Basic Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES: PHYSICS (P1)

COMMON TEST

MARCH 2015

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 50

TIME : 1 hour

This question paper consists of 8 pages and a 1-page data sheet.

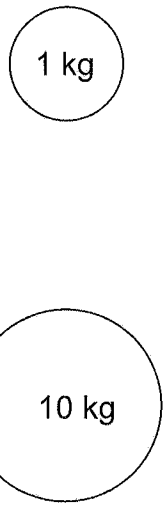
INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK**.
2. This question paper consists of FIVE 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.
12. Write neatly and legibly.

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 – 1.4) in the ANSWER BOOK, for example 1.11 D.

1.1 A sphere of mass 1 kg is held vertically above another sphere of mass 10 kg at a point near the Earth's surface.



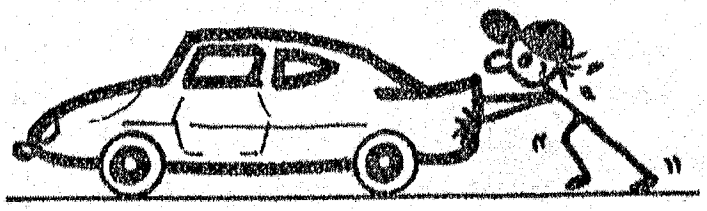
The spheres are released simultaneously. If the effects of air friction are ignored, the distance between the spheres as they fall vertically will . . .

A increase
B decrease
C remain the same
D first decrease then increase (2)

1.2 The momentum of an object falling vertically from rest is, ***p***, after a time, ***t***. If the effects of friction are ignored, what will the momentum be after time ***2t*** ?

A ***p***
B ***2 p***
C ***3 p***
D ***6 p*** (2)

1.3 A boy pushes a motor car with a constant force of 400 N. The car experiences a constant frictional force of 100 N while it is moving.



The magnitude of the force exerted by the car on the boy is . . .

A 100 N
B 200 N
C 300 N
D 400 N (2)

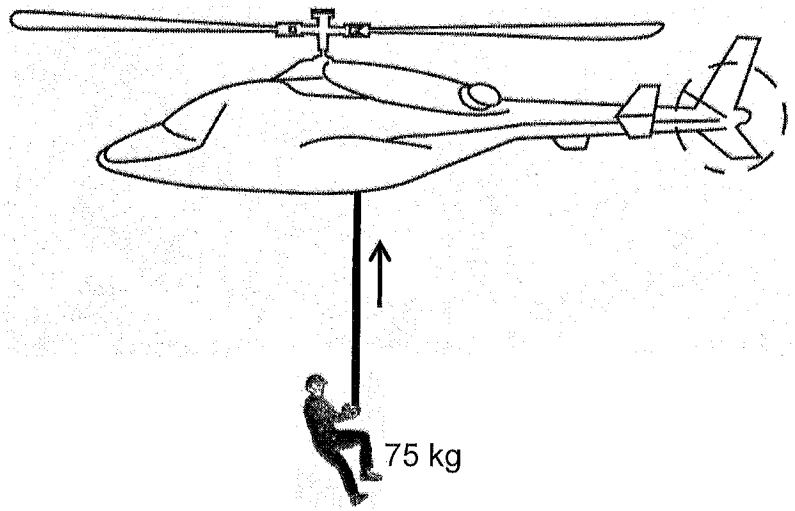
1.4 A rocket of mass, M, has a weight, W, on the surface of the earth. The rocket is blasted off to a height equal to the earth's radius. At this point the mass of the rocket has decreased to ½ M because some of the fuel has been used up. The gravitational force of attraction between the rocket and the earth at this height is . . .

A 4 W
B 8 W
C ½ W
D ⅛ W (2)

[8]

QUESTION 2 (Start on a new page)

During a rescue mission, a stationary helicopter lifts a soldier of mass 75 kg, vertically upwards at a constant acceleration of 0,4 $m \cdot s^{-2}$, by means of a rope. Ignore the effects of air friction when answering the following questions.



2.1 State Newton's Second Law of Motion, in words. (2)

2.2 Draw a labelled free-body diagram showing all the forces acting on the soldier while he is being lifted vertically upwards. (3)

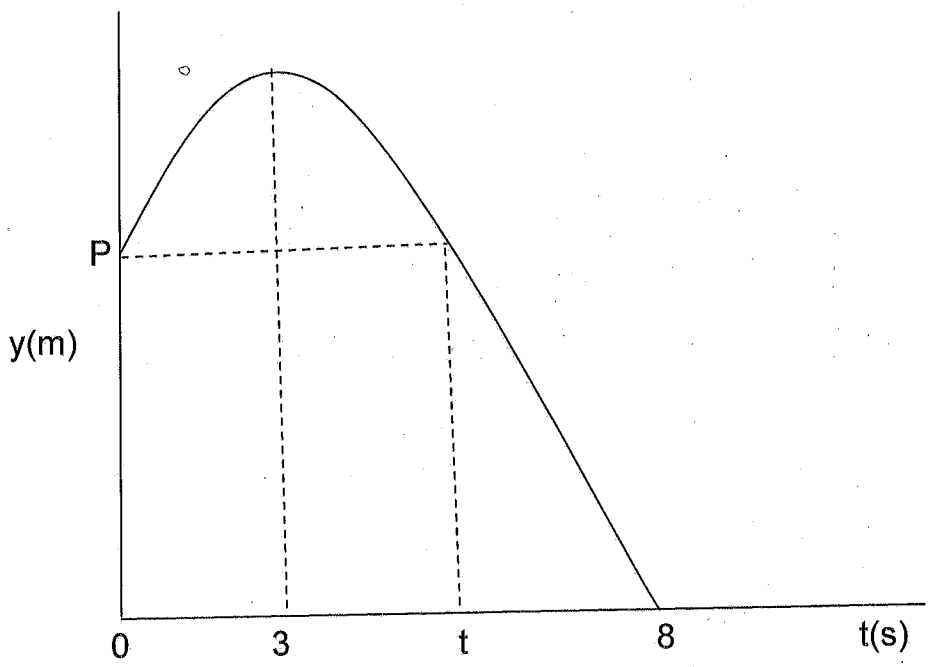
2.3 Calculate the magnitude of the force which the rope exerts on the soldier while the soldier is accelerating upwards at 0,4 $m \cdot s^{-2}$. (4)

The helicopter now accelerates vertically downwards.

2.4 How will the tension in the rope be affected?
(Choose from INCREASES, DECREASES, NO EFFECT) (2)
[11]

QUESTION 3 (Start on a new page)

The position-time graph (not drawn to scale), represents the motion of a projectile that is fired vertically upwards from a point, P, above the ground.



Ignore the effects of air friction when answering the following questions.

3.1 How does the magnitude of the initial velocity of the projectile compare with the magnitude of the velocity at time t? (Write down GREATER THAN, EQUAL TO OR LESS THAN) (1)

3.2 What is the value of t? (1)

3.3 How does the acceleration of the projectile at 3 s compare to its acceleration at t? (Write down GREATER THAN, EQUAL TO OR LESS THAN) (1)

3.4 Calculate the magnitude of the velocity with which the projectile was fired vertically upwards. (3)

3.5 Calculate the height of point P. (4)

3.6 Sketch a labelled acceleration-time graph in your answer book for the entire motion of the projectile. (3)
[13]

QUESTION 4 (Start on a new page)

The diagram below represents a minibus of mass 3 200 kg travelling at 12 $m \cdot s^{-1}$ on a straight horizontal road to the right. A car of mass 1 400 kg is travelling towards the minibus on the same road.

The minibus collides with the car. Both vehicles come to an immediate stop after the collision. The above system must be taken as a closed system.

4.1 What is meant by a CLOSED SYSTEM? (2)

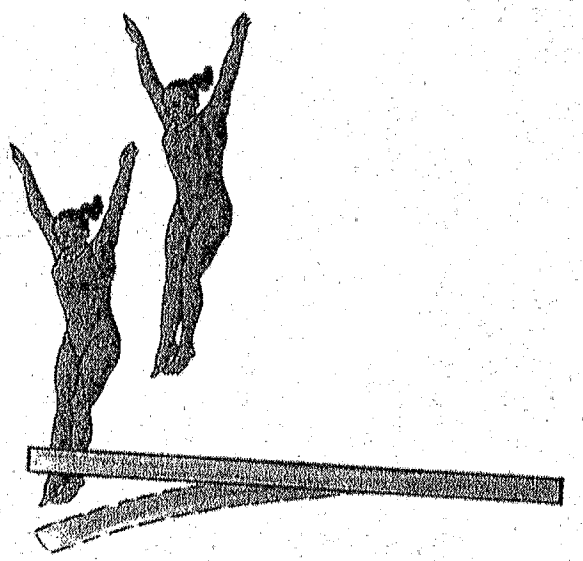
4.2 How does the magnitude of the initial momentum of the minibus compare to the magnitude of the initial momentum of the car?
(Choose from GREATER THAN, EQUAL TO OR LESS THAN) (1)

4.3 State, without performing a calculation, whether the collision between the minibus is elastic or inelastic. (2)

4.4 The speed limit on this road is 20 $m \cdot s^{-1}$.
Determine, by doing the necessary calculations, whether the car was travelling within the speed limit. (5)
[10]

QUESTION 5 (Start on a new page)

The diagram below represents a diver, of mass 75 kg, jumping into the air from the end of a diving board.



The diver lands on the diving board with a speed of 6 $m \cdot s^{-1}$. Her feet is in contact with the board for 0,8 s before she bounces off the board. The diving board exerts a net force of 1 500 N on the diver while she is in contact with the board.

5.1 Define *impulse* in words. (2)

5.2 Calculate the speed with which the diver rebounds after landing on the diving board. (5)

5.3 Give the name of the theorem that you used to answer question 5.2 above. (1)

[8]

TOTAL: 50

DATA FOR PHYSICAL SCIENCES (PHYSICS) GRADE 12

GEGEWENS VIR FISIESE WETENSKAPPE (FISIKA) GRAAD 12

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant	G	6,67 x 10^{-11} $N.m^2.kg^{-2}$

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* $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$
$K = E_k = \frac{1}{2}mv^2$	

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p = mv_f - mv_i$	$F_g = mg$
$F = \frac{Gm_1m_2}{r^2}$	

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MARKING MOMORANDUM

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This memorandum consists of 3 pages.

QUESTION 1

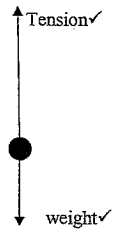
1.1 C✓✓
1.2 B✓✓
1.3 D✓✓
1.4 D✓✓

4 X 2 = [8]

QUESTION 2

2.1 When a resultant(net) force acts on an object, the object will accelerate in the direction of the force. This acceleration is directly proportional to the force✓ and inversely proportional to the mass of the object. ✓ (2)

2.2



Tension greater than weight✓
(length of arrows)

(3)

2.3 $F_{net} = ma$✓

$T + (-Fg) = ma$

$T + -(75 \times 9,8)$ ✓ $= (75 \times 0,4)$✓

$T = 765$ N✓ (4)

2.4 decreases✓✓ (2)
[11]

QUESTION 3

3.1 equal to✓ (1)

3.2 6s✓ (1)

3.3 equal to✓ (1)

3.4 $v_f = v_i + a\Delta t$✓

$0 = v_i + (-9,8)(3)$✓

$= 29,4$ m.s^{-1} ✓ (3)

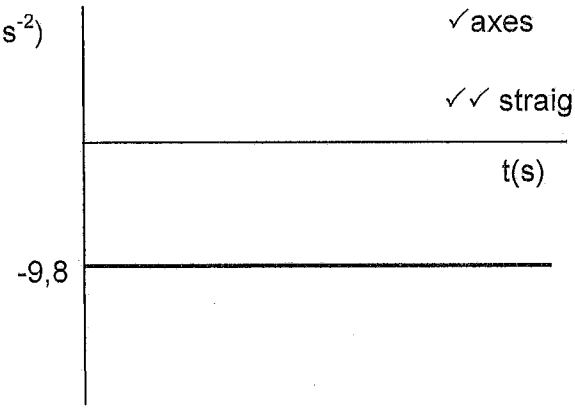
3.5 $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓

$= (29,4)(8)$ ✓ $+ \frac{1}{2}(-9,8)(8)^2$✓

$= -78,4$ m

height $= 78,4$ m✓ (4)

3.6



✓axes

✓✓ straight line parallel to the X-axis

(3)

If candidates draw above X-axis maximum 2 marks.

[13]

QUESTION 4

4.1 No external forces act on the system✓✓ / Net external force is zero (2)

4.2 equal to✓ (1)

4.3 inelastic✓✓ (2)

4.4 Total p before = Total p after

$(mv_i)_{minibus} + (mv_i)_{car} = (mv_f)_{minibus} + (mv_f)_{car}$ ✓

(3 200 x 12) ✓ + $(1\ 400 \times v_i)_{car}$ ✓ = 0

$(v_i)car = -27{,}43\ m.s^{-1}$✓

Since the speed of the car is greater than 20 $m.s^{-1}$, the car has exceeded the speed limit. ✓ (5)

[10]

QUESTION 5

5.1 product of the net force and the time for which the force acts.✓ ✓ (2)

5.2 Take downward motion as negative

$F_{net}\Delta t = m\Delta v$✓

(1500) ✓ (0,8) ✓ = 75✓ (v_f - (-6))

$V_f = 10\ m{\cdot}s^{-1}$ ✓

OR

Take downward motion as positive

$F_{net}\Delta t = m\Delta v$✓

(-1500) ✓ (0,8) ✓ = 75✓ (v_f - 6)

$V_f = -10\ m{\cdot}s^{-1}$ ✓ (5)

5.3 impulse-momentum theorem✓ (1)

[8]

TOTAL: [50]