education

Department of Education
FREE STATE PROVINCE



CONTROL TEST

GRADE 12

PHYSICAL SCIENCES

MARCH 2022

MARKS: 100

TIME: 2 HOURS

This paper consists of 11 pages and one information sheet.

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INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of SIX questions. Answer ALL 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 sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable pocket 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 where applicable.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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

1.1 When two objects collide during an ELASTIC COLLISION,

A both momentum and kinetic energy are conserved.

B both impulse and momentum are conserved.

C only kinetic energy is conserved.

D only momentum is conserved. (2)

1.2 A vector quantity with the same DIRECTION as the velocity of an object is the ... of the object.

A rate of the change in momentum

B momentum

C impulse

D inertia (2)

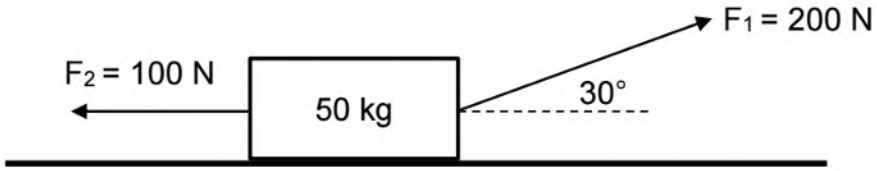
1.3 An airbag can protect the driver of a vehicle from serious injuries during a collision. Which one of the following best describes how that is possible?

	Net force on the driver	**Impact time**
A	Increase	Increase
B	Decrease	Decrease
C	Decrease	Increase
D	Decrease	Remain the same

(2)

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1.4 Two forces of 200 N and 100 N are simultaneously applied to a stationary box that has been placed on a flat surface. One of the forces is horizontal and the other one is applied at an angle of 30° to the horizontal as shown below.



The normal force acting on the box is DECREASED by …

A increasing the angle at which the 200 N force is acting.

B decreasing the angle at which the 200 N force is acting.

C decreasing the magnitude of F_1.

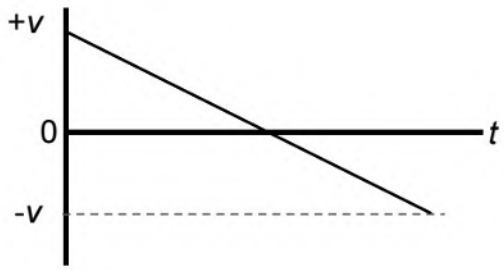
D increasing the magnitude of F_2. (2)

1.5 A ball is thrown vertically upward and returns to the thrower's hand. Taking upward as POSITIVE, which one of the following combinations best describes the velocity and acceleration of the ball when it is moving DOWNWARDS towards the thrower's hand? Ignore air resistance.

	Velocity	**Acceleration**
A	+	+
B	+	-
C	-	+
D	-	-

(2)

1.6 Consider the velocity versus time graph for an object moving VERTICALLY. Upward is taken as positive.



Which one of the following statements is correct?

A The object's speed is decreasing throughout the motion.

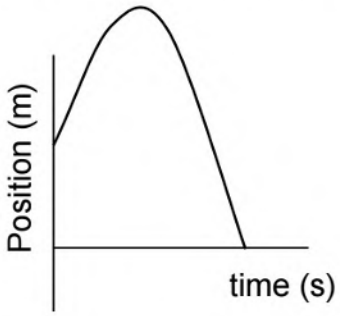
B The object is travelling downwards throughout the motion.

C The object is travelling with a constant velocity throughout the motion.

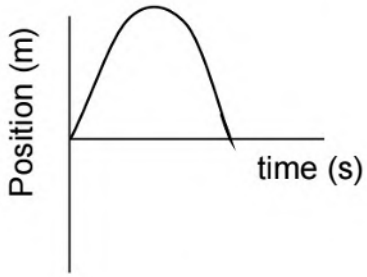
D The object is travelling with a constant acceleration throughout the motion. (2)

1.7 An object is dropped from a hot air balloon moving upward at a constant velocity. Which one of the following position versus time graphs best represents the motion of the object UNTIL IT HITS THE GROUND?

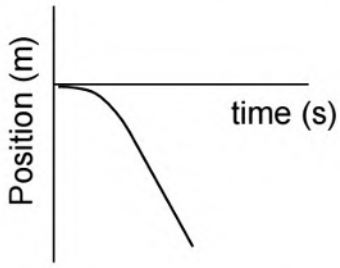
A



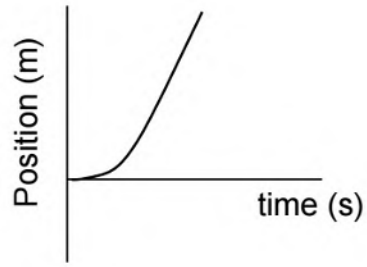
B



C

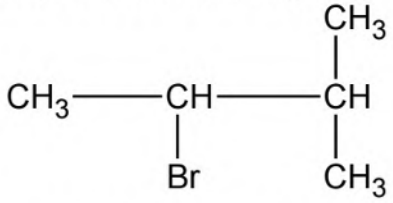


D



(2)

1.8 The condensed structural formula of an organic compound is shown below.



Which one of the following is the correct IUPAC name of this compound?

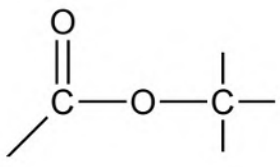
A 2-methyl-3-bromobutane

B 2-bromo-3-methylbutane

C 2-bromo-1,1-dimethylpropane

D 2-bromo-3,3-dimethylpropane (2)

1.9 Consider the functional group on the right. For which one of the following homologous series is this the functional group?



A Aldehydes

B Alcohols

C Ketones

D Esters (2)

1.10 The MELTING point of a compound is the …

A minimum temperature at which it boils.

B maximum temperature at which it boils.

C temperature at which its vapour pressure equals atmospheric pressure.

D temperature at which the solid and liquid phases of a substance are at equilibrium. (2)

[20]

QUESTION 2

Two crates, **A** and **B**, with masses of 8 kg and 5 kg respectively, are stationary on a rough, horizontal surface. The crates are connected by a light, inextensible string. When force *F*, with a magnitude of 80 N and making an angle of 30° with the horizontal, is applied to the 8 kg block, both blocks move to the right.



2.1 State *Newton's second law of motion* in words. (2)

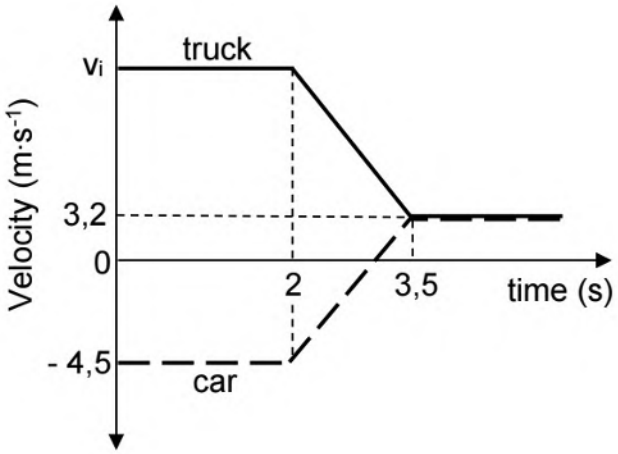
2.2 Draw a free-body diagram of ALL the forces acting on the 5 kg block (4)

2.3 The magnitudes of the frictional forces acting on crates **A** and **B** are 7,68 N and 4,9 N respectively. Calculate the magnitude of the acceleration of block **B**. (5)

[11]

QUESTION 3

A truck of mass 2 000 kg is moving eastward and collides with a car of mass 900 kg moving at a speed of 4,5 $m \cdot s^{-1}$. After the collision, the truck and the car are entangled into a wreck which moves as ONE UNIT with a speed of 3,2 $m \cdot s^{-1}$. The graph (not drawn to scale) represents the motion of the vehicles just before and after the collision.



3.1 Are the vehicles moving in the SAME or OPPOSITE directions BEFORE the collision? (1)

3.2 State the *principle of conservation of momentum* in words. (2)

3.3 What do you understand by the term *isolated system* as used in physics? (2)

Use the information in the graph to answer the following questions.

3.4 How long is the collision between the car and the truck? (1)

3.5 Use a calculation to show that the speed of the truck before the collision, v_i in the graph, is equal to 6,665 $m \cdot s^{-1}$. (4)

3.6 Calculate the average net force acting on the car during the collision. (4)

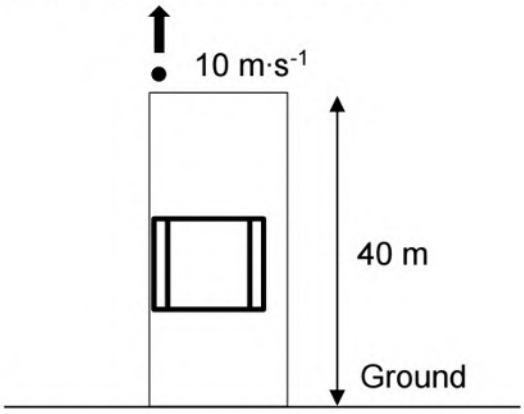
3.7 Determine, by means of calculations, what type of collision this is (elastic or inelastic) and give a reason as well for your choice. (5)

3.8 How does the magnitude of the average net force exerted by the truck on the car compare with the magnitude of the average net force exerted by the car on the truck? Choose from greater than, smaller than or equal to. Name a physics law or a principle to support your answer. (2)

[21]

QUESTION 4

An object is projected vertically upward at a velocity of 10 $m \cdot s^{-1}$ from the top of a building, which is 40 m high. Ignore air resistance.



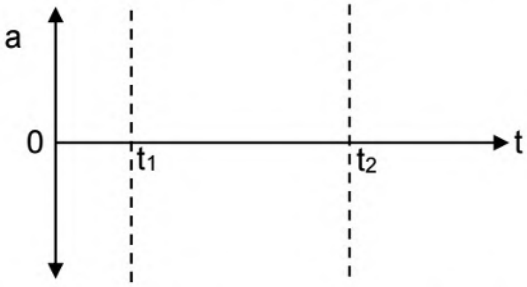
4.1 Define the term *projectile* in words. (2)

4.2 Calculate the:

4.2.1 Maximum height the object reaches above the ground. (4)

4.2.2 Time it takes the object to hit the ground (from the instant it has been projected). (4)

4.3 Draw the following set of axes in your answer book.



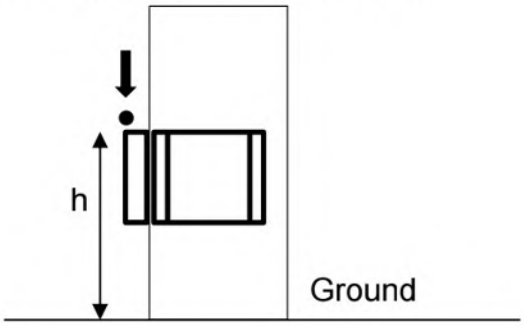
Use it to draw a sketch graph of acceleration versus time to represent the motion of the object from the moment it is projected from the top of the building (at t = 0) until it strikes the GROUND.

t_1 and t_2 represent the times when the object is at its HIGHEST position and when it strikes the GROUND respectively.

GIVE AN INDICATION NEXT TO YOUR GRAPH WHICH DIRECTION YOU CONSIDER AS POSITIVE. (2)

The object is again projected vertically upward from the top of the building at 10 $m \cdot s^{-1}$ as before. Someone in the building opens a window while the object is on its way up.

On its way down, the object strikes the top of the window, at a height *h*, 3,4 s after it has been projected from the top of the building.



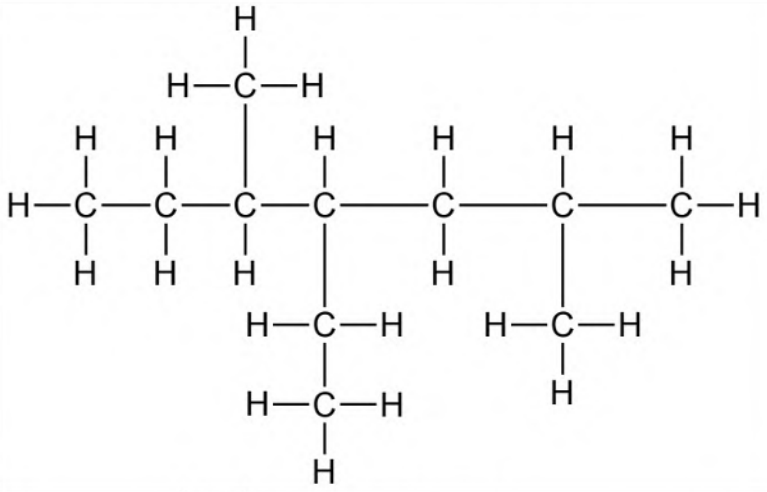
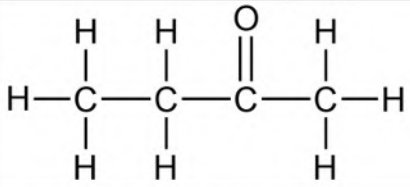
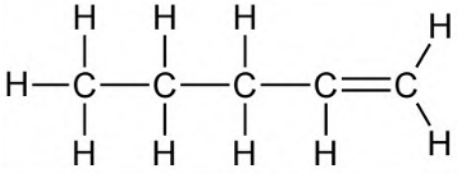
4.4 Calculate the:

4.4.1 Magnitude of the velocity of the object when it strikes the top of the window. (3)

4.4.2 Height, *h*, above the ground. (5)
[20]

QUESTION 5

The letters **A** to **H** in the table below represent eight organic compounds.

A	$C_4H_{10}O$	**B**	
C		**D**	
E	3,4-dimethylpentan-2-ol	**F**	$CH_3(CH_2)_2COOH$
G	Ethyl ethanoate	**H**	Pentan-3-one

5.1 Define the term *saturated compound*. (2)

5.2 Write down the following:

5.2.1 Letter that represents an UNSATURATED compound. (1)

5.2.2 IUPAC name of **B** (3)

5.2.3 Letter that represents a FUNCTIONAL ISOMER of compound **F**. (1)

5.2.4 NAME of the functional group of compound **C** (1)

5.2.5 General formula of the homologous series to which compound **D** belongs. (1)

5.3 Define the term *homologous series*. (2)

5.4 For compound **E**:

5.4.1 To which homologous series does it belong? (1)

5.4.2 Write down its CONDENSED STRUCTURAL FORMULA. (2)

5.4.3 Is it a primary, secondary, or tertiary compound? (1)

5.4.4 Explain your answer to question 5.4.3. (1)
[16]

QUESTION 6

A learner uses four organic compounds (**A**, **B**, **C** and **D)** to investigate the effect of the CHAIN LENGTH on BOILING POINT. The obtained results are shown in the table below.

Compound	Condensed structural formula	Boiling point (°C)
A	$CH_3CH_2CH_2CH_2CH_2OH$	138
B	$CH_3CH_2CH_2OH$	96
C	CH_3CH_2OH	77
D	CH_3OH	64

6.1 Define the term *vapour pressure*. (2)

6.2 Write down the INDEPENDENT variable for this investigation. (1)

6.3 State, with a reason, which ONE **(A**, **B**, **C** or **D)** of these compounds has the HIGHEST vapour pressure. (2)

6.4 Compound **A** is now compared to pentane.

6.4.1 Is the boiling point of **A** HIGHER THAN, LOWER THAN or EQUAL TO that of pentane? (1)

6.4.2 Refer to the TYPES of intermolecular forces to explain the answer to question 6.4.1. (4)

6.5 Write down the general conclusion that can be made about the boiling points of compounds **A**, **B**, **C** and **D**. (2)
[12]

GRAND TOTAL: 100

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m \cdot s^{-2}$

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

MOTION / *BEWEGING*

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

FORCE / *KRAG*

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p$	$\Delta p = mv_f - mv_i$
$\mu_s = \frac{f_{s(max)}}{N}$ / $\mu_s = \frac{f_{s(maks)}}{N}$	$\mu_k = \frac{f_k}{N}$

WEIGHT AND ENERGY / *GEWIG EN ENERGIE*

$w = mg$ or/*of* $F_g = mg$	$U = mgh$ or/*of* $E_p = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	

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