education

DEPARTMENT: EDUCATION
MPUMALANGA PROVINCE

GRADE 12

PHYSICAL SCIENCES MONTHLY TEST

APRIL 2020

TOPIC: MOMENTUM & IMPULSE

QUESTION PAPER

(CORRECTED COPY)

MARKS: 55

TIME: 1:10 HOURS

This question paper consists of 6 pages

INSTRUCTIONS

1. Attempt ALL questions
2. Round off your final answers to a minimum of TWO decimal places.
3. Write neatly and legibly.

QUESTION 1

1.1 A stone is thrown vertically upwards into the air. Which combination in the table below shows the correct change in the momentum and the potential energy of the stone? (Ignore the effects of air friction)

	Momentum	**Potential energy**
A	Increases	Decreases
B	Decreases	Increases
C	Increases	Increases
D	Decreases	Stays constant

(2)

1.2 A body moving at a constant velocity has kinetic energy **E** and momentum **p**. The velocity of the body is doubled. Which ONE of the following correctly gives the magnitudes of both the kinetic energy and momentum?

	Kinetic Energy	**Momentum**
A	2 E	2 p
B	4 E	4 p
C	4 E	2 p
D	2 E	4 p

(2)

1.3 A railway coal truck moving with constant velocity collides with a similar truck which is stationary. Both trucks become coupled together and move off in the same direction as the first truck. Which ONE of the following statements correctly describes the system making up the two trucks above?

A Both the momentum and kinetic energy is conserved.

B Neither the momentum nor the kinetic energy is conserved.

C The momentum is conserved but the kinetic energy is not conserved.

D The kinetic energy is conserved but the momentum is not conserved. (2)

1.4 Which ONE of the following physical quantities represents the RATE OF CHANGE OF MOMENTUM of an object?

A Force

B Kinetic energy

C Impulse

D Acceleration (2)

1.5 The kinetic energy of a car moving at constant velocity ***v*** is *K*. The velocity of the car changes to ***2v***. What is the new kinetic energy of the car?

A $\frac{1}{4}K$

B $\frac{1}{2}K$

C $2K$

D $4K$ (2)

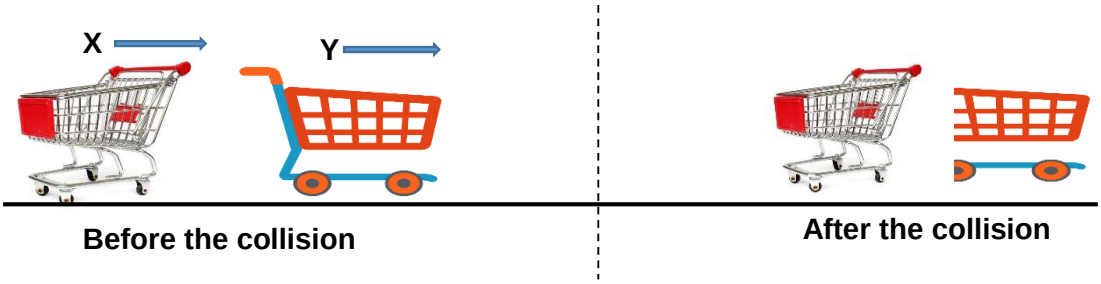
[10]

QUESTION 2

Two shopping trolleys, **X** and **Y**, are both moving to the right along the same straight line. The mass of trolley **Y** is 12 kg and its kinetic energy is 37,5 J.

2.1 Calculate the speed of trolley **Y**. (3)

Trolley **X** of mass 30 kg collides with trolley **Y** and they stick together on impact. After the collision, the combined speed of the trolleys is 3, 2 $m \cdot s^{-1}$. (Ignore the effects of friction.)



2.2 Write down the principle of conservation of linear momentum in words. (2)

2.3 Calculate the speed of trolley **X** before the collision. (5)

During the collision, trolley **X** exerts a force on trolley **Y**. The collision time is 0,2 s.

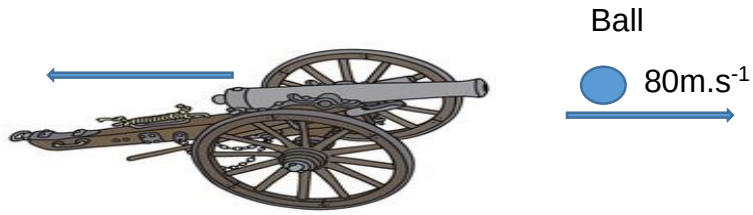
2.4.1 Define the term inelastic collision (2)

2.4.2 Calculate the magnitude of the force that trolley **X** exerts on trolley **Y**. (4)

[16]

QUESTION 3

A cannon has a mass of 1 250 kg and is a 1 000 times heavier than the cannon ball that it fires during a routine training exercise. The cannon ball leaves the barrel at a horizontal velocity of 80 m·s^{-1}.



The cannon moves back ward and comes to **rest** 1 second after being fired.

3.1 Define, in words, the term *impulse.* (2)

3.2 Calculate the:

3.2.1 Maximum velocity with which the cannon moves backwards (5)

3.2.2 Magnitude of the average net force that causes the cannon to come to rest. (4)

[11]

QUESTION 4

A trolley, mass 5 kg, moves at 4 m·s^{-1} east across a frictionless horizontal surface. A box of mass 1,5 kg is dropped onto the trolley.

4.1 Define in words the Law of Conservation of Momentum. (2)

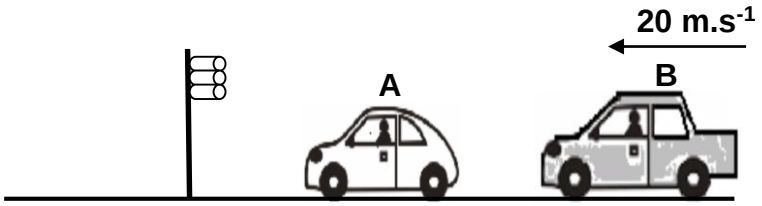
4.2 State the condition for an elastic collision. (1)

4.3 Calculate the change in momentum of the trolley. (5)

[8]

QUESTION 5

The most common reasons for rear-end collisions are too short a following distance, speeding and failing brakes. The sketch below represents one such collision. Car **A** of mass 1 100 kg, stationary at a traffic light, is hit from behind by Car **B** of mass 1 300 kg, travelling at 20 m·s^{-1}.



Before the collision

Immediately after the collision Car **A** moves forward at 14 m·s^{-1}. Ignore friction.

5.1 State Newton's second law in terms of momentum (2)

5.2 Calculate the speed of car **B** immediately after the collision. (4)

5.3 To improve passenger safety modern cars are designed to crumple partially on impact.

5.3.1 Give a reason why the principle of conservation of linear momentum is still valid during crumpling. (1)

5.3.2 Explain how crumple zones on cars can improve passenger safety. Include a relevant physics equation in your answer. (3)

[10]

TOTAL:55

DATA FOR PHYSICAL SCIENCES P1 GRADE 12 CAPS

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 m·s^{-2}
Speed of light in a vacuum	c	3,0 x 10^{8} m·s^{-1}
Planck's constant	h	6,63 x 10^{-34} J·s
Gravitational constant	G	6,67 x 10^{-11} N·m^{2}·kg^{-2}

Coulombs constant	k	$9,0 \times 10^{9}\ N \cdot m^2 \cdot C^{-2}$
Charge on electron	e	$-1,6 \times 10^{-19}\ C$
Electron mass	m_e	$9,11 \times 10^{-31}\ kg$

TABLE 2: MOTION

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

TABLE 3: FORCE

$F_{net} = ma$	$p = mv$
$f_{s(max)} = \mu_s N$	$f_k = \mu_k N$
$F_{net} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{r^2}$	$g = \frac{Gm}{r^2}$

TABLE 4: WORK, ENERGY AND POWER

$W = F\Delta x \cos\theta$	$U = mgh$ or/of $E_P = mgh$
$K = \frac{1}{2} mv^2$ or/of $E_k = \frac{1}{2} mv^2$	$W_{net} = \Delta K$ or/of $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/of $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = F \cdot v_{av}$ / $P_{gem} = F \cdot v_{gem}$	