higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE
(First Paper)
NQF LEVEL 3

(10021003)

9 March 2018 (X-Paper)
09:00–12:00

A Nonprogrammable scientific calculator and drawing instruments may be used.

This question paper consists of 10 pages, 1 graph paper and 1 data sheet.

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TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Answer both SECTION A and SECTION B in the ANSWER BOOK provided.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write your examination number (and centre number) in the appropriate spaces on the ANSWER BOOK provided.
5. In ALL calculations, formulae and substitutions must be shown.
6. All final answers must be accurately approximated to TWO decimal places.
7. Write neatly and legibly.

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SECTION A

QUESTION 1

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

1.1 The force between an object and a surface that tends to oppose the motion of an object

1.2 A term used to describe the bending of light when it passes from one medium to another medium

1.3 The energy output of a machine divided by the energy input

1.4 A device that changes the kinetic energy of a rotating coil into electricity

1.5 Electrical quantity measured in volts

(5 × 1) **[5]**

QUESTION 2

Choose an item from COLUMN B that matches an item 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	Region in which an electric charge experiences a force	A	longitudinal wave
2.2	Electric bell	B	acceleration
2.3	Device designed to store charge	C	convex
2.4	Product of velocity and time	D	electric field
2.5	Sound	E	transformer
		F	distance
		G	transverse wave
		H	capacitor
		I	electromagnets
		J	displacement

(5 × 1) **[5]**

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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 One newton is the force that will give an object with a mass of 1 kg an acceleration of 1 $m.s^{-2}$.

3.2 Sound travels faster in ice than in water and faster in water than in air.

3.3 For a converging (convex) lens, rays parallel to the principal axis will diverge away from the focal point.

3.4 The acceleration of an object depends directly on its objects.

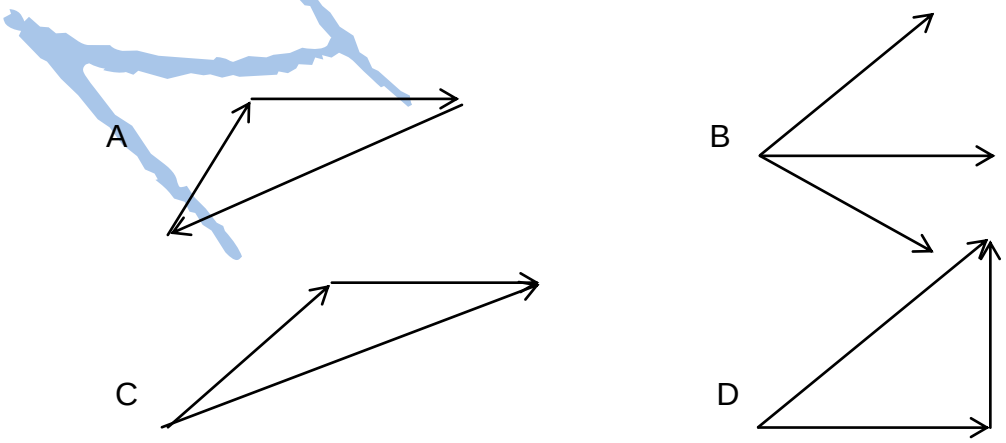
3.5 Electric field strength is the strongest where the field lines are close to one another.

(5 × 2) **[10]**

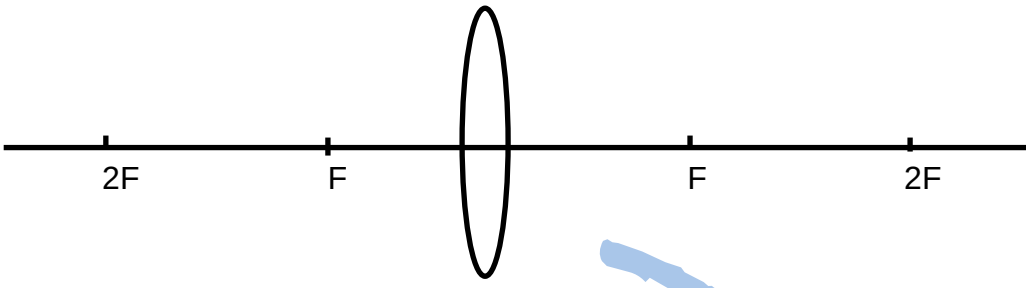
QUESTION 4

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 Which ONE of the following force diagrams is the best representation of three forces in equilibrium?



4.2 An object is placed to the left of a converging lens.



What is the nature of the image formed if the object is placed at 2F?

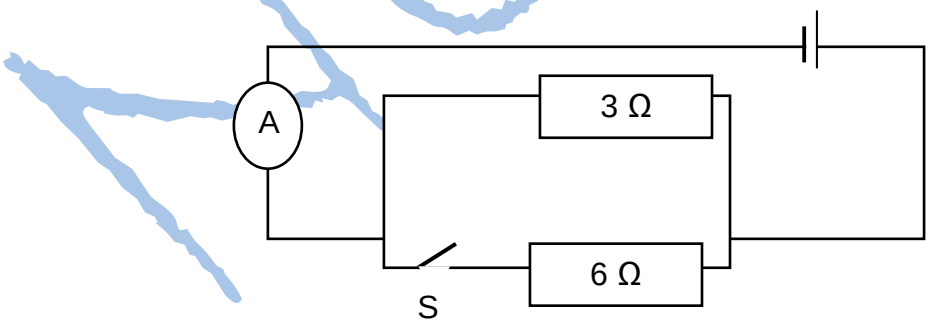
A	Real	inverted	smaller than object
B	Real	inverted	same size as object
C	Virtual	erect	larger than object
D	Virtual	erect	smaller than object

4.3 An electrostatic force exists in a vacuum between two charged objects. The system is now changed so that the force is 50% less.

This happens because …

A the charge on one of the objects is removed.
B the charge on one of the objects was doubled.
C the charge on both objects was doubled.
D the charge on one of the objects was halved.

4.4 In the circuit below the ammeter reads 8 A.



If the switch is closed, the ammeter reading will be …

A 0 A.
B less than 8 A.
C greater than 8 A.
D 8 A.

4.5 The wavelength of a longitudinal wave is the distance between …

A a compression and a rarefaction.
B any two compressions or rarefactions.
C two successive compressions or rarefactions.
D two points that are moving out of phase.

(5 × 3) **[15]**

TOTAL SECTION A: 35

SECTION B

QUESTION 5

5.1 Name ONE instrument used to measure:

5.1.1 The amount of force needed to pull a trolley

5.1.2 The length of a work bench

5.1.3 The amount of current passing through a point in a circuit

(3 × 1) (3)

5.2 Convert the following:

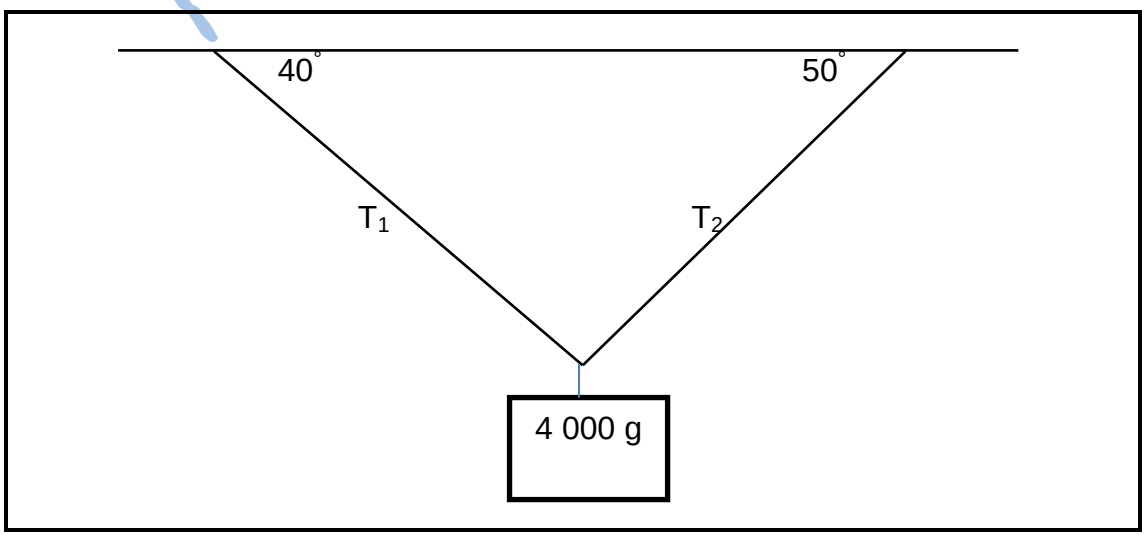
5.2.1 4 dm^3 to cm^3

5.2.2 20 000 g to kg

(2 × 1) (2)
[5]

QUESTION 6

6.1 Study the diagram below and answer the questions.



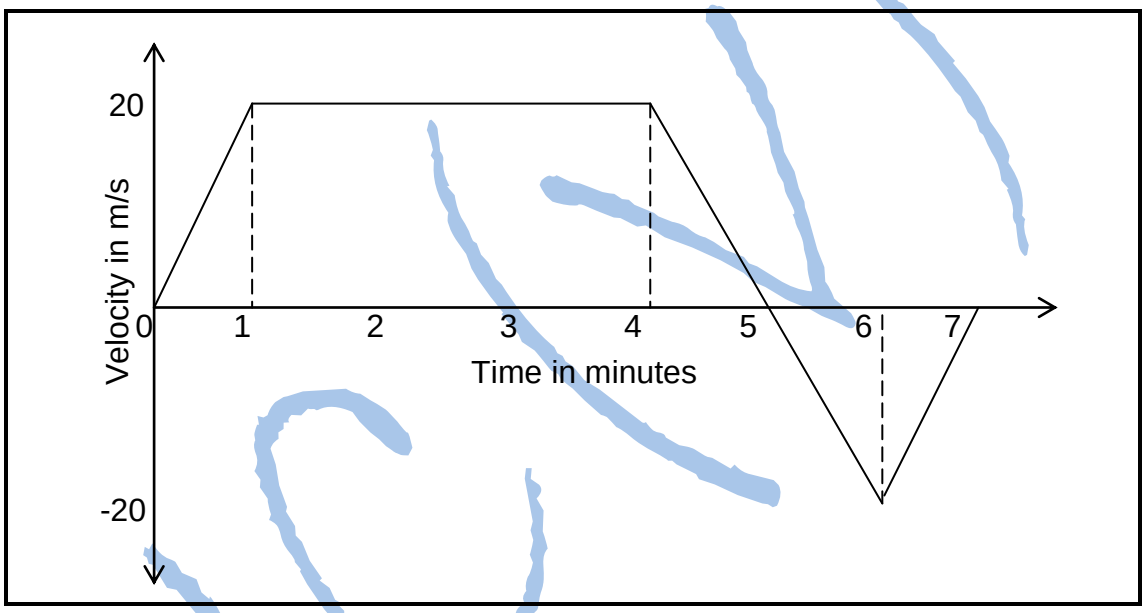
6.1.1 Draw a labelled force diagram of the given diagram. (3)

6.1.2 Draw the vector diagram of the given diagram. (5)

6.1.3 Determine T_1 and T_2 from the drawn vector diagram. (4)

6.1.4 What is the resultant force of the forces experienced by the 4 000 g object that is hanging on the diagram? (1)

6.2 The diagram below represents the motion of a train that is initially moving south.



Use the diagram to answer the following questions:

6.2.1 Describe the motion of the train from the starting point to the 7th minute. (5)

6.2.2 Calculate the acceleration of the train from 0 to the first minute in $m.s^{-2}$. (4)

6.2.3 Calculate the displacement of the train for the full 7-minute trip. (4)

6.2.4 Calculate the distance the train travelled (in metres) for the full 7-minute trip. (2)

[28]

QUESTION 7

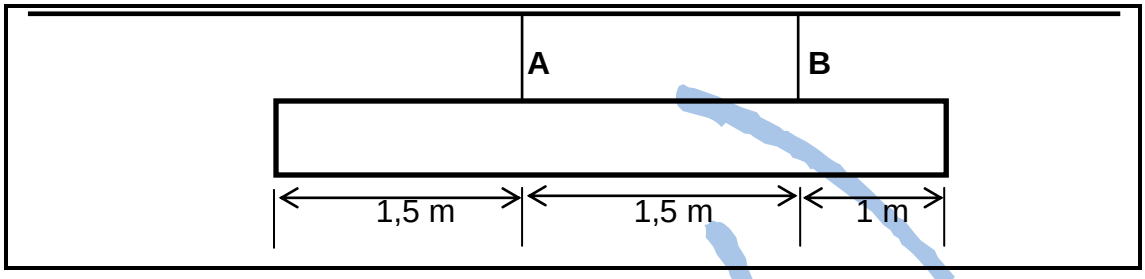
7.1 A crane lifts a load of 150 kg off the ground at 0,5 $m.s^{-2}$ vertically upwards.

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

7.1.2 Calculate the magnitude of the resultant force acting on the load. (2)

7.1.3 Calculate the lifting force exerted on the load by the rope attached to the load. (5)

7.2 In the sketch below a 4 m-long signboard with a mass of 100 kg is hanging by cables A and B.



7.2.1 Show that A = 653,33 N by using the second condition of equilibrium. (3)

7.2.2 Show that B = 326,67 N by using the second condition of equilibrium. (3)

7.2.3 State the first condition for equilibrium. (2)

7.2.4 Show that the signboard is in equilibrium. (2)

7.3 A load with a mass of 200 kg is pushed up on a ramp that is 12 m long to a height of 4 m.

7.3.1 Calculate the ideal mechanical advantage. (2)

7.3.2 Calculate the effort needed if all resistance forces are ignored. (3)

[24]

QUESTION 8

8.1 Give TWO differences between sound waves and radio waves. (2)

8.2 Define the following terms:

8.2.1 Frequency

8.2.2 Wavelength

(2 × 2) (4)

8.3 A tuning fork makes 1 024 complete vibrations in 4 s.

8.3.1 What is the frequency of the fork? (2)

8.3.2 What is the wavelength of this sound in air if the speed of sound in air is 340 $m.s^{-1}$? (2)

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8.3.3 What will the wavelength of this sound be if it moves into water and if the speed of sound in water is 1 500 $m.s^{-1}$? (2)

8.3.4 What effect does this have on the wave direction? (2)

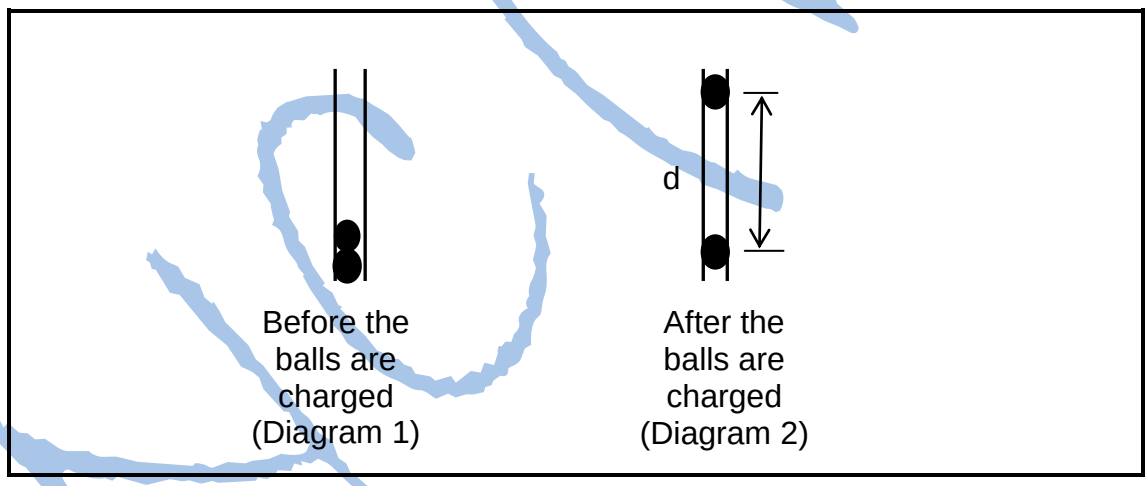
8.4 An object 1 cm high is placed 20 cm from a convex lens of focal length 25 cm.

8.4.1 Draw an accurate ray diagram to determine the position of the image formed by this lens. (6)

8.4.2 What is the nature of the image formed? (3)
[23]

QUESTION 9

9.1 Two polystyrene balls are placed in a glass tube as indicated in the diagram below. The two balls are given a charge of +3 µC each and the top ball moves up by a distance (d) as shown in the diagram. The mass of each ball is 30 g.



9.1.1 State Coulomb's law. (2)

9.1.2 Calculate the distance (d) separating the two balls after they have been charged. (5)

9.1.3 Explain why the distance separating the two balls will decrease with time. (2)

9.2 Define the following terms:

9.2.1 Dielectric

9.2.2 Insulator

9.2.3 Capacitance

(6)

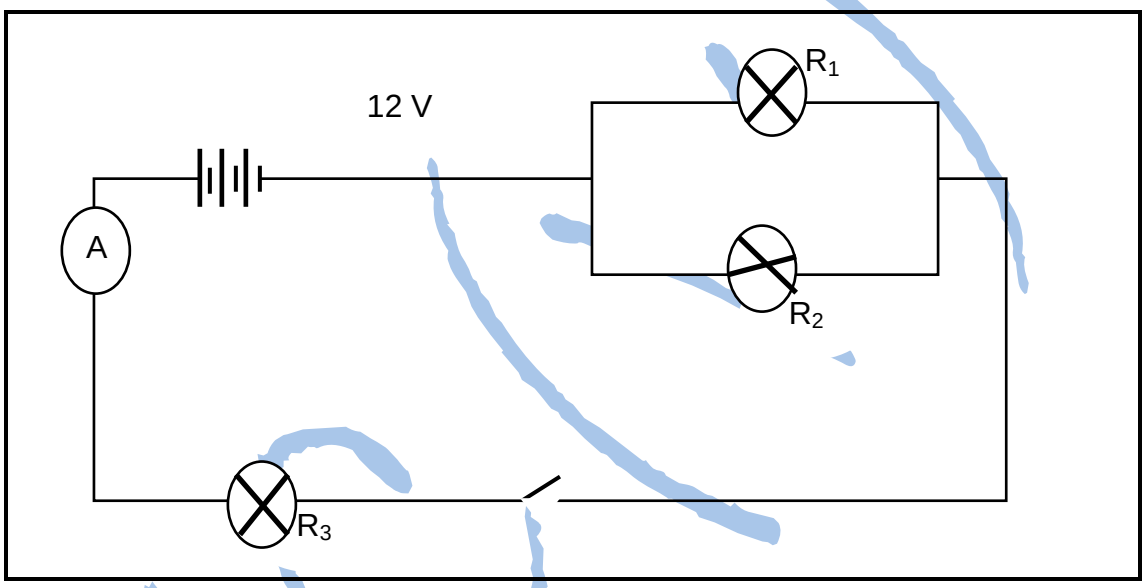
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9.3 Determine the charge stored in a capacitor of a flashlight unit of a camera, if its capacitance is 5 µF and the voltage across it is 200 V. (3)

[18]

QUESTION 10

10.1 Study the circuit diagram below and answer the question. The three cells are connected in series. R_1, R_2 and R_3 represent three identical globes each with a resistance of 3 Ω.



When the switch is closed calculate the following:

10.1.1 The total resistance of the circuit (4)

10.1.2 The reading on the ammeter (3)

10.1.3 The potential difference across the R_3 resistor (3)

10.1.4 How does the brightness of globes R_3 and R_2 compare? Give a full explanation. (3)

10.2 240 C of charge passes a point X in a circuit every minute.

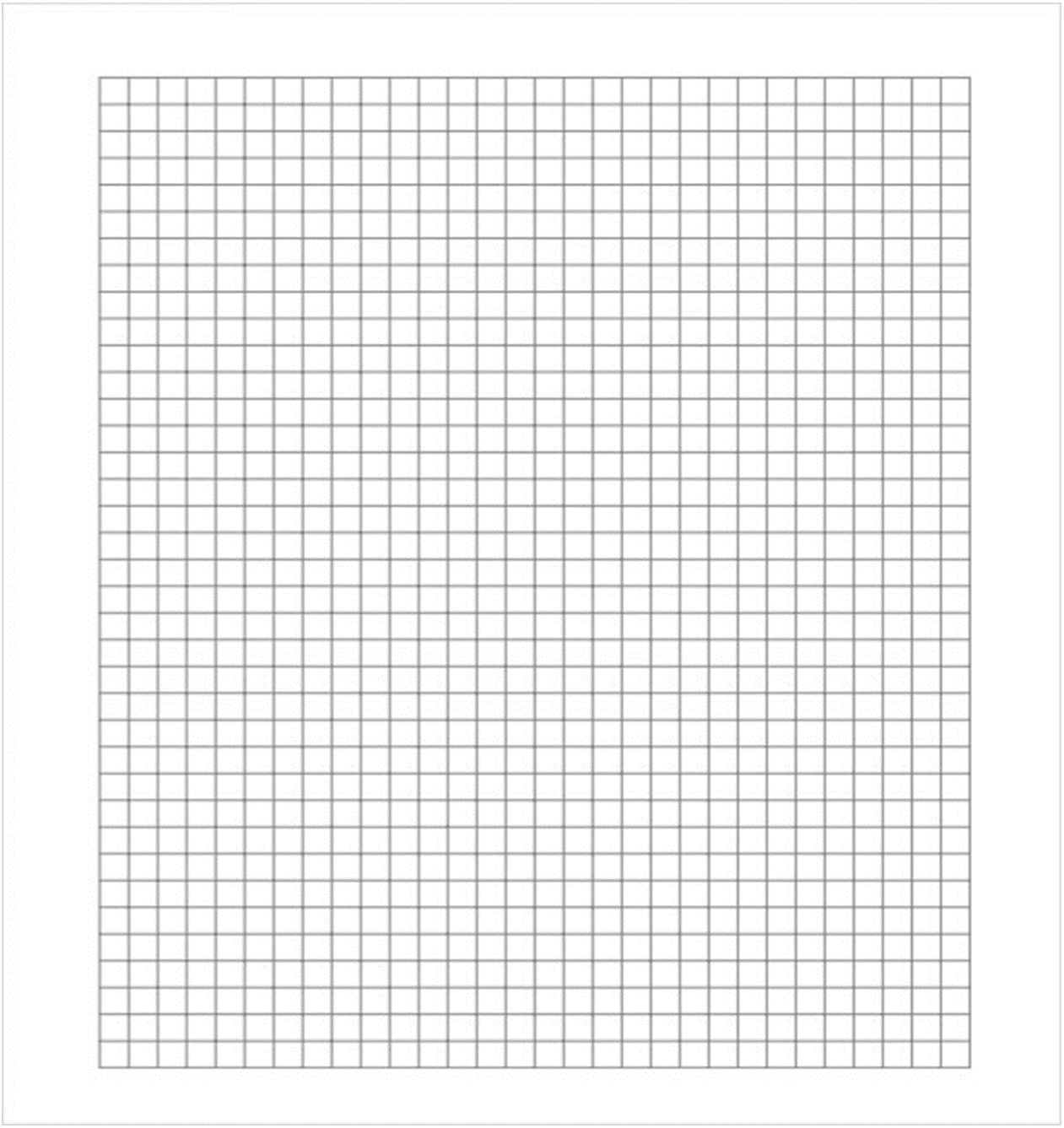
Calculate the amount of current passing through point X in the circuit. (4)

[17]

TOTAL SECTION B: 115
GRAND TOTAL : 150

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GRAPH PAPER



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DATA SHEET

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9{,}8\ m.s^{-2}$
Speed of light in vacuum	c	$3{,}0\times10^{8}\ m.s^{-1}$
Gravitational constant	G	$6{,}67\times10^{-11}\ Nm.kg^{-2}$
Coulomb's constant	k	$9{,}0\times10^{9}\ Nm.C^{-2}$
Charge of an electron	e^{-}	$-1{,}6\times10^{-19}\ C$
Electron mass	m_e	$9{,}11\times10^{-31}\ kg$

TABLE 2: FORMULAE

MECHANICS

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

WAVES, SOUND AND LIGHT

$v=f\lambda$
$T=1/f$

MAGNETISM AND ELECTRICITY

$R_T=R_1+R_2+R_3+...$	$Q=It$
$1/R_T=1/R_1+1/R_2+1/R_3+...$	$E=IR+Ir$
$V=IR$	$V=W/Q$
$F=kQ_1Q_2/r^2$	$E=F/q$
$E=kQ/r^2$	$E=V/d$
$C=\in_0 A/d$	$P=VI$
$C=Q/V$	$V_1/V_2=N_1/N_2=I_2/I_1$
$U=kQ_1Q_2/r$	

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