education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: PHYSICS
PAPER 1

COMMON TEST

SEPTEMBER 2018

MARKS: 150

TIME: 2 hours

This question paper consists of 13 pages and 1 data sheet.

INSTRUCTIONS AND INFORMATION

1. Write your name and class (for example 10A) in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You are advised to use the attached DATA SHEETS.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your final answers to a minimum of TWO decimal places.
9. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions.
Each question has only ONE correct answer. Choose the answer and write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK, for example 1.11 E.

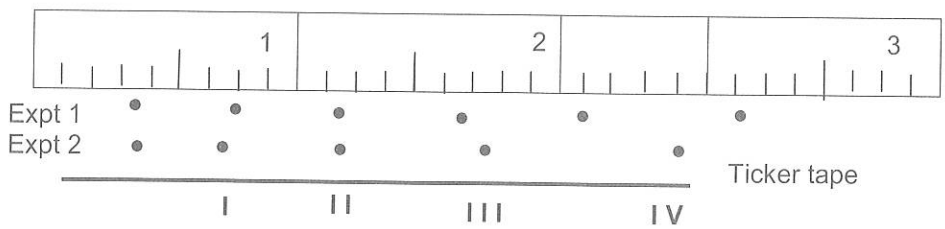
1.1 Which ONE of the following pairs of physical quantities consists of two scalars? (2)

A Speed and acceleration
B Distance and speed
C Displacement and velocity
D Velocity and acceleration

1.2 A motorbike moving at a speed v, has a kinetic energy E. If the speed of the motorbike decreases to $\frac{1}{2}v$, the kinetic energy will be : (2)

A $\frac{1}{2}E$
B $2E$
C $4E$
D $\frac{1}{4}E$

1.3 The diagram below shows the series of dots left by a trolley in two experiments in which its motion was being investigated with ticker tape. The frequency of the ticker timer is the same in both experiments.

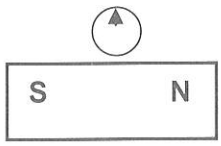


At which point did the trolley have the same instantaneous velocity for both experiments? (2)

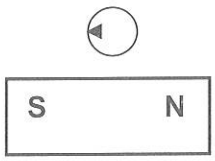
A I
B II
C III
D IV

1.4 The pointer ⊕ on a compass is the north pole of a small magnet. If a compass was placed next to a bar magnet, as shown below, what will be the correct direction of the pointer?

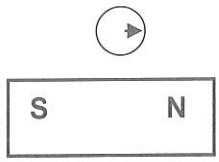
A



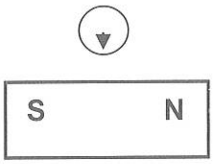
B



C



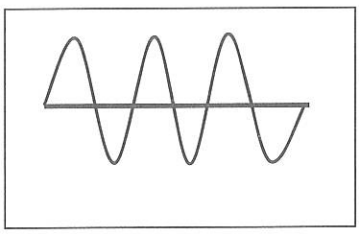
D



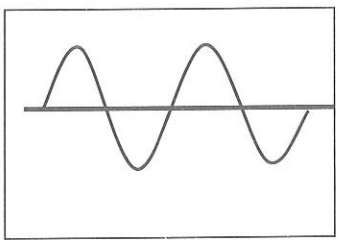
(2)

1.5 The following are waveforms for different sounds.
Which one has the HIGHEST PITCH?

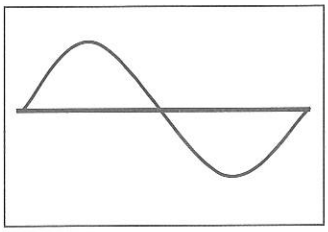
A



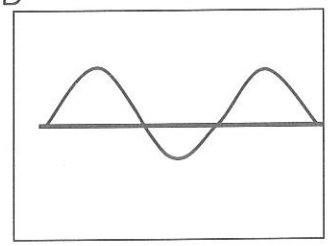
B



C



D



(2)

1.6 In a wave motion two complete wave cycles are made in $2x$ seconds. What will be the period and frequency of this wave?

	Period(s)	Frequency (Hz)
A	x	$2x$
B	x	$\frac{1}{x}$
C	x	$\frac{1}{2x}$
D	$2x$	$\frac{1}{2x}$

(2)

1.7 A photon of an electromagnetic wave having the HIGHEST ENERGY will have the:

A longest wavelength and highest frequency
B longest wavelength
C shortest wavelength and highest frequency
D lowest frequency

(2)

1.8 Consider the following statements regarding voltmeters:

(I) Voltmeters are always connected in parallel
(II) Voltmeters connected across equal resistors that are in parallel, will give the same reading.
(III) When a switch in a circuit is closed, a voltmeter connected across a battery reads the EMF of the battery
(IV) Voltmeters have very high resistance

Which of the above statements are TRUE?

A I , II and III
B II, III and IV
C I, III and IV
D I, II, III and IV

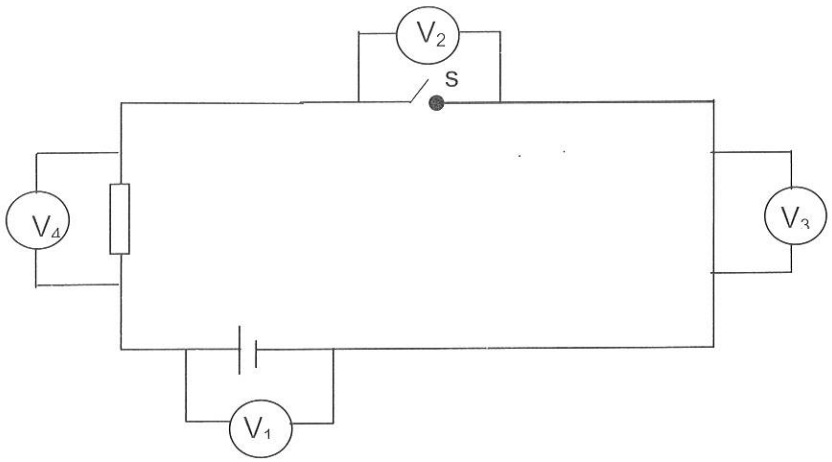
(2)

1.9 The resistance of a conductor is NOT dependent upon:

A The length of the conductor
B The thickness of the conductor
C The strength of the current flowing through the conductor
D Type of conductor

(2)

1.10 In the circuit below, the emf of the battery is 6 V.



Which voltmeter reading is INCORRECT when the switch is opened, as shown?

A $V_1 = 6\ V$
B $V_2 = 0$
C $V_3 = 0$
D $V_4 = 0$

(2)
[20]

QUESTION 2

2.1 A 10 kg block has three forces of magnitude *3 N* each acting on it in a STRAIGHT LINE.

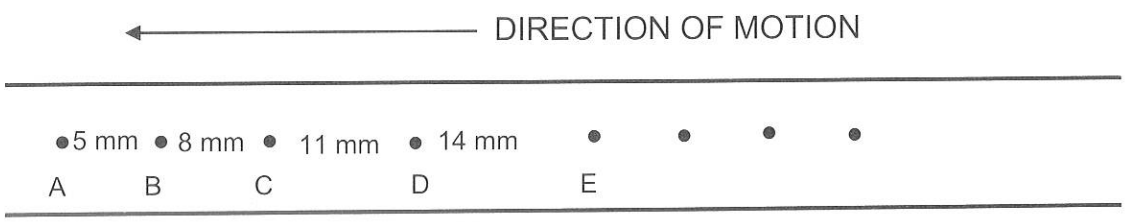
2.1.1 Define *resultant vector*. (2)

2.1.2 Calculate the magnitude of the maximum resultant force. (2)

2.1.3 Calculate the magnitude of the minimum resultant force. (2)

2.2 A trolley is placed on a sloping runway. The trolley moves down the slope at a constant acceleration.

A ticker tape is connected to the trolley and is pulled through a ticker timer when the trolley moves. The frequency of the timer is 50 Hz. The tape produced is represented below:



2.2.1 Determine the period of the timer. (1)

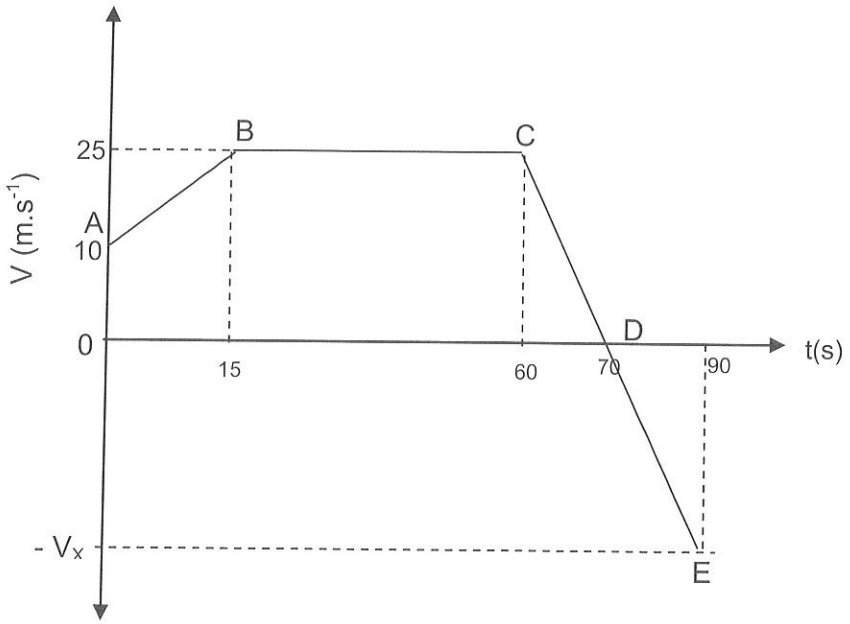
2.2.2 Calculate average velocity of the trolley for the interval A - C. (3)

2.2.3 After how long will the trolley reach point E? (2)

2.2.4 Describe the motion of the trolley after it passes point E. (2)
[14]

QUESTION 3

The velocity-time graph below is for the motion of a car along a straight road.
The car is initially travelling NORTHWARDS.



3.1 Describe, in words, the motion of the car from B to C. (2)

3.2 Define *acceleration*. (2)

3.3 Calculate the acceleration of the car for the interval:

3.3.1 AB (3)

3.3.2 CD (2)

3.4 What happened to the car at point D? (2)

3.5 Using the graph only (NOT equations of motion) determine the displacement of the car over the 70 second period. (4)

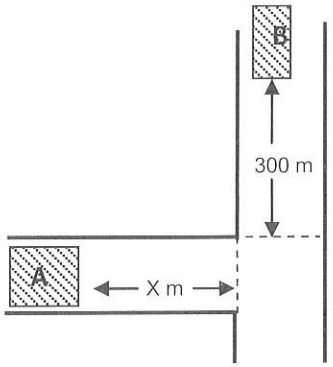
3.6 Determine V_X (magnitude and direction) as shown on the graph. (4)

3.7 Sketch an acceleration-time graph for the car over the entire journey. Indicate all relevant acceleration and time values. (5)

[24]

QUESTION 4

Two cars A and B, approach an intersection as shown. Car A is travelling at a constant velocity of 30 $m.s^{-1}$. When car B is 300 m from the intersection its velocity is 20 $m.s^{-1}$ At the same time, car A is 'x' metres away from the intersection.



4.1 How long will it take car B to reach the intersection if its acceleration is 2 $m.s^{-2}$. (4)

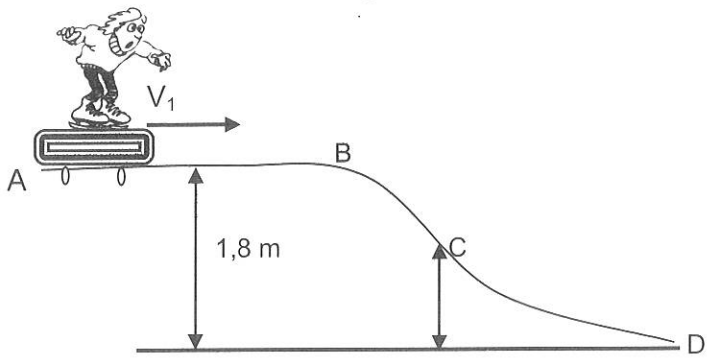
When car A is 'x' metres away from the intersection the driver applies his brakes.

4.2 Calculate the minimum acceleration that the car A must undergo in order to avoid a collision with car B. (3)

4.3 Hence, calculate the distance 'x' in metres. (4)
[11]

QUESTION 5

A boy on his skateboard (total mass of 50 kg) is moving at an UNKNOWN SPEED along a track that has a vertical height of 1,8 m. He approaches a slope along the track at point B and moves down the slope and reaches point D with a speed of 6.5 $m.s^{-1}$. (Neglect friction when answering the following questions).



5.1 State the law of conservation of mechanical energy. (2)

5.2 Calculate the total mechanical energy of the system. (3)

5.3 Calculate the boy's gravitational potential energy at point A. (3)

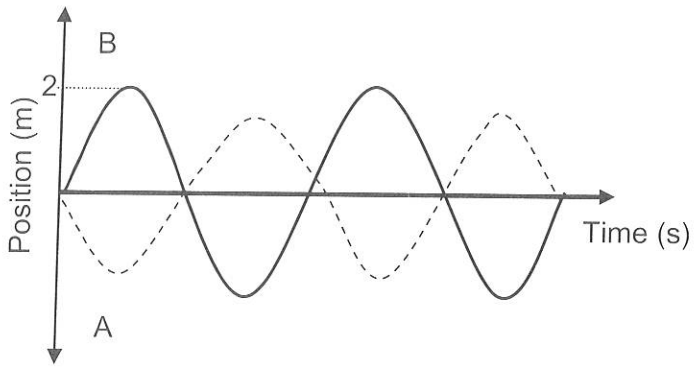
5.4 Using energy principles, calculate the speed of the boy at point A. (4)

5.5 At point C, the kinetic energy of the boy INCREASED BY 400 J. Calculate the vertical height of point C? (4)

[16]

QUESTION 6

The diagram below shows two waves A and B, of the same wavelength but different amplitudes intersecting.



6.1 Define *amplitude*. (2)

6.2 Determine the amplitude of A if it's amplitude is two thirds that of B. (2)

6.3 Draw the shape of the resultant wave as the two waves (A and B) cross. On the diagram show the resultant amplitude. (3)

6.4 What type of interference is illustrated here? (1)

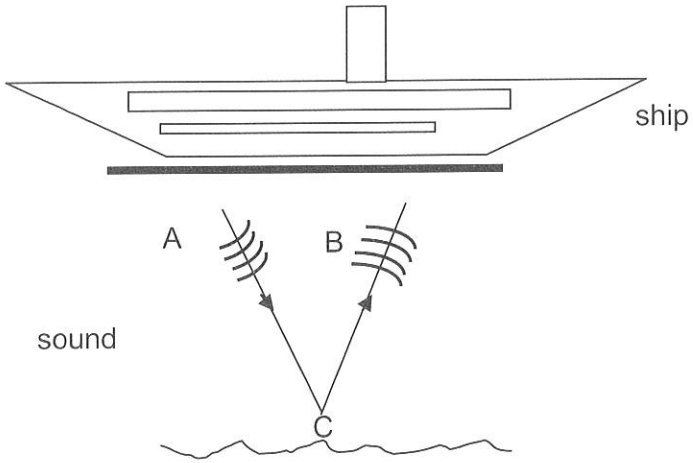
6.5 Name the principle used to answer QUESTION 6.3. (1)

6.6 If A and B are both sound waves, what property of the sound will be affected when the two waves cross each other? (1)

[10]

QUESTION 7

A ship's echo sounder sends out sound waves down from a sender unit A and the waves are collected by a receiver unit B.



7.1 What happens to the sound waves at point C? (1)

7.2 The frequency of the sound waves is 20 kHz. If the speed of the sound in water is 1500 $m.s^{-1}$, calculate the wavelength of the sound waves in water. (3)

7.3 Calculate the depth of the water beneath the ship, if the waves take 8,5 seconds to move from A to B. (4)

7.4 If the sound waves were to travel the same distance through AIR instead of water, how would this affect each of the following?

Choose from: INCREASE, DECREASE or REMAINS THE SAME

7.4.1 The time taken for the sound wave to return to the receiver. Give a reason. (2)

7.4.2 The frequency of the sound. (1)

[11]

QUESTION 8

There are different types of Electromagnetic waves that are used in our daily lives. Cellphones and computers in particular operate using wave technology. Wi-Fi is fast becoming a popular tool used by these gadgets for electronic communication.

8.1 What type of waves are electromagnetic waves? Choose from TRANSVERSE or LONGITUDINAL (1)

8.2 Name the type of electromagnetic wave used in Wi-Fi. (1)

8.3 Why is this type of radiation suitable for use in Wi-Fi? (2)

The sun is a source of electromagnetic waves. A photon of ultraviolet light transfers $4{,}64 \times 10^{-18}$ Joules of energy when it falls onto the skin during exposure to the sun.

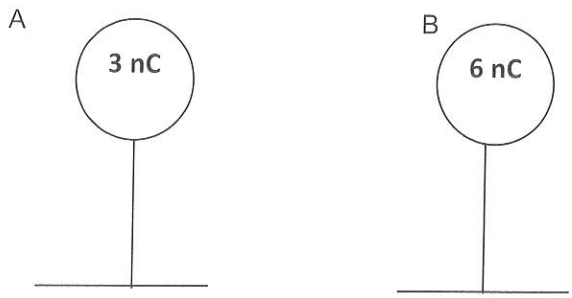
8.4 Define the *photon*. (2)

8.5 At what speed does the photon travel from the sun? (1)

8.6 Calculate the wavelength of the photon. (3)
[10]

QUESTION 9

Two positively charged spheres, A and B, each carry charges of 3 nC and 6nC respectively are mounted on insulated stands.
The spheres are allowed to touch and are then separated.



9.1 State the Principle of Conservation of Charge. (2)

9.2 Why was an external force used to make spheres A and B touch? (2)

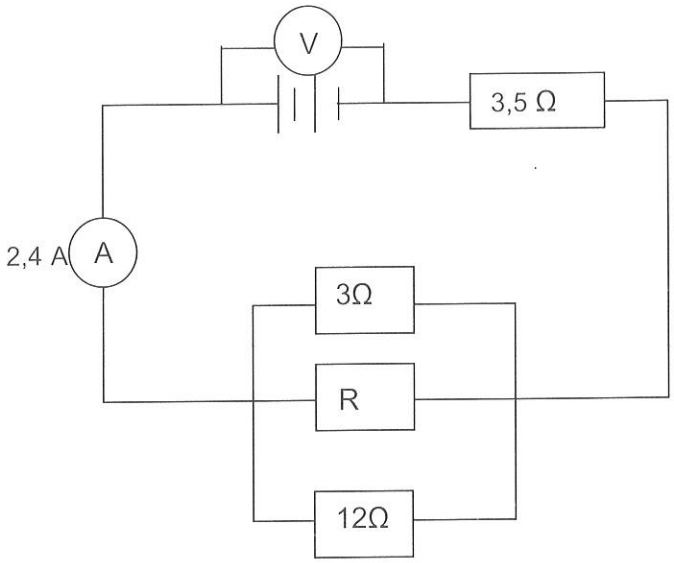
9.3 During contact, which sphere, A or B, lost electrons? (1)

9.4 Calculate the number of electrons transferred during contact. (4)

[9]

QUESTION 10

Four resistors are connected as shown below. The total resistance of the circuit is 5 Ω and the ammeter reads 2,4 A.



10.1 Calculate the effective resistance of the parallel combination. (2)

10.2 Determine the value of R. (3)

10.3 Determine the reading on the voltmeter if the battery transfers a total of 15000 Joules of energy to 1250 C of charge. (3)

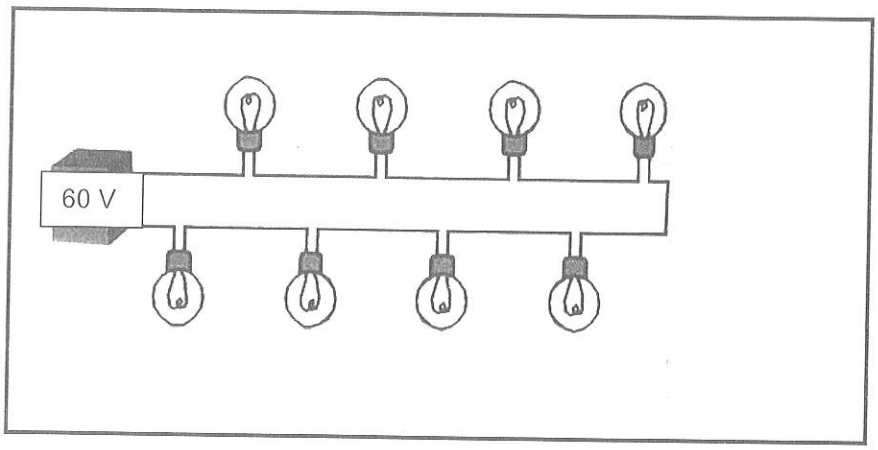
10.4 What energy conversion takes place in the battery? (2)

10.5 Calculate the amount of charge passing through the 3,5 Ω resistor in 3 minutes. (4)

[14]

QUESTION 11

A shop window is lit by means of eight identical bulbs that are connected to a 60 V power source. The resistance of each bulb is 12,5 Ω. The circuit diagram is shown below.



11.1 Define resistance. (2)

11.2 Calculate the total resistance of the circuit. (2)

11.3 One of the bulbs in the circuit stops working. How will this influence the other bulbs? Give a reason. (2)

11.4 What is the potential difference across one light bulb in the circuit? (2)

11.5 Will all the bulbs burn with the same brightness? (YES or NO) Give a reason. (2)

11.6 How will the brightness of the bulbs be affected if only FIVE bulbs were to be connected in exactly the same way? State whether brightness of bulbs will INCREASE, DECREASE or REMAIN THE SAME. (1)

[11]

TOTAL: 150

DATA FOR PHYSICAL SCIENCES

PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m{\cdot}s^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^{8}\ m{\cdot}s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}\ J{\cdot}s$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$

TABLE 2: FORMULAE/ *TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or/*of* $E = h\frac{c}{\lambda}$	

ELECTROSTATICS/*ELEKTROSTATIKA*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$Q = I\Delta t$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
$R_s = R_1 + R_2 + \ldots$	$V = \frac{W}{q}$

PHYSIC GR 10 + GR11

education

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NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES P1 (PHYSICS)

COMMON TEST

MARKING GUIDELINE

SEPTEMBER 2018

MARKS: 100

This marking guideline consists of 8 pages.

QUESTION 1

1.1 B ✓✓ (2)

1.2 D ✓✓ (2)

1.3 A ✓✓ (2)

1.4 B✓✓ (2)

1.5 A✓✓ (2)

1.6 B✓✓ (2)

1.7 C✓✓ (2)

1.8 D ✓✓ (2)

1.9 C✓✓ (2)

1.10 B ✓✓ (2)

[20]

QUESTION 2

2.1.1 A single vector having the same effect as two or more vectors together. ✓✓ (2)

2.1.2 Resultant force = 3 x 3 = 9 N ✓✓ (2)

2.1.3 Resultant Force = (3+3) - 3 ✓ = 3 N ✓ (2)

2.2.1 $T = \frac{1}{f} = \frac{1}{50} = 0,02\ s$ ✓ (1)

2.2.2 $V = \frac{13 \times 10^{-3}}{2 \times 0,02} = 0,325\ m.s^{-1}$ ✓ (3)

2.2.3 $\Delta t = 4 \times 0,02$ ✓ = 0,08 s ✓ (2)

2.2.4 constant velocity ✓✓ OR equal displacements per time interval ✓ ✓ (2)

[14]

QUESTION 3

3.1 constant velocity of 25 m.s^{-1} ✓ for 45 s ✓ (2)

3.2 The rate of change of velocity. ✓✓ (2)

3.3.1

$$\text{Gradient} = \frac{V_2 - V_1}{\Delta t}$$
$$= \frac{25 - 10}{15} \checkmark \checkmark$$
$$a = 1 \text{ m.s}^{-2} \text{ northwards} \checkmark$$

(3)

3.3.2

$$\text{Gradient} = \frac{V_2 - V_1}{\Delta t}$$
$$= \frac{0 - 25}{10} \checkmark$$
$$a = -2,5 \text{ m.s}^{-2}$$
$$a = 2,5 \text{ m.s}^{-2} \text{ southwards} \checkmark$$

(2)

3.4 The car changed direction ✓ ✓ (2)

3.5 Displacement = area under the graph

$$\Delta x = \frac{1}{2}(10 + 25)(15) \checkmark + (45 \times 25) \checkmark + \frac{1}{2}(10)(25) \checkmark$$

$$= 1512,50 \text{ m} \checkmark$$

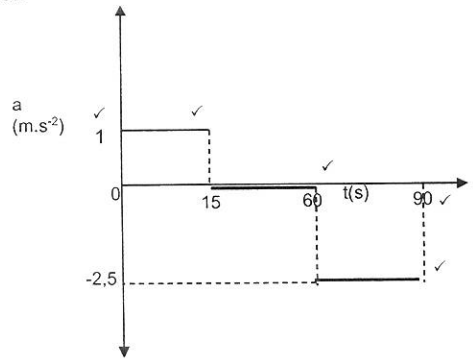
(4)

3.6

$$a = \frac{v_f - v_i}{\Delta t}$$
$$-2,5 \checkmark = \frac{-v_x - 0}{90 - 70} \checkmark$$
$$\therefore v_x = -50 \text{ m.s}^{-2}$$
$$= 50 \text{ m.s}^{-2} \checkmark \text{ southwards} \checkmark$$

(4)

3.7



1 mark for shape of each graph (3 marks)
Time values (1 mark)
Acceleration values (1 mark)

(5)

[24]

QUESTION 4

4.1 $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

$300 \checkmark = 20 \Delta t + \frac{1}{2}(2) \Delta t^2 \checkmark$

$\Delta t = 10 \text{ s} \checkmark$ OR $\Delta t = -30$ s (reject this answer : time must be positive) (4)

4.2 $V_f = V_1 + a \Delta t \checkmark$

$0 = 30 + a(10) \checkmark$ (+)

$a = -3 \text{ m.s}^{-2} \checkmark$ (3)

4.3 $v_f^2 = v_i^2 + 2 a \Delta x \checkmark$

$0 = (30)^2 + 2(-3)(\Delta x) \checkmark$

$\Delta x = 150 \text{ m} \checkmark$ (4)

[11]

QUESTION 5

5.1 The total mechanical energy of an isolated system remains constant ✓ ✓ (2)

5.2 Mechanical Energy at D = $E_p + E_k$ at D ✓

$= 0 + \frac{1}{2}(50)(6,5)^2 \checkmark$

$= 1\,056,25 \text{ J} \checkmark$ (3)

5.3 E_p = mgh ✓
= (50)(9,8)(1,8) ✓
= 882 J ✓ (3)

5.4 $E_p + E_k$ at A = E_T ✓
882 + ½ (50)v^2 ✓ = 1056,25 ✓
v = 2,64 m.s^{-1} ✓ (4)

5.5 At C: ΔE_p = mgh
882 – 400 ✓ ✓ = 1056,25h ✓
v = 2,64 m.s^{-1} ✓

OR At C: Total E_K = (1 056,25 – 882) + 400 = 574.25 J

$E_p + E_k$ at C = $E_p + E_k$ at D
(50) (9,8) h ✓+ 574,25 ✓ = 1 056,25 ✓

$$h = \frac{1056,25 - 574,25}{(50)(9,8)}$$

= 0,98 m ✓ (4)

[16]

QUESTION 6

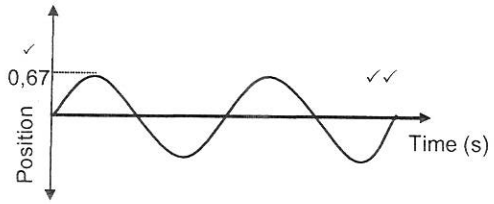
6.1 The maximum disturbance of a particle from its rest position ✓✓ (2)

6.2

$$A = \frac{2}{3} \times 2 \quad ✓✓$$

= 1,33 m (2)

6.3



(3)

6.4 Destructive Interference ✓ (1)

6.5 The principle of superposition✓ (1)

6.6 Volume/ Loudness ✓ (1)
[10]

QUESTION 7

7.1 The wave is reflected ✓ (1)

7.2

$$\lambda = \frac{v}{f} ✓$$

$$= \frac{1500}{20000} \quad ✓$$

=0,075m✓ (3)

7.3

d =v.Δ. ✓
= (1500) (8,5)✓

$$= \frac{12\,750 \text{ m}}{2^{✓}}$$

= 6 375 m ✓ (4)

7.4.1 Decrease ✓ Sound travels faster through water✓ (2)

7.4.2 Remains the same ✓ (1)
[11]

QUESTION 8

8.1 Transverse✓ (1)

8.2 Radio Waves ✓ (1)

8.3 Radio waves have longest wavelength ✓ and can be transmitted over long distances ✓ (2)

8.4 A package of energy in light ✓✓ (2)

8.5 3 x 10^8 m.s^{-1} ✓ (1)

8.6

$$E = \frac{hc}{\lambda} ✓$$

$$4,64 \times 10^{-18} = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda} ✓$$

$$\lambda = 4,29 \times 10^{-8} \text{ m} \quad ✓$$

(3)
[10]

QUESTION 9

9.1 The total charge of an isolated system remains constant during physical contact. ✓✓ (2)

9.2 The spheres carry same charge ✓. Like charges repel each other ✓ (2)

9.3 A ✓ (1)

9.4 $Q = \frac{Q_1 + Q_2}{2} = \frac{3 + 6}{2} \overset{\checkmark}{=} 4{,}5 \text{ nc}$

$n = \frac{\Delta Q}{q} = \frac{4{,}5 \times 10^{-9} - 3 \times 10^{-9}}{1{,}6 \times 10^{-19}} \overset{\checkmark}{\checkmark} = \frac{1.5 \times 10^{-9}}{1{,}6 \times 10^{-19}} = 9{,}375 \times 10^{9} \checkmark$ (4)

[9]

QUESTION 10

10.1

$Rp = R_T - R_S$

$= 5 - 3{,}5$ ✓

$= 1{,}5\,\Omega$ ✓ (2)

10.2

$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{1{,}5}$ ✓ $= \frac{1}{3} + \frac{1}{R_x} + \frac{1}{12}$ ✓

$\therefore Rx = 4\Omega$ ✓ (3)

10.3 $V = \frac{w}{q} \overset{\checkmark}{=} \frac{15000}{1250} = 12V$ ✓

OR

$V = IR$ ✓ $= 2{,}4 \times 5$ ✓ $= 12$ V✓ (3)

10.4 Chemical energy ✓ to electrical energy✓ (2)

10.5 $Q = I.\Delta t \overset{\checkmark}{=} (2{,}4) \overset{\checkmark}{(3 \times 60)} \overset{\checkmark}{=} 432$ C ✓ (4)

[14]

QUESTION 11

11.1 The ratio of the potential difference across a resistor to the current in the resistor. ✓✓ (2)

11.2 $R_T = 8(12{,}5)$ ✓ = 100 Ω ✓ (2)

11.3 This is a series circuit therefore the circuit will be incomplete ✓and all bulbs will not glow ✓ (2)

11.4 $V = \frac{60}{8} \overset{\checkmark}{=} 7{,}5V$ ✓ (2)

11.5 Yes ✓ current is the same anywhere in a series circuit✓ OR
Bulbs are identical ✓ (2)

11.6 INCREASE ✓ (1)

[11]

TOTAL MARKS: 150