1 Write down the names of two types of lenses. (2)

10.1.2 Write down the *name* of the eye condition when a person can only see nearby objects. (1)

10.1.3 Which type of lens can be used to correct the condition mentioned in QUESTION 10.1.2? (1)

10.1.4 Draw a ray diagram showing the image formation of a lens in QUESTION 10.1.3 when the object is placed beyond 2 F. (6)

10.1.5 A concave mirror produces a three-times magnified (enlarged) real image of an object placed 10 cm in front of it. Calculate the position of the image. (4)
[14]

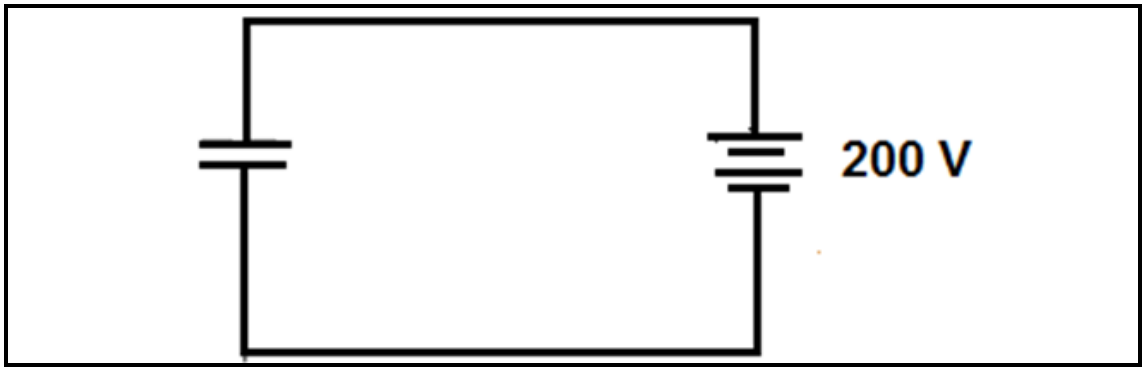
QUESTION 11

11.1 Define the term *capacitor*. (2)

11.2 Two parallel plates are arranged to form a capacitor. Each plate has an area of 1 m^2. The plates are separated by a 2 mm air gap.

11.2.1 Calculate the capacitance of the capacitor. (4)

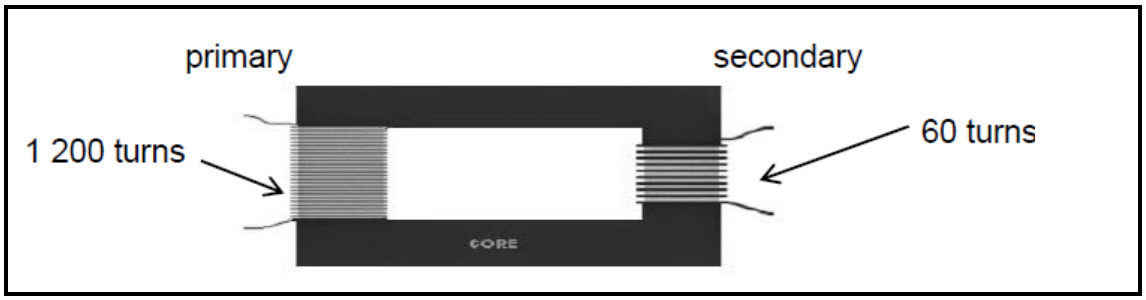
The capacitor in QUESTION 11.2 is connected to a power source of 200 V as shown below



11.2.2 Calculate the charge that accumulates on each plate when it is connected to a 200 V power source (3)

11.2.3 How can the amount of the charge stored on each plate of the capacitor be increased without altering the design of the capacitor? (1)

11.3 The diagram below shows a transformer that has 1 200 turns on the primary coil and 60 turns on the secondary coil. The secondary voltage is 24 volts



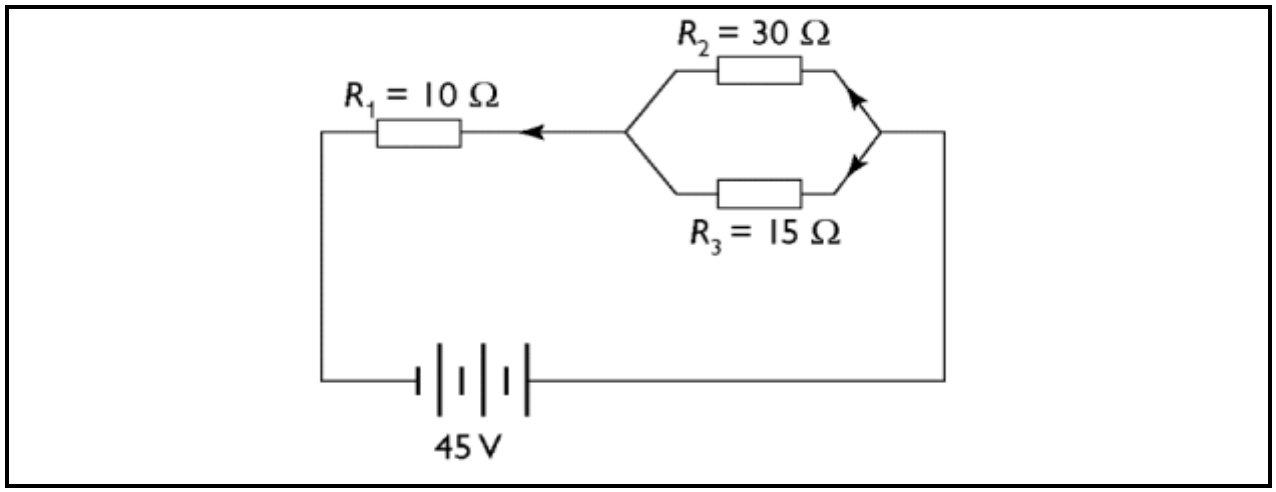
11.3.1 Is this a step-up transformer or a step-down transformer? (1)

11.3.2 Calculate the primary voltage for this transformer. (4)

[15]

QUESTION 12

Study the diagram below and answer the questions that follow. The resistance of the connecting wires and the ammeter is negligible.



12.1 State Ohm's law in words (2)

12.2 Calculate:

12.2.1 The total resistance in the circuit (4)

12.2.2 The total current in the circuit (3)

12.2.3 The potential difference in the 15 Ω resistor (4)

12.2.4 Calculate the current flowing in the 30 Ω resistor. (3)

12.2.5 Between the 30 Ω resistor and the 15 Ω resistor, which resistor will use more current? (1)

12.2.6 Explain the answer in QUESTION 12.2.5. (2)

[19]

TOTAL SECTION B: 115
GRAND TOTAL: 150

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DATA FOR PHYSICAL SCIENCE LEVEL 3

INFORMATION SHEETS – PAPER 1

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	$9,0 \times 10^{9}\ N.m^{2}.C^{-2}$
Charge of an electron	e	$-1,6 \times 10^{-19}\ C$
Electron mass	m_e	$9 \times 10^{-31}\ kg$
Permittivity of free space	ε_0	$8,85 \times 10^{-12}\ F.m^{-1}$

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TABLE 2: FORMULAE

MECHANICS

v= $\frac{d}{\Delta t}$	
$v = u + at$ / $v_f = v_i + a\Delta t$ a = $\frac{v_f - v_i}{\Delta t}$	$F = \frac{Gm_1m_2}{r^2}$
$v^2 = u^2$+2as/ $vf^2 = vi^2 + a\Delta x$	$MA = \frac{load}{effort}$ OR $MA = \frac{load\ length}{effort\ length}$
$S = ut + \frac{1}{2}at^2$ or $\Delta y = vi\Delta t + \frac{1}{2}\ a\ \Delta t^2$	$VR = \frac{S_E}{S_R}$
$F = ma$ $Fg = mg$ $W = mg$	$W = F\ x\ s$
$\tau = \perp F.s$	$Efficiency = \frac{MA}{VR}$
$Ek = \frac{1}{2}mv^2$	$R^2 = X^2 + Y^2$
$Ep = mgh$	$F_x = FCos\theta$
$v = \frac{s}{t}$	$Fy = FSin\theta$

WAVES, SOUND AND LIGHT

$V = f\lambda$
$T = \frac{1}{f}$
M = $\frac{h_i}{h_0} = \frac{-d_i}{d_o}$

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MAGNETISM AND ELECTRICITY

$F = \frac{kQ_1Q_2}{r^2}$	$R_T = R_1 + R_2 + R_3 \ldots$
$E = \frac{kQ}{r^2}$	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$
$C = \frac{\kappa\, \varepsilon_o A}{d}$	$Q = It$
$C = \frac{Q}{V}$	$V = IR$
$E = \frac{V}{d}$	$V = \frac{W}{Q}$
$E = \frac{F}{q}$	$Emf = I(R + r)$ $Emf = IR + Ir$
$\Delta\Phi B = B \perp A = B\,A\,cos\,\theta$	$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_1}{I_2}$
$E = -N\frac{\Delta\Phi B}{\Delta t}$	P = VI

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