ALEXANDER ROAD HIGH SCHOOL

NOVEMBER 2020 180 MIN

PHYSICAL SCIENCES EXAMINATION

MH, PE TOTAL = 150

GRADE 10

Instructions

- The question paper consists of 11 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided AND section B and C on folio sheets.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system.
- Round off to two (2) decimal places where necessary.
- A formula sheet has been provided at the end of the question paper.
- A periodic table has been provided on the back of the answer sheet.

SECTION A

- Answer on the answer sheet -

QUESTION 1: Multiple choice

Four possible options are provided as answers to the following questions. Each question has only 1 correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.10) on the answer sheet.

1.1 Which ONE of the following pairs of quantities are BOTH scalar quantities?

A. Force and direction
B. Displacement and distance
C. Time and speed
D. Acceleration and displacement

1.2 If an object moves 25 m north, then 20 m at a bearing of 30° and finally 30 m to the west, then the correct tail-to-head diagram for the entire motion of the object is…

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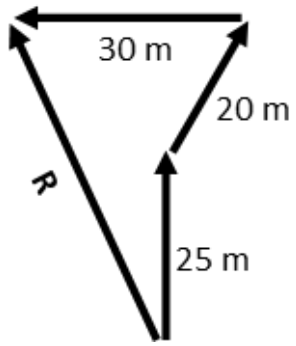
<tr>
<td>A.
 
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 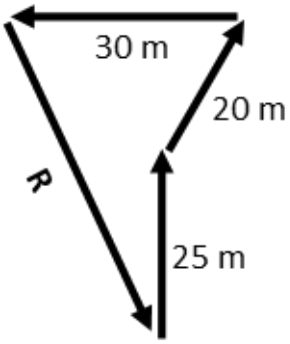
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 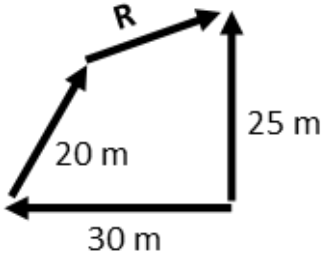
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 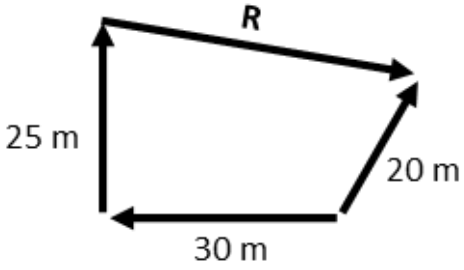
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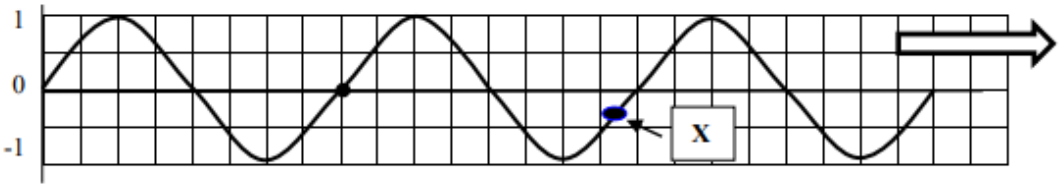
1.3 The wave form is moving from left to right (in the direction of the arrow).



In which direction is point X about to move?

A. ↓

B. ↑

C. ↙

D. ↗

1.4 The equivalent UNITS for current strength and potential difference are:

	Current Strength	Potential Difference
A	I	V
B	C.s	J.C
C	V	A
D	$C.s^{-1}$	$J.C^{-1}$

1.5 A car with a constant acceleration is moving with …

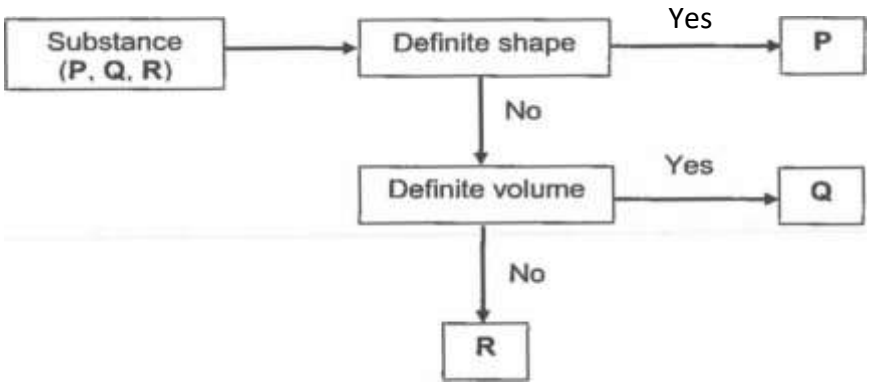
A. a velocity that never changes.
B. increasing or decreasing velocity.
C. randomly changing velocity.
D. randomly changing velocity always in a positive direction.

1.6 Which ONE of the following symbols of atoms and ions have the same number of valence electrons?

1. Na^{+} 2. Mg^{2+} 3. Ar 4. O^{2-}

A. 1 & 2
B. 3 & 4
C. 1, 2 & 3
D. All of them

1.7 A learner used the flow chart below to classify some examples of substances P, Q and R



The substance could be respectively

	P	**Q**	**R**
A	air	sand	water
B	sand	water	air
C	sand	air	water
D	water	sand	air

1.8 The term used for the phase change from solid to gas is:

A. Evaporation

B. Condensation

C. Sublimation

D. Boiling

1.9 Which ONE of the following electron configurations represents a halogen?

A. $1s^2$

B. $1s^2\ 2s^2$

C. $1s^2\ 2s^2\ 2p^5$

D. $1s^2\ 2s^2\ 2p^6\ 3s^1$

1.10 In a 20 g sample of molecules, which sample below has the greatest number of moles?

A. H_2
B. N_2
C. CO_2
D. NH_3

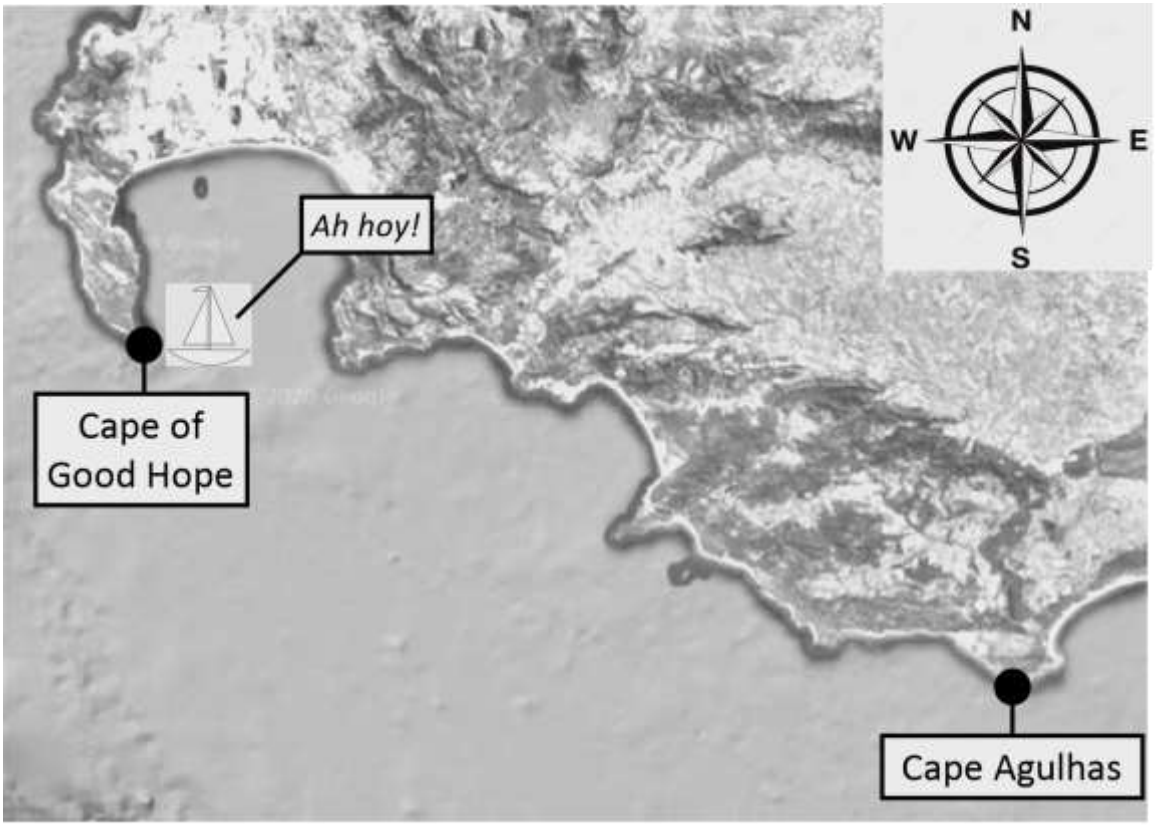
TOTAL SECTION A [20]

SECTION B - PHYSICS

-Answer on folio paper-

QUESTION 2:

A fisherman wants to sail from the tip of the Cape of Good Hope to Cape Agulhas (the southern-most tip of Africa). On the day he sets sail, the ocean current is pushing the ship with a force of 350 N east whilst the wind is also pushing the boat with a force of 850 N east.



2.1 Define the term *vector*. (1)

2.2 Calculate the resultant force exerted on the boat by the ocean current and the wind. Label the resultant force as $F_{weather}$. (2)

2.3 In order to counter the effects of the ocean current and the wind, the fisherman sails due south. The motor of the boat produces a force of 3 500 N in magnitude.

2.3.1 Sketch a vector diagram showing the force of the weather ($F_{weather}$), the force of the boat's motor (F_{motor}) and the resultant force acting on the boat ($F_{resultant}$). It is **not** necessary to draw your diagram to scale. (3)

2.3.2 Determine the **magnitude and bearing** of $F_{resultant}$. (3)

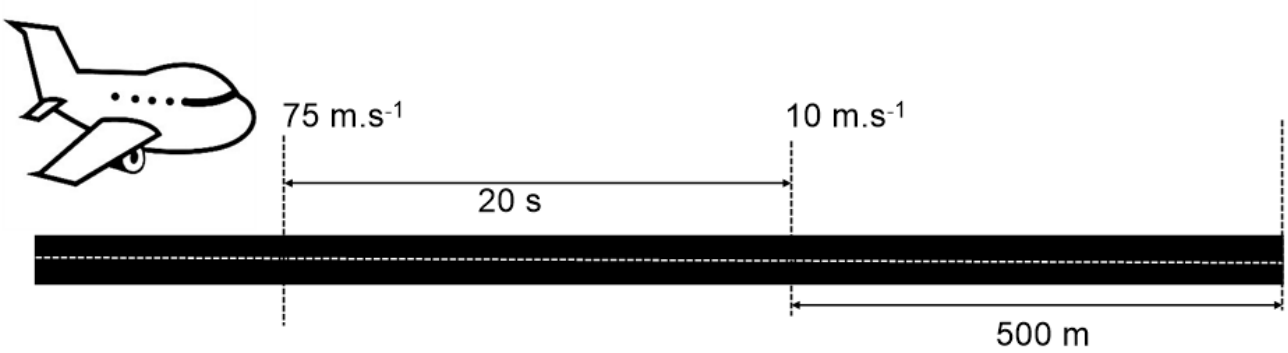
2.4 According to the fisherman's calculations the bearing of the boat needs to be 130° for him to reach Cape Agulhas. Based on your answer in question 2.3.2, what can the fisherman do to achieve this bearing? (1)

[10]

QUESTION 3:

An aeroplane comes in to land in an easterly direction. The aeroplane touches down on the runway at a velocity of 75 $m.s^{-1}$. After 20 s the velocity of the aeroplane is 10 $m.s^{-1}$.

The aeroplane then continues at a CONSTANT VELOCITY for a further 500 m before leaving the runway.



3.1 Define the term *velocity*. (2)

3.2 Convert 75 $m.s^{-1}$ to $km.h^{-1}$. (1)

3.3 Calculate the acceleration of the aeroplane during the first 20 s. (3)

3.4 Calculate the total time the aeroplane spends on the runway. (4)

3.5 Draw the acceleration vs time graph for the aeroplane while it is on the runway. (5)
Label the axis and indicate all relevant coordinates.
Use easterly as positive.

3.6 Which physical quantity is represented by the area under the graph drawn in 3.5? (1)

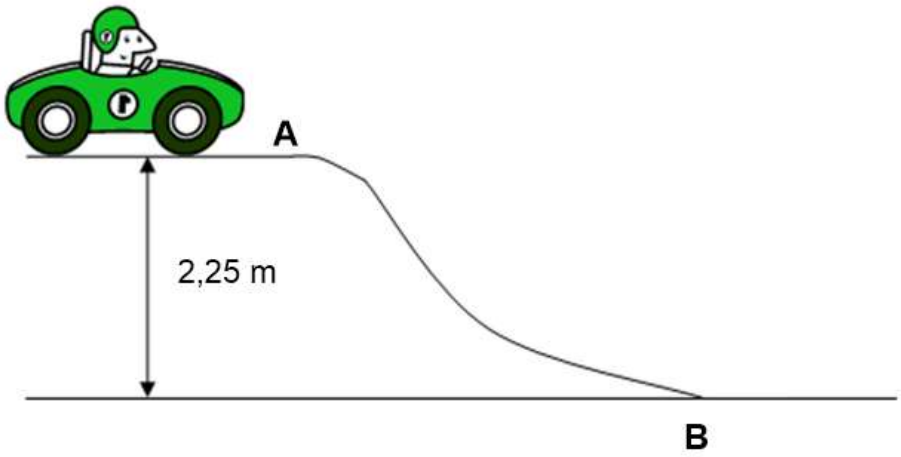
[16]

QUESTION 4:

Looking for something to do during Lockdown, two friends decide to determine the relationship between potential energy and kinetic energy at different heights.

They place a toy car of mass 0,150 kg, on a ramp, 2,25 m high. They push the car and it reaches point A at a speed of 5 $m.s^{-1}$ before it rolls down the ramp to point B at the bottom of the ramp.

Ignore friction.



4.1 Calculate the gravitational potential energy of the car at point A. (3)

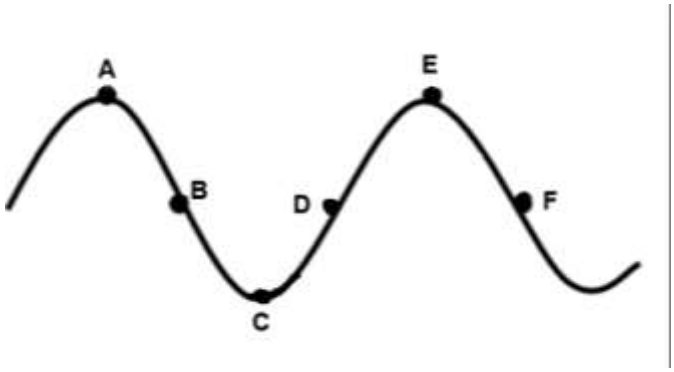
4.2 Determine the kinetic energy of the car at point A. (3)

4.3 Determine the maximum speed the car will reach. (4)

[10]

QUESTION 5:

5.1 Study the transverse wave below and answer the following questions.

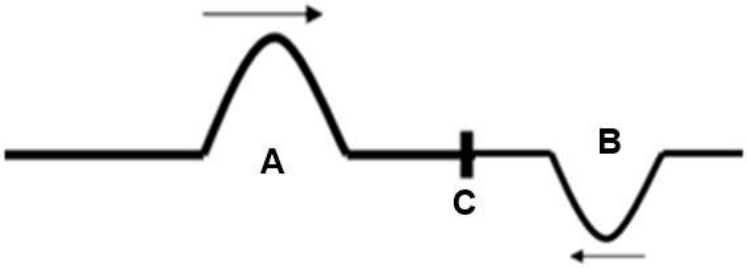


5.1.1 Write down ONE letter that indicates a trough. (1)

5.1.2 The distance between B and which other letter indicates one wavelength? (1)

5.1.3 Write down the letters of ANY two points which are OUT of phase. (1)

5.2 Two pulses, A and B, move towards each other at the same speed. The amplitude of pulse A is 3 cm and the amplitude of pulse B is 2 cm. The pulses meet each other at C.



5.2.1 Name the type of interference that occurs at C. (1)

5.2.2 Make a labelled sketch to show the resultant pulse at C. Indicate the amplitude of the resultant pulse in cm. (2)

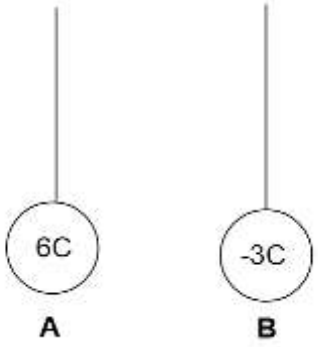
5.3 A wave machine produces 15 waves per minute on the surface of the water. What is the frequency of the waves? (2)

5.4 A man stands between two high cliffs. He finds that when he claps his hands, he hears the echo from the one cliff after 2 s and the echo from the other cliff after 4 s.
Calculate the distance between the two cliffs if the speed of sound in the air is 340 $m.s^{-1}$. (5)

[13]

QUESTION 6:

Consider the diagram below that depicts two graphite covered polystyrene balls suspended from cotton threads. Ball A has a net positive charge of 6 C and ball B has a net negative charge of 3 C.



6.1 State the *Law of Conservation of Charge*. (2)

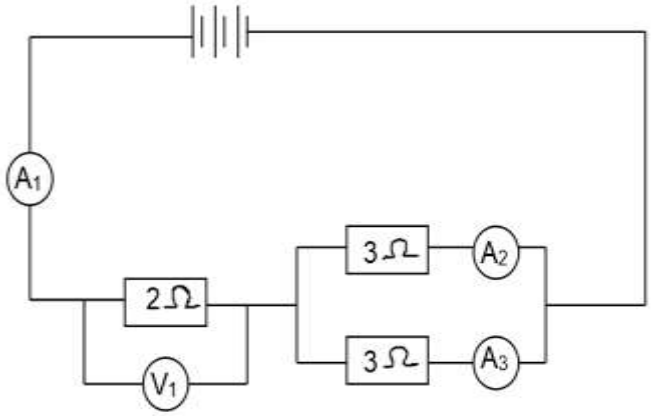
6.2 Calculate the net charge on each ball after they touch and then separate. (2)

6.3 Calculate the number of electrons that was transferred. (3)

[7]

QUESTION 7:

A 10 V battery is connected to a circuit with one 2 Ω and two identical 3 Ω resistors connected as shown.



7.1 Calculate the total resistance in the circuit. (3)

7.2 Calculate the reading on A_1. (3)

7.3 Calculate the reading on V_1. (3)

7.4 Calculate the energy transferred to the 2 Ω resistor in one minute. (5)

[14]

TOTAL SECTION B [70]

SECTION C – CHEMISTRY

-Answer on folio paper-

QUESTION 8:

8.1 Consider the following symbol $^{23}_{11}Na$

8.1.1 Given the numbers of sub-atomic particles in its atoms and the charges of each. (3)

8.1.2 What are the charges of the sub-atomic particles? (1)

8.2 In a sample of chlorine, the following two isotopes $^{35}_{17}Cl$ and $^{37}_{17}Cl$ exist in the proportions of 70% and 30% respectively. Calculate the relative atomic mass of chlorine in the sample. (3)

8.3.1 Define the term “ionization energy”. (2)

8.3.2 How does the first ionization energy of Lithium compare to that of Sodium? (2)

8.3.3 Give a reason for your answer in 8.3.2 above. (2)

[13]

QUESTION 9:

9.1 Consider the elements sodium and chlorine and the compound they form, sodium chloride.

9.1.1 Show the Aufbau diagram of chlorine. (2)

9.1.2 Show the Lewis notation for sodium, chlorine and their compound sodium chloride. (4)

9.1.3 What type of bonding occurs between these elements in the compound? (1)

9.1.4 What type of bonding occurs between the sodium atoms in the element? (1)

9.1.5 Draw two labelled diagrams showing the structure of the crystal lattices in each of:
a) Sodium and
b) Sodium Chloride.
(Include between 9 - 12 'atoms' in each diagram. Annotation must include the charges and names of parts of the drawing) (4)

9.1.6 Give two physical properties of each of these substances: sodium and sodium chloride that differ from each other. (4)

9.2. Show the Lewis of the water molecule. (1)

[17]

QUESTION 10:

10.1 Write chemical formulae for the following compounds:

10.1.1 Ammonium carbonate. (2)

10.1.2 Magnesium nitrate. (2)

10.1.3 Hydrogen sulphide. (2)

10.2 Write the name of the following formula using, also the stock notation:
$Fe_2(SO_4)_3$ (2)

10.3 Balance the following equations:

10.3.1 $N_2 + H_2 \rightarrow NH_3$ (2)

10.3.2 $Cu + HNO_3 \rightarrow H_2O + NO_2 + Cu(NO_3)_2$ (2)

10.4 Given the following word equation write a balanced equation using formulae: Sodium hydroxide plus sulphuric acid reacts to form water plus sodium sulphate. (3)

[15]

QUESTION 11:

11.1 Define the chemistry concept of a "mole" (2)

11.2 Consider 13 g of magnesium reacting with an excess of HCl according to the following balanced chemical equation:

$$2HCl_{(aq)} + Mg \rightarrow H_{2(g)} + MgCl_{2(aq)}$$

11.2.1 What is the common name for $HCl_{(aq)}$? (1)

11.2.2 Calculate the mass of $MgCl_2$ formed. (4)

11.2.3 Calculate the volume of hydrogen gas formed at STP. (3)

11.2.4 a) What does the acronym STP stand for? (1)

b) Why does STP have to be stipulated in question 11.2.3 above? (1)

11.3 What is the percentage composition by mass of Mg in $MgCl_2$? (3)

[15]

TOTAL SECTION C [60]

Formula Sheet

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	$6,63 \times 10^{-34}$ J.s
Charge on electron	e	$-1,6 \times 10^{19}$ C
Electron mass	m_e	$9,11 \times 10^{-31}$ kg
Avogadro's constant	N_A	$6,02 \times 10^{23}$ mol^{-1}
Standard pressure	p^θ	$1,013 \times 10^5$ Pa
Molar gas volume at STP	V_m	22,4 $dm^3.mol^{-1}$
Standard temperature	T^θ	273 K

Formulae:

MOTION

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

WORK, ENERGY AND POWER

$E_p = mgh$	$E_k = \frac{1}{2}mv^2$
$E_M = E_k + E_p$	

WAVES, SOUND AND LIGHT

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf \quad or \quad E = \frac{hc}{\lambda}$	

ELECTROSTATICS

$Q = \frac{Q_1 + Q_2}{2}$	$n = \frac{Q}{e}$

ELECTRIC CIRCUITS

$Q = I\,\Delta t$	$V = IR$
$V = \frac{W}{Q}$	$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$
$R_S = R_1 + R_2 + \cdots$	

CHEMISTRY

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$n = \frac{V}{V_m}$	$c = \frac{n}{V} \quad \text{or} \quad c = \frac{m}{MV}$