higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE

(First paper)

NQF LEVEL 3

(10021003)

10 March 2020 (X-paper)
09:00–12:00

A nonprogrammable calculator may be used.

This question paper consists of 12 pages and 1 data sheet.

401Q1S2010

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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. Approximate all final answers to two decimal places.
5. Show the formulae and substitutions in all calculations.
6. Start each section on a new page.
7. Use only a blue or black pen.
8. Write neatly and legibly.

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SECTION A

QUESTION 1

Give a word or term for each of the following descriptions by writing only the answer next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 Number of vibrations that passes through a point in one second

1.2 The distance between successive threads of a screw

1.3 The law that states that when an unbalanced force acts on an object, the object's velocity changes

1.4 The nature of an image formed by a concave lens

1.5 The phenomenon that occurs when the frequency of a sound wave coincides with the natural frequency of the vibration of an object

(5 × 1) **[5]**

QUESTION 2

Choose a term 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	A device used to determine resistance accurately	A	sound waves
2.2	Can travel through a vacuum	B	myopic
2.3	Measured in farad	C	Wheatstone bridge
2.4	Near-sightedness	D	friction
2.5	The force that resists the motion of surfaces in contact	E	dielectric
		F	weight
		G	voltmeter
		H	capacitance
		I	hypermetropia
		J	radio waves

(5 × 1) **[5]**

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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 During destructive interference between two sound waves, a compression coincides with a rarefaction.

3.2 Transformers that are found in cellphone chargers are step-up transformers.

3.3 Nonconcurrent forces will always balance one another if their magnitudes are the same.

3.4 The velocity of an object is a maximum at its turning point.

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

(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 image formed on the retina of the human eye is …

A real and inverted.
B virtual and erect.
C real and enlarged.
D virtual and enlarged.

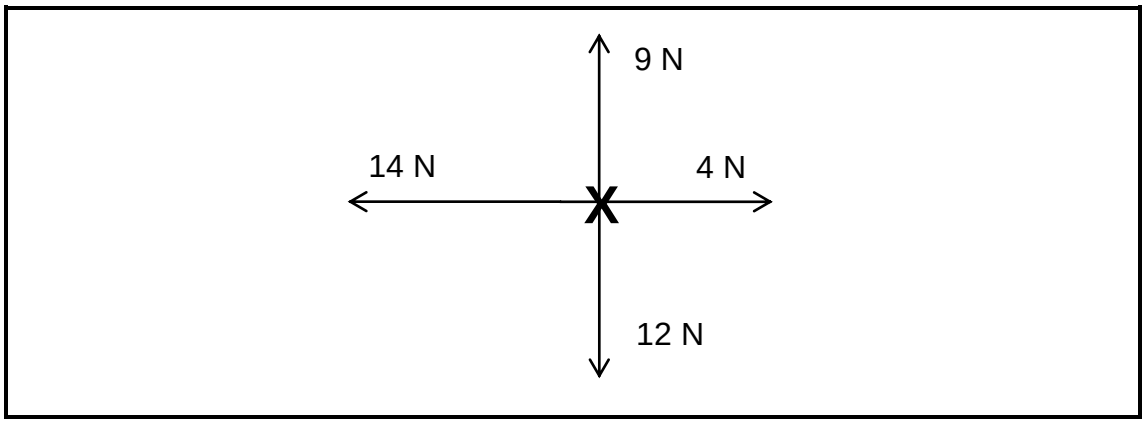
4.2 The unit of $N \cdot C^{-1}$ is the same as …

A $A \cdot s$
B $J \cdot C^{-1}$
C $V \cdot m^{-1}$
D $V \cdot A$

4.3 What effect will an increase in the frequency of a vibration have on the pitch and loudness of sound?

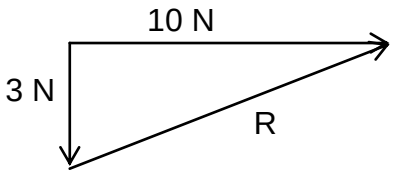
	PITCH	LOUDNESS
A	Decrease	no effect
B	Increase	no effect
C	No effect	decrease
D	No effect	increase

4.4 Four coplanar forces act at point X as shown in the sketch below (diagram not drawn to scale).

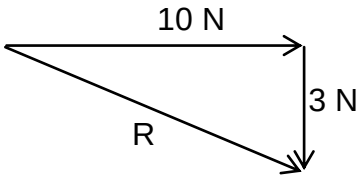


Which ONE of the following diagrams correctly represents the resultant (R) of these four forces?

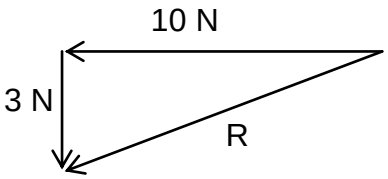
A



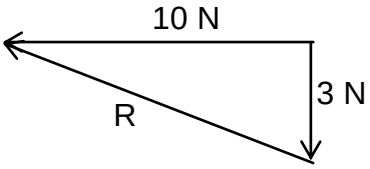
C



B



D



4.5 An object with a mass of **m** has an acceleration of **a** when subjected to a net force **F.**

What will be the new acceleration if the net force increased four times and the mass of the object was doubled?

A ½ a
B ¼ a
C 4 a
D 2 a

(5 × 3) **[15]**

TOTAL SECTION A: 35

SECTION B

QUESTION 5

5.1 What physical quantities are measured using the following instruments?

5.1.1 Spring balance

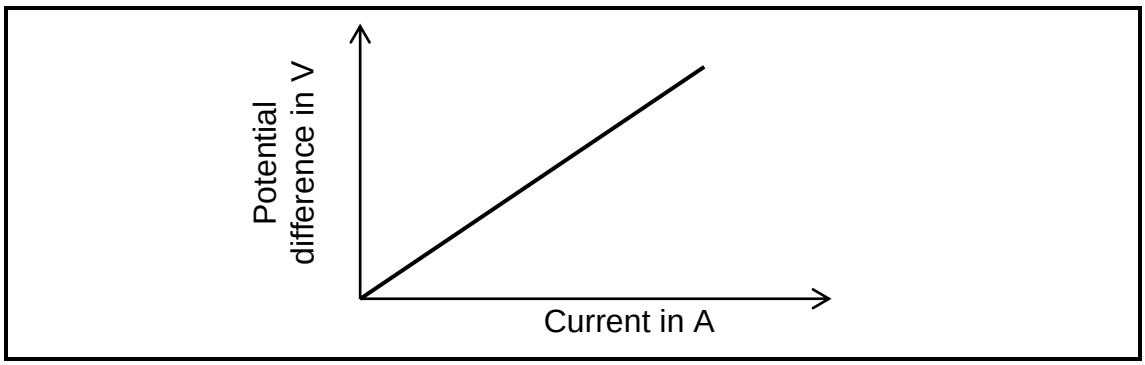
5.1.2 Tape measure

5.1.3 Pipette

(3 × 1) (3)

5.2 A student investigated the relationship between the potential difference and current in a conductor at constant temperature.

From her results, she drew the following graph.

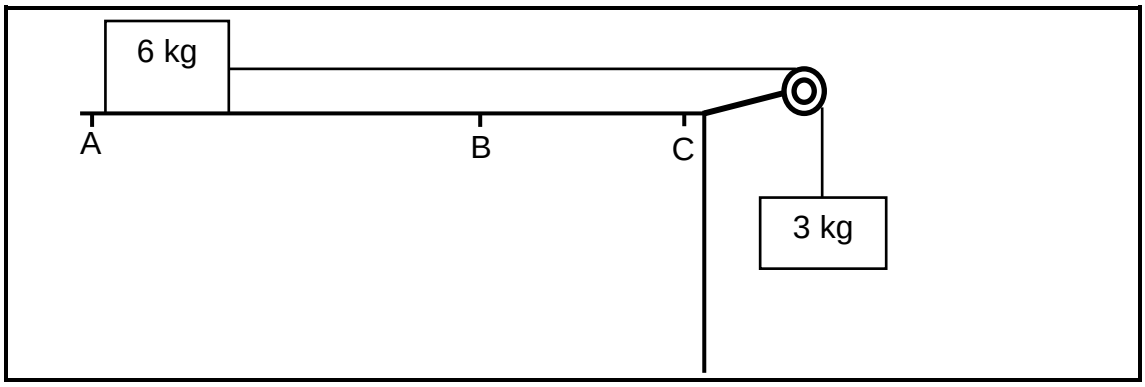


Write a suitable conclusion for this investigation. (2)
[5]

QUESTION 6

6.1 An object with a mass of 3 kg hangs on an inelastic, weightless string which passes over a frictionless pulley and is then attached to another object with a mass of 6 kg resting on a horizontal surface as shown in the diagram below.

The surface AB is rough and the surface BC is smooth.



6.1.1 Draw a labelled diagram showing all the forces acting on the free-body of 6 kg. (4)

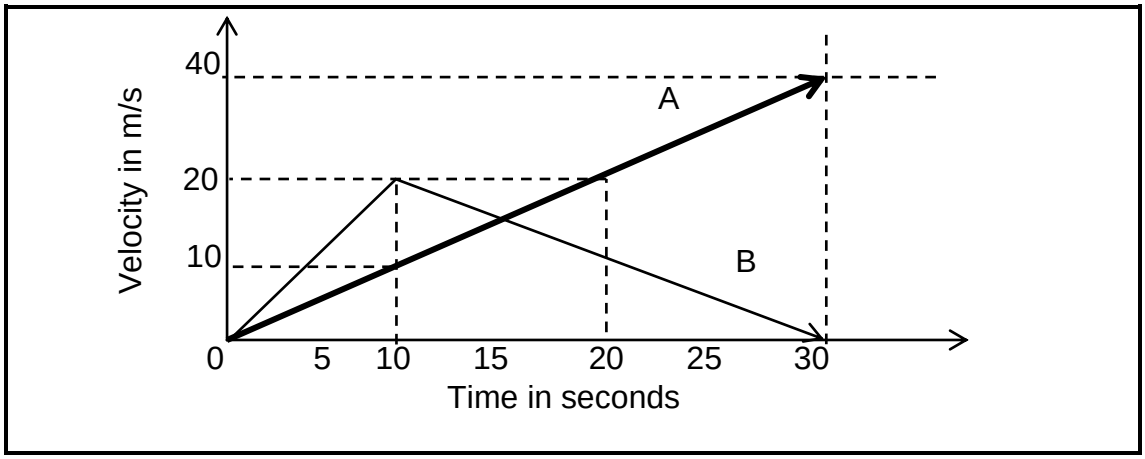
6.1.2 If the initial acceleration of the object of 3 kg is 0,8 $m \cdot s^{-2}$, what is the tension in the string? (4)

6.1.3 Calculate the magnitude of the frictional force acting on the object of 6 kg as it moves along AB. (4)

6.1.4 Will the tension in the string INCREASE, DECREASE or REMAIN THE SAME when the object of 6 kg travels along BC? (2)

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6.2 The graph below shows the change in velocity for two cars, A and B as they move along a straight horizontal track. Use this graph to answer the questions below. Do not use the equations of motion.



6.2.1 Which car, A or B has the larger acceleration during the first ten seconds? (1)

6.2.2 If car B has a mass of 1 000 kg, calculate the net force acting on it during the last 20 seconds. (5)

6.2.3 Determine the displacement of car A at t = 20 s. (2)

6.2.4 Determine the displacement of car B at t = 20 s. (3)

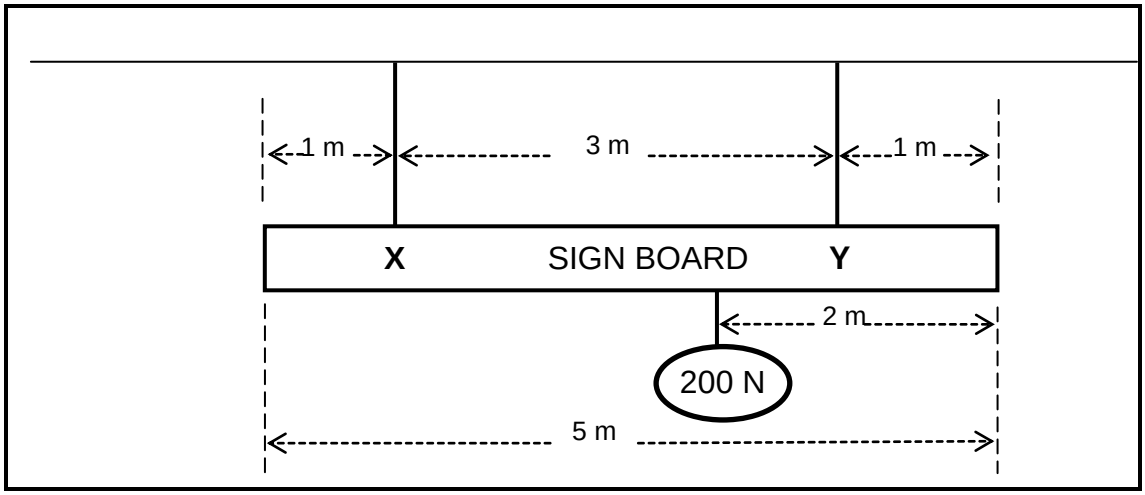
6.2.5 Which car is ahead at t = 20 s? (1)

[26]

QUESTION 7

7.1 State ONE condition for equilibrium parallel forces. (2)

7.2 A 5 m long signboard with a mass of 100 kg is suspended by two cables at points **X** and **Y** respectively. An object weighing 200 N hangs 2 m from the right end of the signboard.



7.2.1 Draw a labelled force diagram showing all the forces acting on the signboard. (4)

7.2.2 Calculate the tension in the cable at point **X**. (5)

7.2.3 Calculate the tension in the cable at point **Y**. (3)

7.3 A bolt on the flywheel of an engine is tightened by a spanner with a length of 20 cm. There are 20 threads in 1 cm on the bolt. Assuming that the efficiency of this screw is 20%.

Calculate:

7.3.1 Velocity ratio of the spanner-bolt machine

7.3.2 Actual mechanical advantage

7.3.3 Effort required for the bolt to exert a force of 200 N

(3 × 3) (9)

[23]

QUESTION 8

8.1 Explain how the following types of waves are produced:

8.1.1 Radio waves

8.1.2 Sound waves

(2 × 2) (4)

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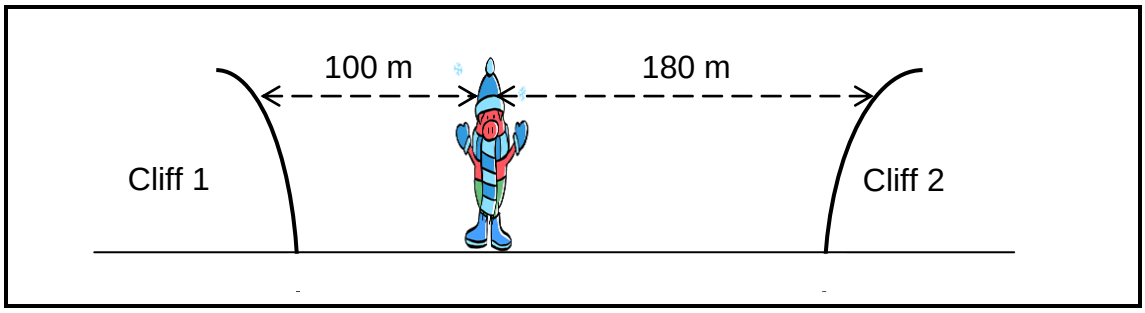
8.2 Define the following terms:

8.2.1 Loudness

8.2.2 Sound intensity

(2 × 2) (4)

8.3 Mishack stands between two cliffs as shown on the diagram below and claps his hands once. The sound produced has a frequency of 5 kHz.



Assume that the speed of sound in air is 340 $m \cdot s^{-1}$.

8.3.1 Calculate the wavelength of the sound wave produced by the clap of his hands. (3)

8.3.2 Mishack hears two echoes.

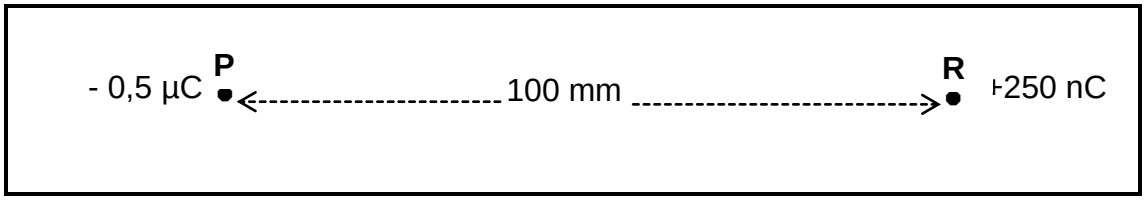
Determine the time lapse before Mishack hears the first echo. (3)

8.3.3 How far away from cliff 1 must Mishack position himself if he wishes to hear both the echoes at the same time? (2)

[16]

QUESTION 9

9.1 A negative point charge of 0,5 µC and a positive point charge of 250 nC are placed 100 mm apart at points P and R respectively.



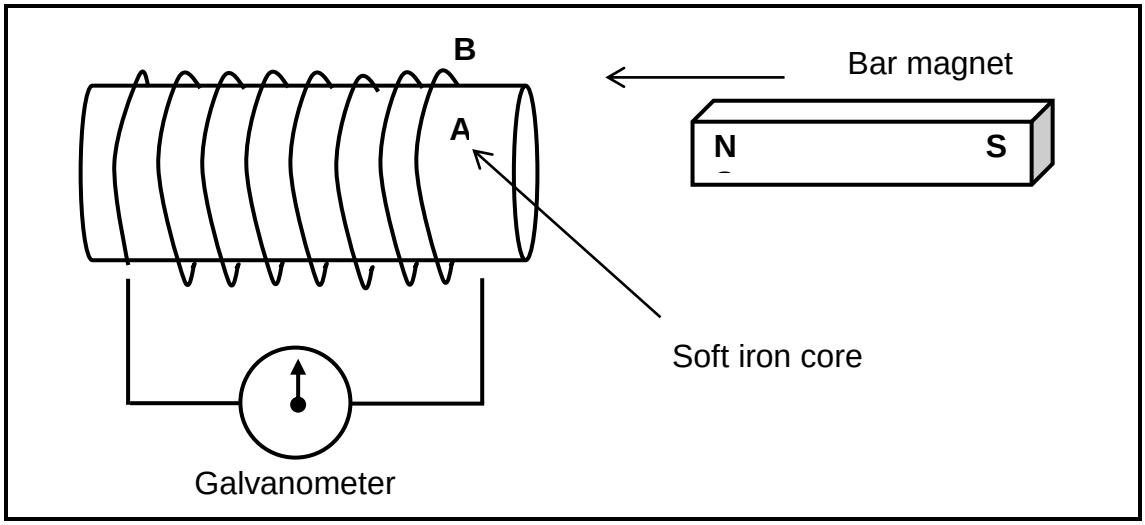
9.1.1 State Coulomb's law. (2)

9.1.2 Calculate the magnitude of the electrostatic force between the two point charges. (5)

9.1.3 What is the magnitude of the electric field strength at point R? (3)

9.2 A conductor is coiled around a soft iron core and then connected to a galvanometer.

The needle on the galvanometer deflects to the right when the north pole of a bar magnet approaches the soft iron core.



9.2.1 In which direction does the current in the coil flow? Choose from A to B or from B to A. (2)

9.2.2 Give an explanation for the answer to QUESTION 9.2.1. (3)

9.2.3 Will the needle on the galvanometer deflect to the RIGHT or LEFT if the north pole of the bar magnet was moved away from the soft iron core. (1)

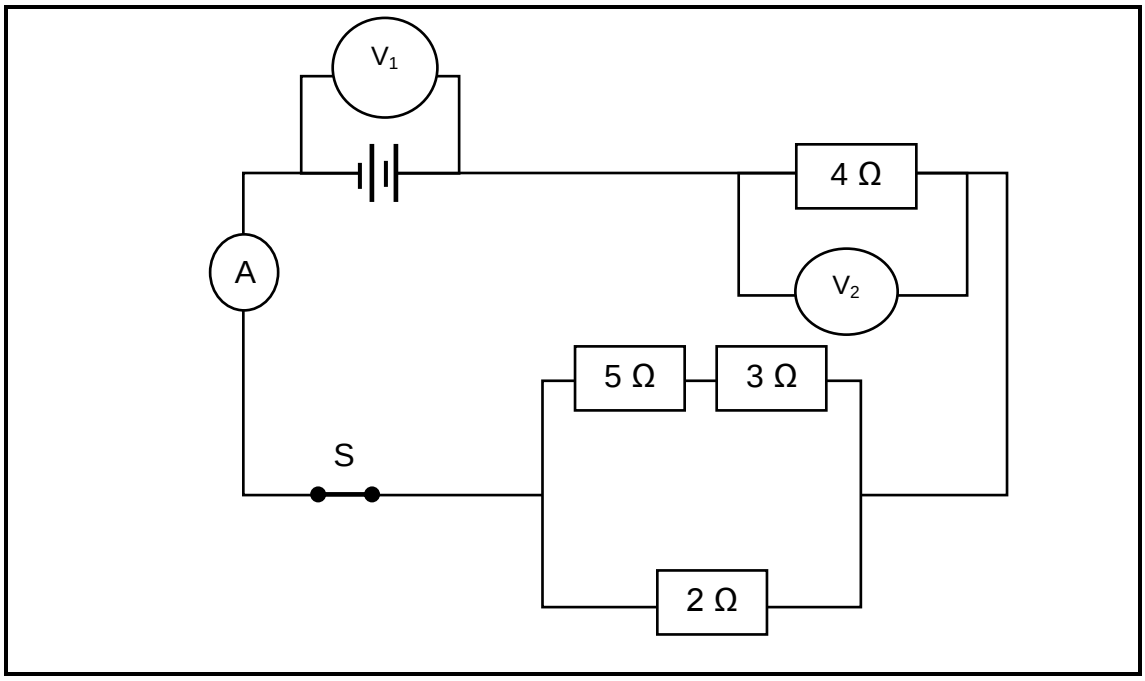
9.2.4 State TWO methods of increasing the size of the induced current. (4)

9.3 State TWO physical changes that may be made to a capacitor in order to double the quantity of charge that it can store. (4)

[24]

QUESTION 10

The battery in the circuit has an internal resistance of 0,6 Ω. The voltmeter (v_1) reads 8,4 V when the switch S is closed.



10.1 Calculate the total external resistance of the circuit. (4)

10.2 What is the ammeter reading? (3)

10.3 Determine the EMF of the battery. (4)

10.4 Calculate the reading on V_2. (3)

10.5 When switch S is open, what is the reading on:

10.5.1 V_1

10.5.2 V_2

(2 × 1) (2)

10.6 What will happen to the reading on V_2 if the 2 Ω resistor was removed? Will it INCREASE, DECREASE or REMAIN THE SAME? (1)

10.7 Give an explanation for the answer to QUESTION 10.6. (4)

[21]

TOTAL SECTION B: 115
GRAND TOTAL: 150

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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

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

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