KWAZULU-NATAL PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES

COMMON TEST

JUNE 2022

TIME: 2 hours

MARKS: 100

This question paper consists of 9 pages and 1 data sheet.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

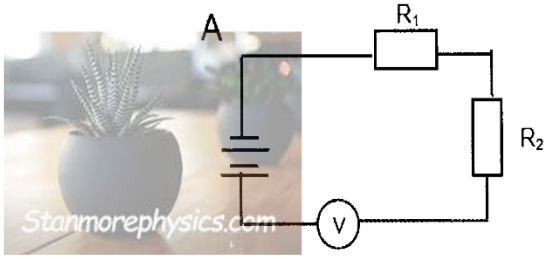
1. Write your name on the **ANSWER BOOK.**
2. This question paper consists of **SEVEN** questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subsections, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, et cetera where required.

QUESTION 1: MULTIPLE CHOICE QUESTIONS

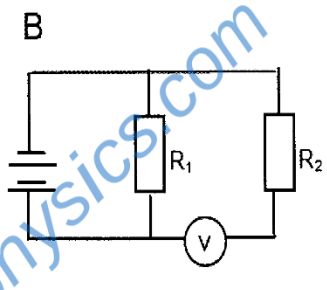
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A - D) next to the question number (1.1 — 1.7) in the ANSWER BOOK, for example 1.8 D.

1.1 Which circuit diagram shows voltmeter V connected correctly to measure the potential difference across resistor R_2?

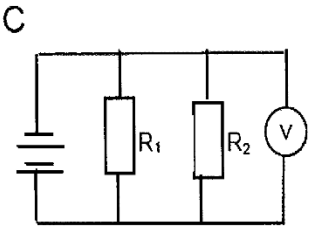
A



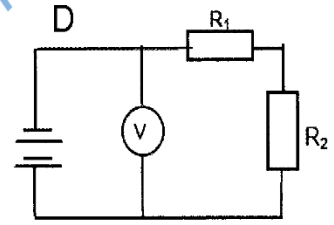
B



C



D

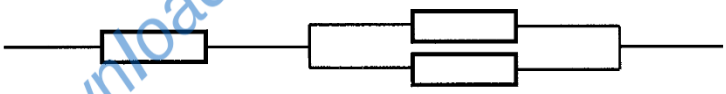


(2)

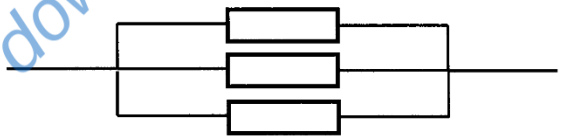
1.2 Three identical resistors can be connected in different ways as shown in the diagrams below. Which ONE of the connections will result in the LOWEST effective resistance

A

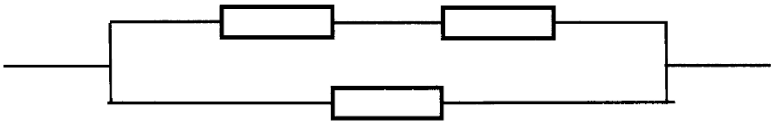
B



C



D



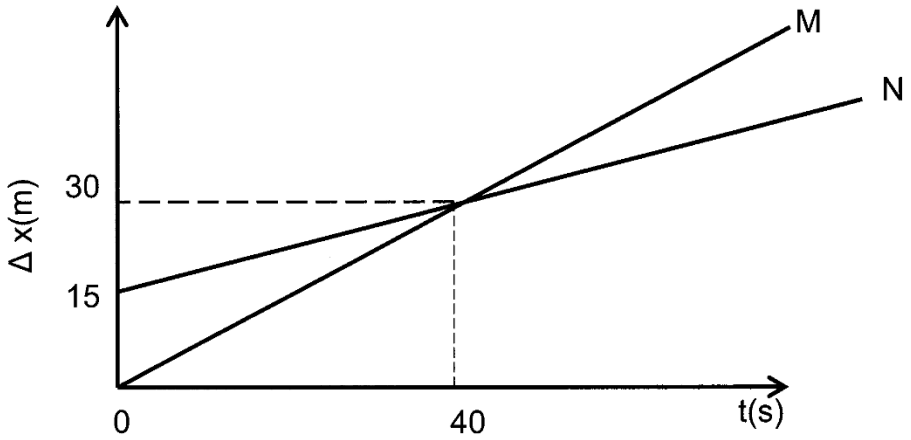
(2)

1.3 Which ONE of the following combinations is correct?

	Distance	Displacement	Velocity
A	Scalar	Scalar	Scalar
B	Scalar	Vector	Vector
C	Vector	Scalar	Vector
D	Vector	Vector	Scalar

(2)

1.4 The motion of two objects M and N, are represented in the following position versus time graph.



Which ONE of the following statements correctly describes the motion of the objects?

A M and N are in the same position at t = 0
B M and N have the same velocity at t = 40s
C M and N are accelerating uniformly
D M has a greater velocity than N between t = 0 and t = 40s (2)

1.5 In the equation $\Delta x = v_i t + \frac{1}{2} a\Delta t^2$, what is represented by $\frac{1}{2} a\Delta t^2$?

A Displacement
B Acceleration
C Velocity
D Time

(2)

1.6 An object moving at a velocity **v** has a kinetic energy **E**. If the velocity of the object is increased to **2v**, the kinetic energy of the object will now be…

A **E**
B 2**E**
C 4**E**
D 8**E** (2)

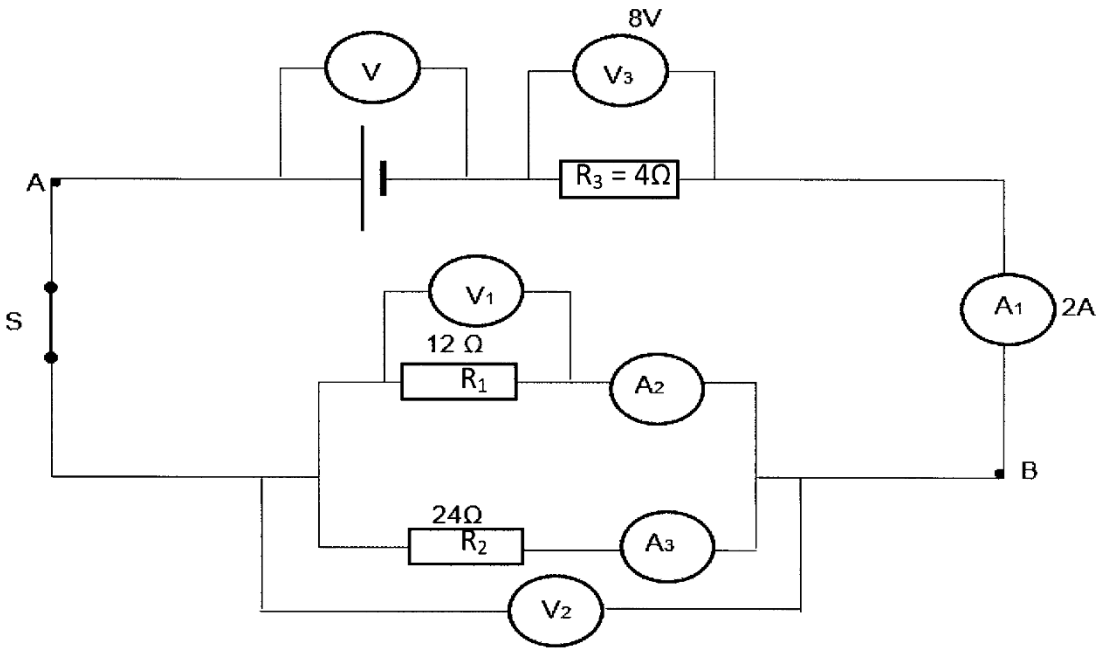
1.7 A stone is dropped from the top of a building. Neglecting friction, as the stone falls to the ground the …

A potential energy increases
B kinetic energy decreases
C potential energy and kinetic energy remain constant
D total mechanical energy remains constant (2)

[14]

QUESTION 2

An electric circuit is set up as shown in the diagram below. Ignore the resistance of the battery and the wires. The battery has an emf of 24V. When switch S is closed the ammeter A_1 reads 2A. and the voltmeter V_3 reads 8V.



2.1 Define *resistance* (2)

2.2 Calculate the total resistance of the circuit (5)

2.3 Determine the reading on:

2.3.1 Voltmeter V_1 (2)
2.3.2 Voltmeter V_2 (1)

2.4 Which ammeter, A_2 or A_3, will have a higher reading?
Give a reason for the answer. (2)

2.5 Calculate the quantity of charge flowing through the 4Ω resistor in 2 minutes (4)

2.6 Determine the amount of work done by the 4Ω resistor in 2 minutes (3)

2.7 Switch S is now opened. How will this affect the reading on voltmeter V?
(Choose from: INCREASES; DECREASES; BECOMES ZERO or REMAINS THE SAME) (2)

2.8 A piece of low resistance conducting wire is connected across points A and B with switch S closed. How will this affect the reading on the ammeter A_1?
(Choose from: INCREASES, DECREASES or REMAINS THE SAME)
Give a reason for the answer
(2)
[23]

QUESTION 3

During a training session an athlete runs 500m in 2 minutes in an easterly direction along a straight road. He stops to rest for 30 seconds. He then covers 800m in 4 minutes in a westerly direction along the same road.

3.1 Draw a vector diagram to represent the motion of the athlete. (Use a scale1cm:100m). Indicate the resultant vector (4)

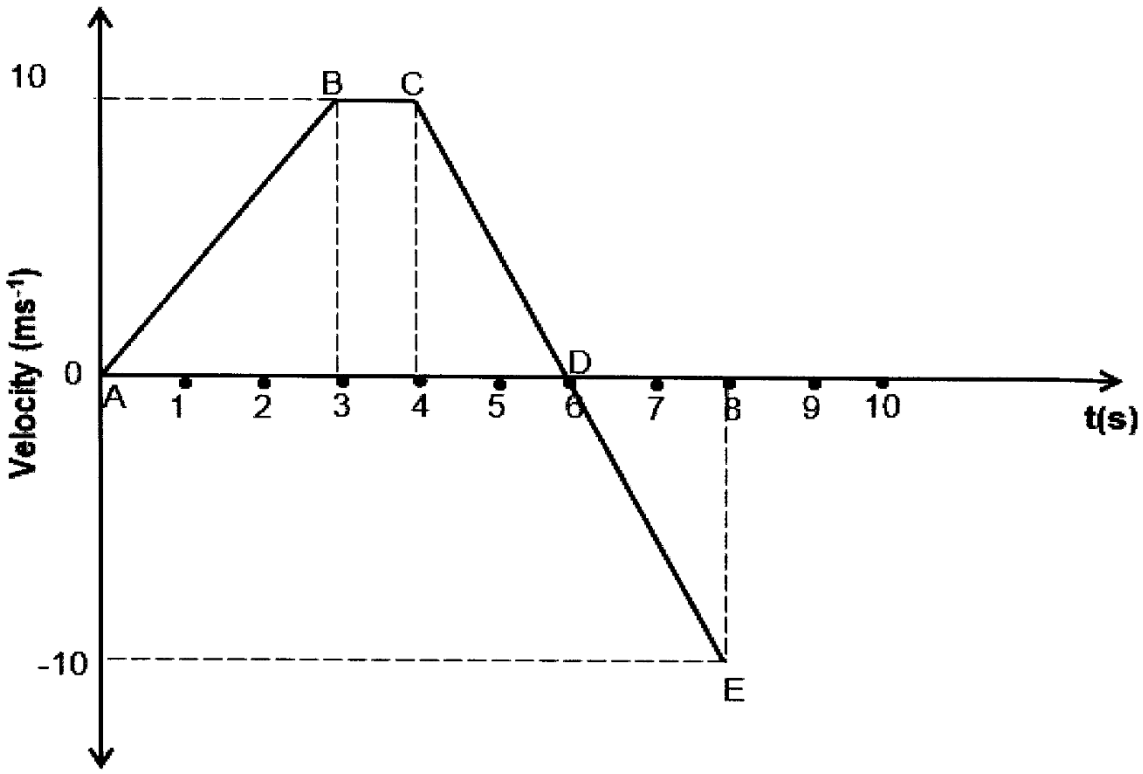
3.2 Define *resultant vector.* (2)

3.3 What is the displacement of the athlete during this training session? (2)

3.4 Calculate the average speed of the athlete during this training session. (4)
[12]

QUESTION 4

The velocity: time graph below illustrates the motion of a car that is initially travelling at 10 ms^{-1} in a SOUTHERLY direction.



USE THE GRAPH ONLY TO ANSWER THE FOLLOWING QUESTIONS (DO NOT USE EQUATIONS OF MOTION)

4.1 Define *velocity* (2)

4.2 Calculate the acceleration of the car during the first 3 seconds (3)

4.3 Describe the motion of the car during the following intervals:

4.3.1 B-C (1)

4.3.2 From t = 5s to t = 7s (3)

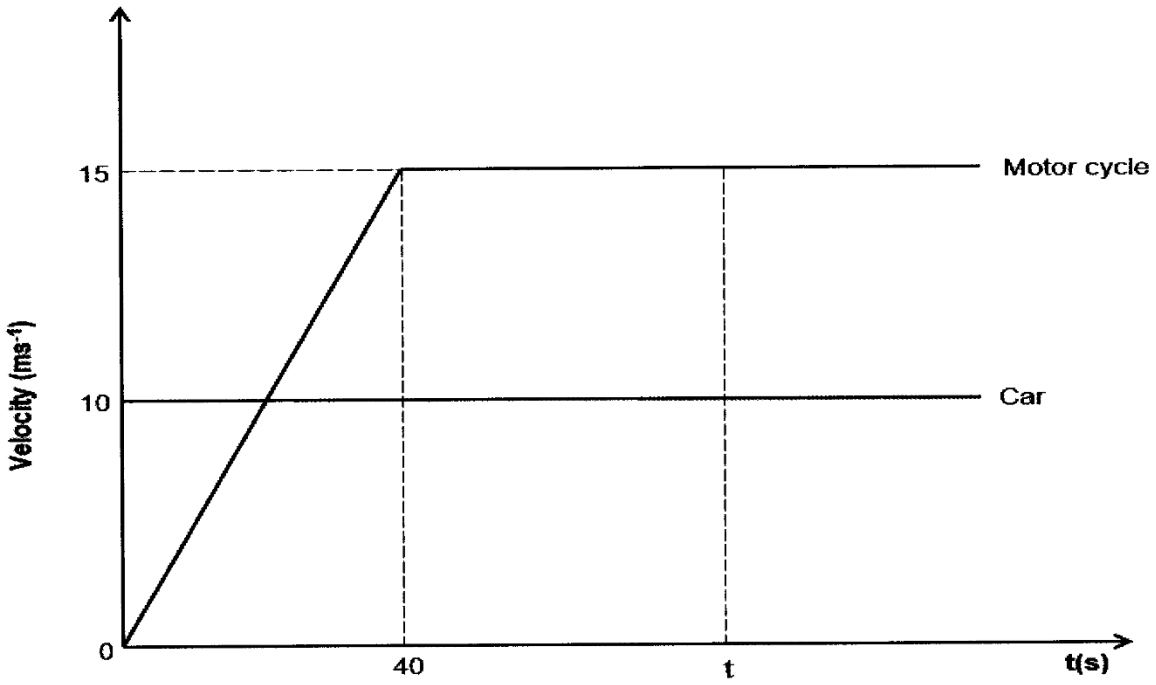
4.4 Calculate the displacement of the car after it has travelled for 8 seconds (5)

4.5 Sketch the acceleration: time graph for the car over the first 4 seconds. Indicate all relevant acceleration and time values (4)

[18]

QUESTION 5

The following velocity – time graph show the motion of a car and a motorcycle.



5.1 Determine which vehicle is ahead after 40 seconds and by what distance (4)

5.2 The two vehicles meet (catch up with each other) at a time t. (4)
Calculate the value of t

[8]

QUESTION 6

A car, travelling at a speed of 10 $m \cdot s^{-1}$, undergoes a constant acceleration of 0,5 $m \cdot s^{-2}$ along a straight road.

6.1 Define *acceleration.* (2)

6.2 Calculate the speed of the car after 15 seconds. (3)

The car continues along this road reaching a speed of 30 $m \cdot s^{-1}$

6.3 Calculate the distance covered by the from the time it started accelerating until it reaches the speed of 30$m \cdot s^{-1}$. (4)

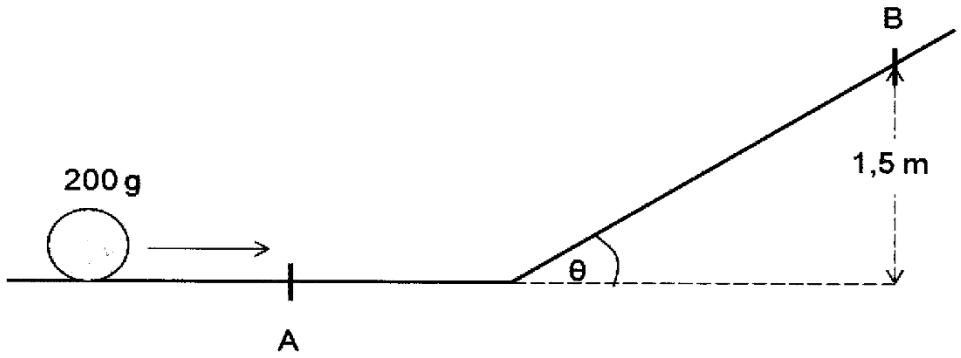
The brakes are applied and the car is now brought to a stop in 10 seconds.

6.4 Calculate the acceleration of the car whilst the brakes are applied. (4)

[13]

QUESTION 7

In a laboratory experiment, a 200g ball is moving along a frictionless horizontal surface when it passes a point A on the surface with an unknown speed. The ball then moves up a frictionless ramp that is inclined at an angle θ and comes to stop at point B which is at a height of 1,5m.



7.1 State the *Law of conservation of mechanical energy* in words. (2)

7.2 Calculate the total mechanical energy of the ball at point B. (4)

7.3 Determine the speed of the ball at point A (4)

The ball now rolls backwards down the incline and passes point A again.

7.4 How will the speed of the ball when it rolls back to point A compare to the speed calculated in Question 7.3?
(Choose from GREATER THAN, LESS THAN or EQUAL TO)
Give a reason for the answer (2)

[12]

TOTAL MARKS: 100

DATA FOR PHYSICAL SCIENCES GRADE 10

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	$9,8\ m{\cdot}s^{-2}$
Charge on electron	e	$-1,6 \times 10^{-19}\ C$

TABLE 2: FORMULAE

MOTION

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

WORK, ENERGY AND POWER

$U = mgh$ or $E_P = mgh$	$K = \frac{1}{2}mv^2$ or $E_k = \frac{1}{2}mv^2$
$E_M = E_k + E_p$ or $E_M = K + U$	

ELECTROSTATICS

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

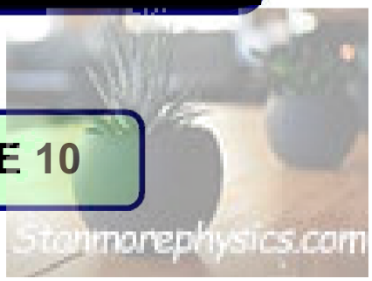
ELECTRIC CIRCUITS

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

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES
JUNE 2022
COMMON TEST
MARKING GUIDELINE

NATIONAL
SENIOR CERTIFICATE



GRADE 10

NB: This marking guideline consists of 5 pages.

QUESTION ONE

1.1 C ✓✓
1.2 C ✓✓
1.3 B ✓✓
1.4 D✓✓
1.5 A ✓✓
1.6 C✓✓
1.7 D ✓✓

[14]

QUESTION TWO

2.1 Ability of a conductor to reduce the flow of current (2)

2.2 $\frac{1}{Rp} = \frac{1}{R_1} + \frac{1}{R_2}$✓

$R_P = \left(\frac{1}{24} + \frac{1}{12}\right)^{-1}$ ✓

= 8 Ω

R_T = Rp + R_3✓

=8 +4✓

=12 Ω✓ (5)

2.3.1 $V_1 = V - V_3$

= 24 – 8✓

=16V✓ (2)

2.3.2 16 V✓ (1)

2.4 A_2✓ Resistance inversely proportional to current✓ (2)

2.5 Q = $I\,\Delta t$✓

= 2A x 120s✓✓

= 240C ✓ (4)

2.6 Positive marking from Q 2.5

$V = \frac{w}{q}$ ✓

$8V = \frac{w}{240C}$✓

w =1920 J✓ (3)

2.7 REMAINS THE SAME✓✓ (2)

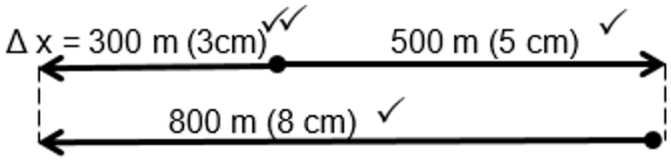
2.8 Increases✓

- R of circuit now decreases ✓ OR: there will be a short-circuit (2)

[23]

QUESTION 3

3.1



(4)

3.2 Single vector that effectively replaces 2 or more vectors acting together✓✓ (2)

3.3 300 m✓ west✓ (2)

3.4 $Average\ speed = \frac{Total\ distance}{total\ time}$✓

$= \frac{1300}{270}$✓✓

= 4.81 m·s^{-1}✓ (4)

[12]

QUESTION 4

4.1 Rate of change of displacement (2)

4.2 $a = \frac{\Delta v}{\Delta t}$ ✓

$= \frac{10 - 0}{3 - 0}$ ✓

= 3,33 ms^{-2} ✓ (3)

4.3.1 Car is moving at constant velocity✓ (1)

4.3.2 Car is slowing down (uniformly)✓ , stops at 6s, changes direction✓ and accelerates uniformly ✓ (3)

4.4

Δ x = area under the graph

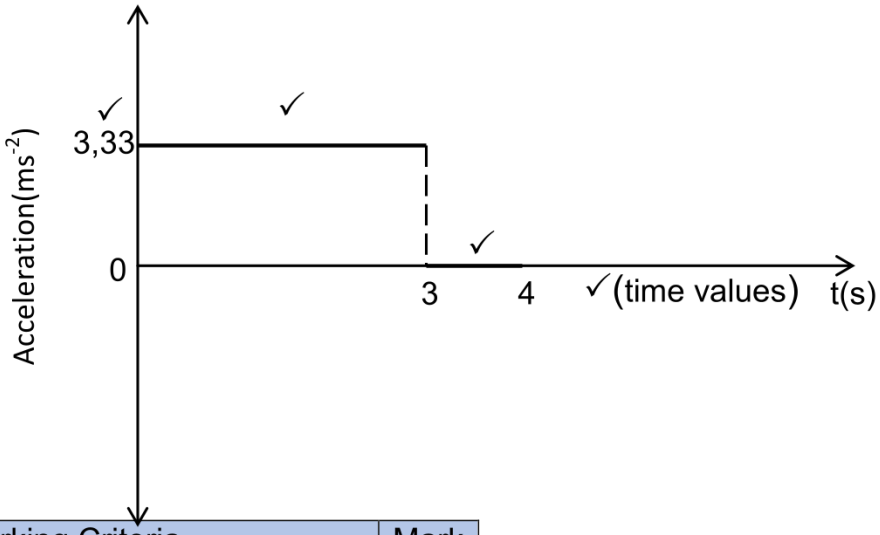
Δ x = (½ bxh) + (lxb) + (½ bxh)+ (½ bxh)

✓ANY ONE

= (½ x 3 x10) ✓+ (1x10)✓ + (½ x 2 x 10) +(½ x 2 x-10)✓

= 25m✓ (5)

4.5



Marking Criteria	Mark
• shape of graph correctly drawn	2
• both acceleration values shown	1
• both time values shown	1

(4)

[18]

QUESTION 5

5.1 Car : $\underline{\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2}$ ⟶ (1 mark for both formulae)

$= 10(40) + \frac{1}{2}(0)\Delta t^2$ ✓

= 400m

Motor cycle : $\underline{\Delta x = \left(\frac{v_i + v_f}{2}\right) \Delta t}$

$= \left(\frac{0 + 15}{2}\right) 40$ ✓

= 300 m

Car is ahead by 400 –300 = 100 m ✓

OR

Car : Δ x = Area = LxB (1 mark for both area formulae)

= (10)(40) ✓

= 400 m

Motor cycle : Δ x = Area = ½ bxh

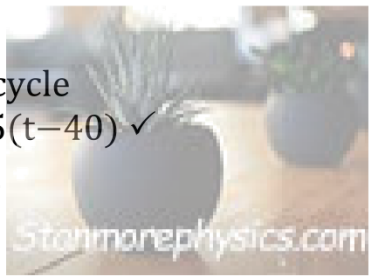
= ½ (40)(15) ✓

= 300 m

400 –300 ✓ = 100 m Car is ahead ✓

(4)

5.2 Car : $\Delta x = Area\ of\ car = 10\ t$ ✓
Motor cycle : $\Delta x =$ Area of motor cycle
$= ½(\ 40x15) + 15(t-40)$ ✓
$10\ t = ½(\ 40x15) + 15(t-40)$ ✓
$t = 60\ s$ ✓



OR
Car : $\Delta x = 400\ m\ at\ t = 40s$
At t-40(s) : $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$
= 10 (t-40) + 0
$\Delta x = 400 + 10(t-40)$ ..... (1) ✓
Motor cycle : $\Delta x = 300$ m at t = 40s
At t - 40(s) : $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$
= 15 (t-40) + 0
$\Delta x = 300 + 15\ (t-40)$ ..... (2) ✓
$\Delta x\ of\ car = \Delta x\ of\ motor\ cycle$
$400 + 10\ (t-40) = 300 + 15(t-40)$ ✓
$t = 60$ s ✓ (4)

QUESTION 6

6.1 Rate of change of velocity (2)

6.2 $v_f = v_i + a\Delta t$ ✓
= 10 ✓+ (0,5 x 15) ✓
= 17,5 $m{\cdot}s^{-1}$ ✓ (4)

6.3 $v_f^2 = v_i^2 + 2a\Delta x$ ✓
30^2 ✓ = $10^2 + 2\ (0,5)\ \Delta x$ ✓
Δx = 800 m ✓ (4)

6.4 $v_f = v_i + a\Delta t$ ✓
$0 = 30 + a\ 10$ ✓
a = -3 $m{\cdot}s^{-2}$
a = 3 $m{\cdot}s^{-2}$ ✓in opposite direction✓ (4)
[14]

QUESTION 7

7.1 Total mechanical energy ✓of an isolated system remains constant✓ (2)

7.2 E_{TOT} = Ep + Ek ✓
= (0,2 x 9.8 x 1,5) ✓ + 0✓
= 2,94 J✓ (4)

7.3 E_{TOT} = Ep + Ek
2,94 J✓ = 0 ✓ + ½ (0,2)(v^2) ✓
v = 5,42 $m{\cdot}s^{-1}$ ✓ (4)

7.4 EQUAL TO ✓ total mechanical energy is conserved. ✓ (2)
[12]

TOTAL : 100 MARKS