Hillcrest High School

PHYSICAL SCIENCE P1

Nov 2024

Grade 10

MARKS: 120

TIME: 2 Hours

EXAMINER: Mrs M. Smith

MODERATOR: Mrs J. Knox-Whitehead
Ms N. Badenhorst

Instructions:

1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (20)
   SECTION B (100)
4. Answer SECTIONS A and B in the ANSWER BOOK.
5. Non-programmable calculators may be used.
6. Appropriate mathematical instruments may be used.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Data sheets are attached for your use.
9. Give brief motivations, discussions, et cetera where required.
10. Numbers must be rounded off to <u>two decimal</u> places

SECTION A - QUESTION 1: MULTIPLE CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only one correct answer. Write only the letter (A-D) next to the question number (1.1-1.10) in the answer book.

1.1 Red light of frequency ***f*** and wavelength ***λ*** shines on an object. The red light is then replaced by light of a higher energy. How do the frequency and wavelength of the light shining on the object now, compare with that of red light?

	frequency	**wavelength**
A.	greater than ***f***	remains the same (***λ***)
B.	less than ***f***	greater than ***λ***
C.	greater than ***f***	less than ***λ***
D.	remains the same (***f***)	less than ***λ***

1.2 The dimensions of four Ohmic conductors are given below.
Which conductor will have the greatest resistance?

A. length : 2m and diameter : 0,5 mm

B. length : 1m and diameter : 0,5 mm

C. length : 1m and diameter : 0,3 mm

D. length : 2m and diameter : 0,3 mm

1.3 The volt can be expressed as a:

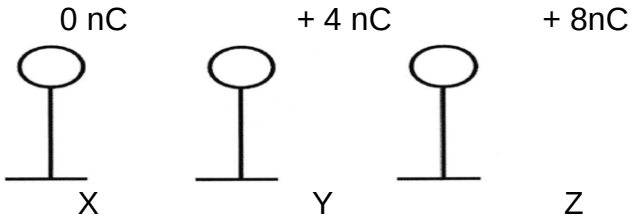
A. joule per coulomb

B. ampere per ohm

C. coulomb per second

D. ampere per second

1.4 Three metal spheres X, Y and Z, are placed on insulated stands.
They carry charges of 0nC, + 4nC and + 8nC respectively.



The greatest charge on X can be produced by touching X with :

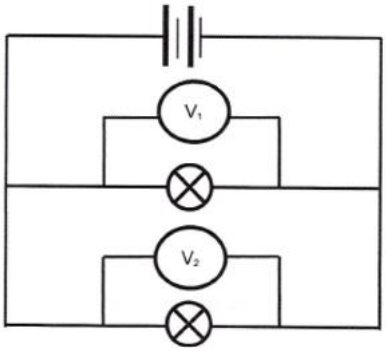
A. Y

B. Y and then Z

C. Z

D. Z and then Y

1.5 Two identical light bulbs are connected in parallel, as shown in the diagram below.
Voltmeters V_1 and V_2 are connected across the light bulbs



Which one of the following statements is correct?

A. $V_1 = 2\ V_2$

B. $V_1 = V_2$

C. $V_1 = ½\ V_2$

D. $V_1 = ¼\ V_2$

1.6 Which of the following contains two vector and one scalar quantity?

A. acceleration, mass, temperature

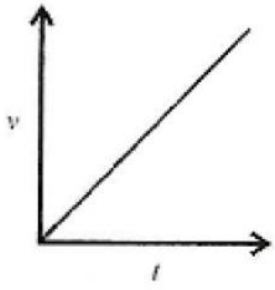
B. distance, displacement, speed

C. mass, force, distance

D. energy , acceleration, velocity

1.7 A car is travelling at a constant velocity along a straight road. It then travels down a steep hill where it speeds up uniformly. Which one of the velocity vs time graphs represents the motion of the car?

A



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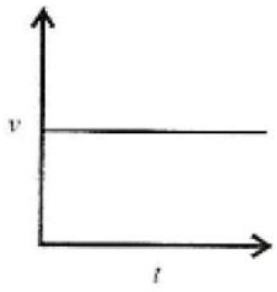
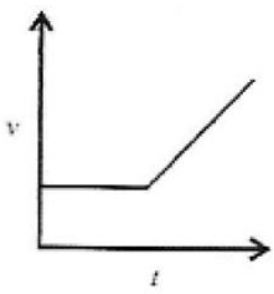
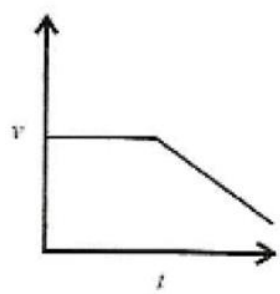


C



D



1.8 The table below shows the changes in the velocity of a car in intervals of 2 seconds.

Time (s)	0	2	4	6	8	10	12	14	16
Velocity ($m.s^{-1}$)	0	5	10	15	20	25	25	25	25

Which one of the following is CORRECT about the acceleration of the car?

The acceleration of the car…..

A. increases for 8 seconds the remains constant

B. remains constant for 8 seconds then becomes zero

C. remains constant for 10 seconds then becomes zero

D. increases for 10 seconds then becomes zero

1.9 An object of **mass m** is dropped from a balcony and strikes the ground with a **kinetic energy E**.

If another object of **mass 2m** is dropped from the same height, it will strike the ground with a kinetic energy equal to …

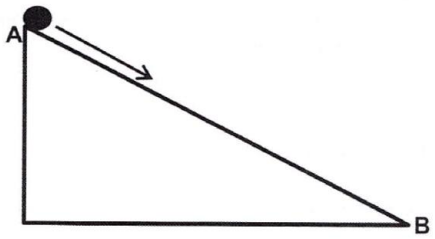
A. ¼ E

B. ½ E

C. E

D. 2E

1.10 An object is released from the top of a frictionless inclined plane, AB as shown below.



Which one of the following statements regarding the mechanical energy is correct ?

A. (Ek + Ep)A > (Ek + Ep)B

B. (Ek + Ep)A = (Ek + Ep)B

C. (Ek + Ep)A < (Ek + Ep)B

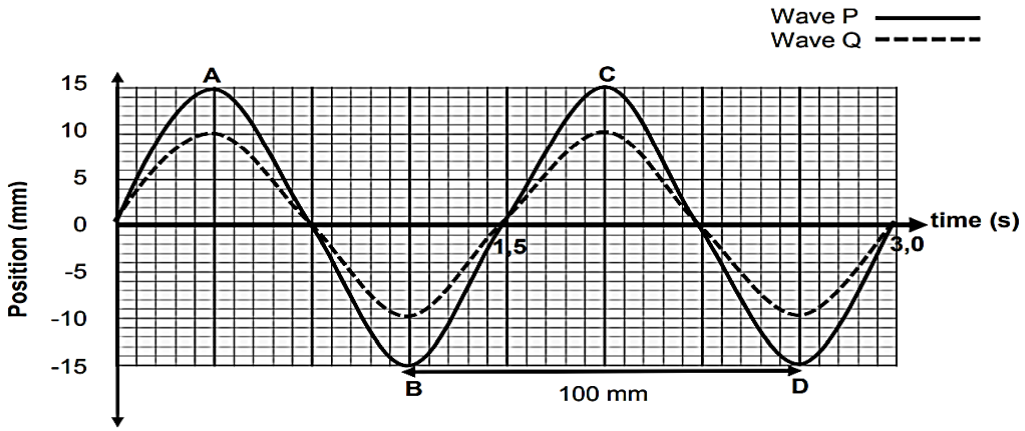
D. (Ek + Ep)A = - (Ek + Ep)B

TOTAL SECTION A (20)

SECTION B

QUESTION 2 **(7)**

The position vs time graph for two water waves, P and Q are shown below.



2.1 Calculate the

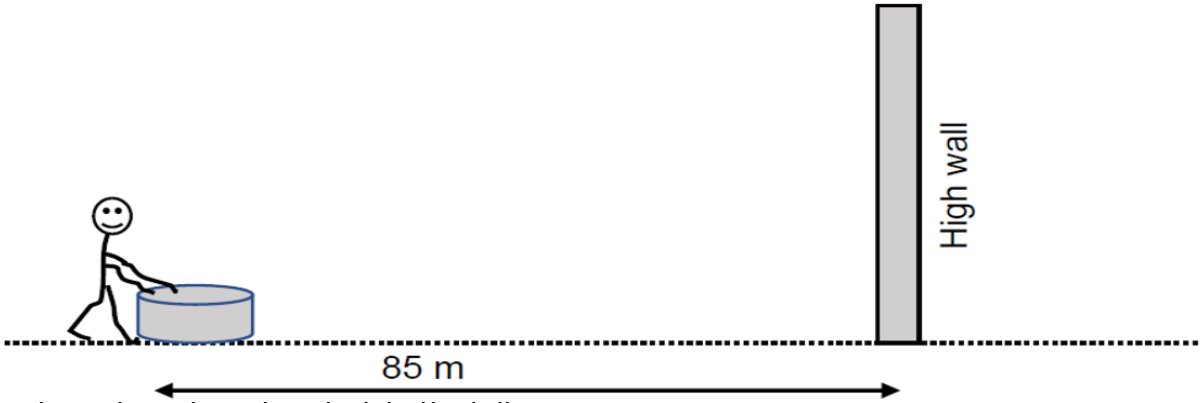
2.1.1 frequency of wave P. (2)

2.1.2 speed of wave P. (3)

2.2 Wave P and Wave Q are superimposed on each other.
State the amplitude of the new wave that forms. (2)

QUESTION 3 **(6)**

Thembi stands 85m from a high wall while she is beating a drum. She notices that the echo of each beat coincides (matches) exactly with the next beat of the drum if she strikes the drum every 0,5 s.



Use the information above to calculate the following.

3.1 The speed of sound in air. (3)

3.2 The wavelength of the sound waves, if the drumskin vibrates with a frequency of 100 Hz. (3)

QUESTION 4 **(5)**

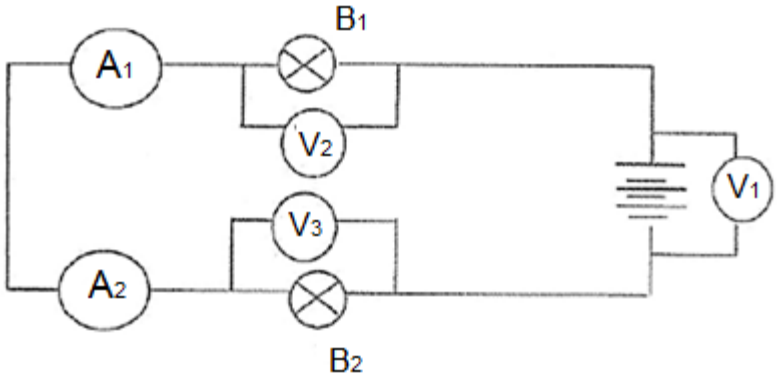
4.1 Calculate the energy of a photon of gamma radiation if it has a wavelength of 1×10^{-6} m (4)

4.2 Describe one use for gamma radiation in the medical industry. (1)

QUESTION 5 **(8)**

Consider the circuit below.

The reading on V_1 is 12V.



5.1 How are the light bulbs B_1 and B_2 connected? (Choose **series / parallel**).
Explain your answer. (2)

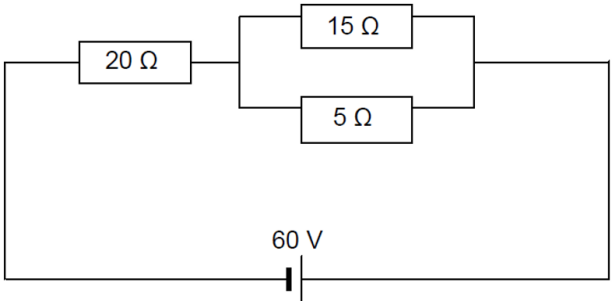
5.2 The resistance of B_2 is twice the resistance of B_1. The total resistance of the circuit is 3Ω.
Calculate

5.2.1 total the current in the circuit (3)

5.2.2 the resistance of B_2 (3)

QUESTION 6 **(10)**

Consider the electrical circuit below and answer the questions that follow.



The combined resistance of the parallel resistors is 3,75 Ω

Calculate

6.1 the total current flowing in the circuit. (4)

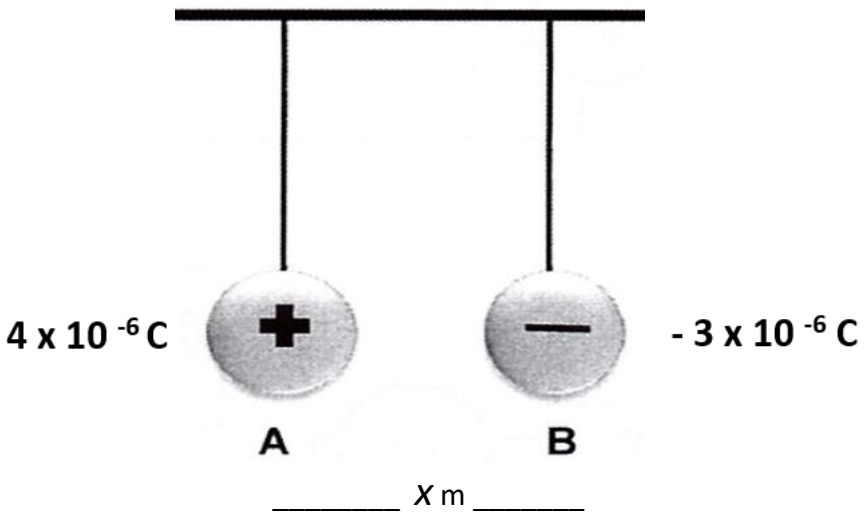
6.2 the voltage across the 5 Ω resistor. (3)

6.3 the energy transferred to the 20 Ω in 2 minutes. (3)

QUESTION 7 **(14)**

Two small identical spheres A and B are suspended by silk threads as shown in the diagram below.

The spheres carry a charge of 4×10^{-6} C and -3×10^{-6} C respectively.



7.1 If a force of magnitude 10,8 N exists between the spheres, calculate the distance ***X*** between their centres. (4)

Sphere A is now brought into contact with sphere B, and the two spheres are then separated.

7.2.1 In which direction did electrons move? (State A to B or B to A). (1)

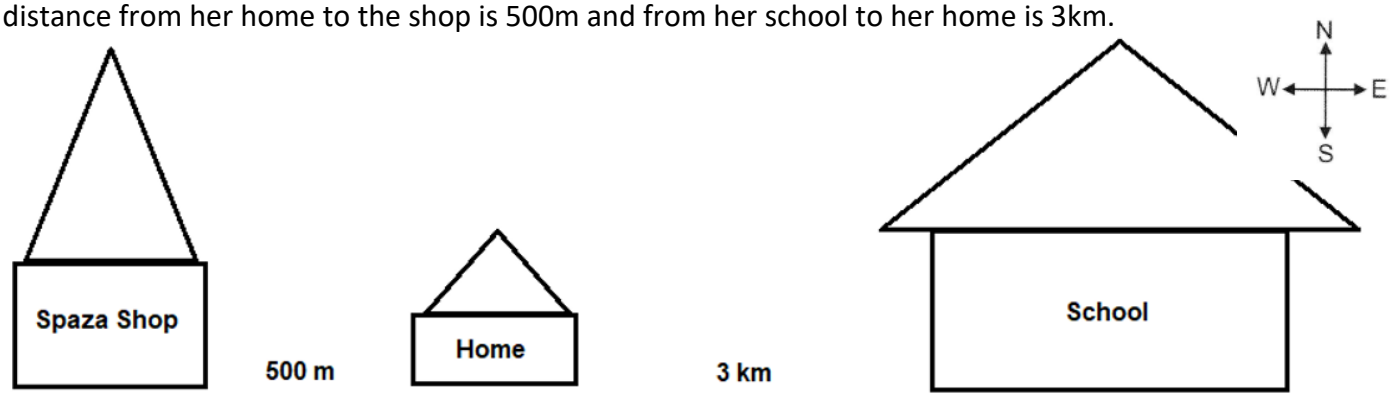
Calculate

7.2.2 the new charge on each of the spheres. (3)

7.2.3 the number of electrons transferred during contact. (6)

QUESTION 8 **(5)**

In the morning, Lucy first walks West, from her home, to the Spaza shop to buy air time and then she walks to school.
The distance from her home to the shop is 500m and from her school to her home is 3km.



8.1 What was Lucy's displacement that morning? (2)

8.2 If it takes Lucy 90 minutes to reach school, calculate her average velocity for the walk. (3)

QUESTION 9 **(7)**

A car is moving at a velocity of 20 $m.s^{-1}$ on a straight road when it approaches a stop sign up ahead.
It slows down uniformly, coming to rest in a distance of 100m.

9.1 Define the term '*acceleration*'. (1)

9.2 Calculate the car's acceleration. (3)

9.3 Calculate the time it took the car to come to rest. (3)

QUESTION 10 **(6)**

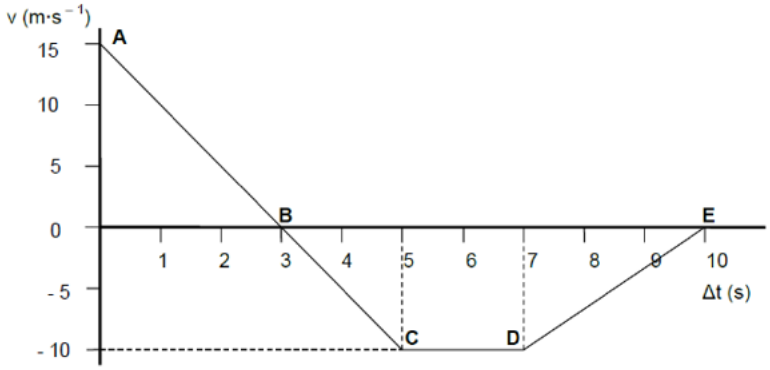
A plane lands at King Shaka airport with a touch down speed of 288 km.h$^{-1.}$
The plane is decelerating at 3 m.s^{-2} when the pilot sees a baby elephant step onto the runway at a distance of 1000m up ahead.

10.1 Show that the touch down speed of the plane is 80 m.s^{-1} . (2)

10.2 Will the plane be able to stop in time to avoid killing the baby elephant? Show your working. (4)

QUESTION 11 **(19)**

The graph below shows the changing velocity of an object over a 10s period. The object was initially moving in a **Northerly direction**.



Using only the graph above, answer the following questions.

11.1 Write down the initial velocity of the object (2)

11.2 In which direction is the object moving from C to D? (1)

11.3 What can you say about **magnitude** of the acceleration of the object from A to B compared with its acceleration from B to C? (**Choose increase / decreases / stays the same**). (1)

11.4 For how many seconds did the object move South? Show your working (2)

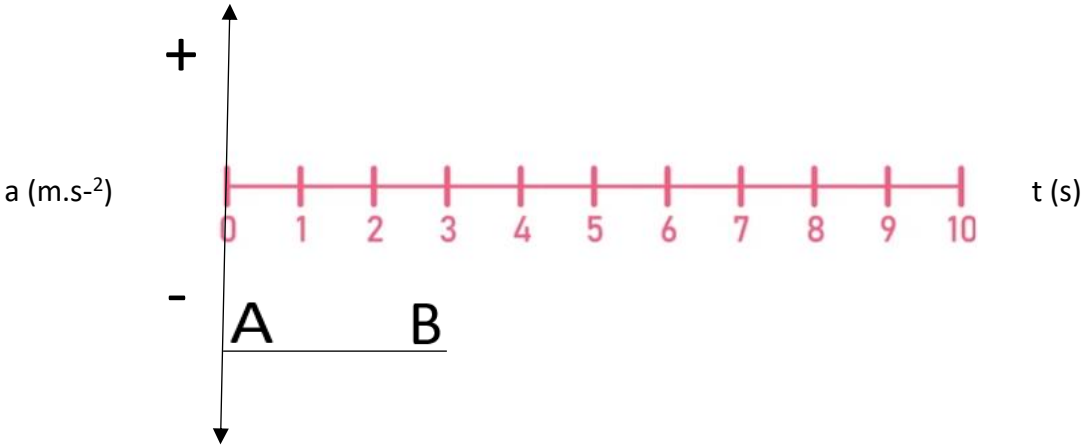
11.5 Using only the graph (and **NOT** the equations of motion)

11.5.1 determine the distance that the object moved during the first 5 seconds, and (5)

11.5.2 the total displacement covered by the object during the first 5 seconds. (2)

11.5.3 the magnitude of acceleration of the object from point D to E. (3)

11.6 Copy the corresponding **acceleration vs time** graph onto your answer sheet.



On the graph, show the motion of the above object moving from B to E, clearly indicating points BC, CD and DE showing their positions accurately on the x axis only and thus the **shape** of the graph. (3)

QUESTION 12 **(3)**

A motor cyclist is racing along a straight road with a kinetic energy of 312 500J .
The mass of the bike, rider and fuel is 250kg.

Calculate the velocity at which the bike is moving. (3)

QUESTION 13 **(10)**

A builder places a 2kg hammer on the top of a ladder which is 4m above the ground.

13.1 Calculate the gravitational potential energy of the hammer while it is on the ladder. (3)

13.2 The hammer then slips and falls to the ground.
Calculate the gravitational potential energy of the hammer 1 m above the ground. (2)

13.3 Use the Law of Conservation of Energy to determine the kinetic energy of the hammer when it is 1 m above the ground. (5)

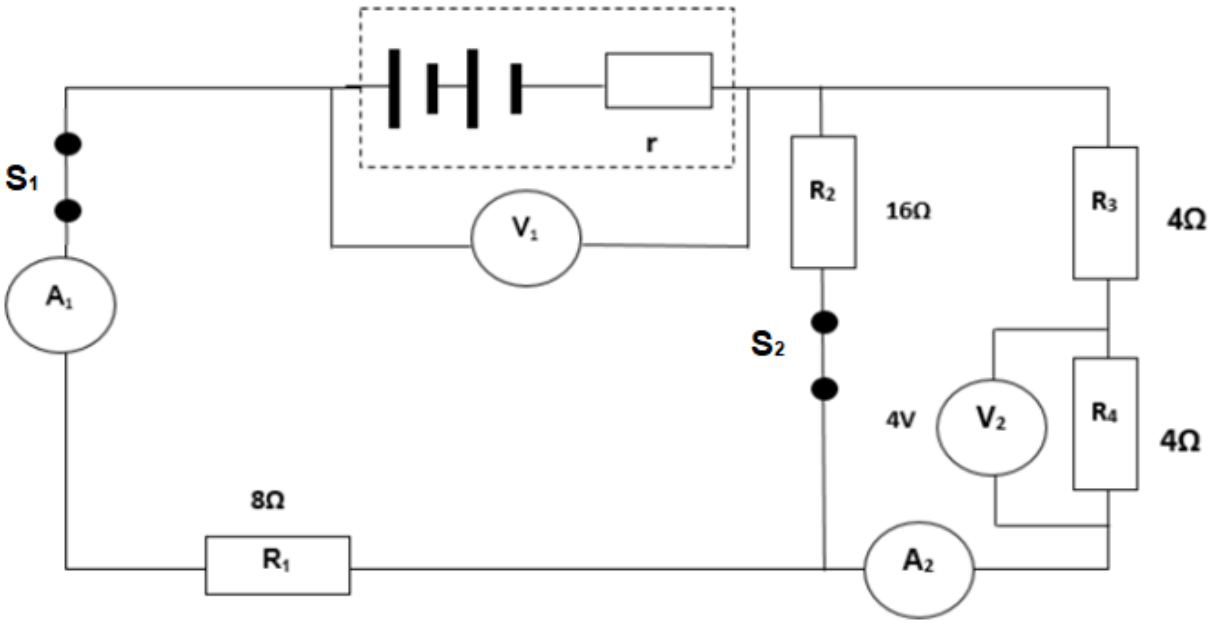
GRAND TOTAL (120)

EXTENTION QUESTION for Miss Badenhorst's class only

Only attempt this question if you are absolutely sure that you have completed questions 1-13.

Question 14

The battery has an emf of 24V in the circuit shown below. When switch **S_1 and S_2** are closed, the reading on **V_1** is 20V and the reading on **V_2** is 4V. The resistance of the different resistors are shown in the diagram. The resistance of the ammeter and connecting wires can be ignored.



If switch S_1 is open (while S_2 remains closed)

State the reading on the following:

4.2.1 V_1

4.2.2 A_1 (2 x 1 = 2)

Both switches are now closed

4.3 Calculate the internal resistance of the battery. (9)

[11]

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)
TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Speed of light in a vacuum	c	$3,0 \times 10^8$ m·s^{-1}
Speed of sound in air	$v_{(air)}$	340 m.s^{-1}
Speed of sound in water	$v_{(water)}$	1500 m.s^{-1}
Planck's constant	h	$6,63 \times 10^{-34}$ J.s
Charge on electron	e^-	-1.6×10^{-19} C
Coulomb's constant	k	9×10^9 N. m^2 C^{-2}
Gravitational acceleration	g	9,8m.s^{-2}

FORMULAE MOTION

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$	$v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

FORMULAE WAVES, LIGHT AND SOUND

$v = f\lambda$	$T = \frac{1}{f}$	$E = hf$ $\quad E = h\frac{c}{\lambda}$
$\Delta x = v\Delta t$		$c = f\lambda$

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\,\Delta t$
W = Vq W = VIΔt W= $I^2R\,\Delta t$ W= $\frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ P = VI P = I^2R P = $\frac{V^2}{R}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$

WORK, ENERGY AND POWER

$E_k = \frac{1}{2}mv^2$

$E_P = mgh$