Basic Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES: PHYSICS (P1)

COMMON TEST

MARCH 2016

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 50

TIME : 1 hour

This question paper consists of 6 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 FOUR 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 SHEET.
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.

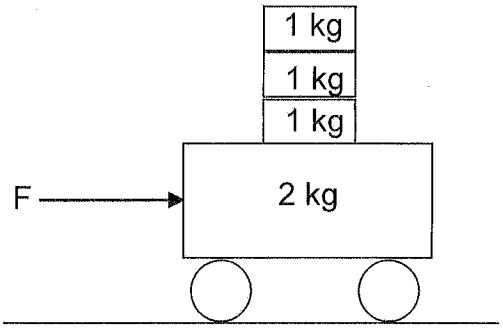
QUESTION 1: MULTIPLE- CHOICE QUESTIONS

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

1.1 A ball is thrown vertically upwards from a point P above the ground. The ball is caught at point P as it falls on its return. Which ONE of the following statements concerning the rate of change of the velocity of the ball, is TRUE?

A It is directed downwards.
B It will be in the same direction as the displacement.
C It changes from a negative value to a positive value.
D It becomes zero when it reaches its maximum height. (2)

1.2 The sketch below shows three 1 kg mass pieces placed on top of a trolley of mass 2 kg.



A force of magnitude F is applied to the 2 kg trolley. The trolley experiences an acceleration of *a*. If one of the 1 kg mass pieces falls off while F is still applied to the 2 kg trolley, the 2 kg trolley will accelerate at . . .

A *0,8 a*
B *a*
C *1,25 a*
D *2 a* (2)

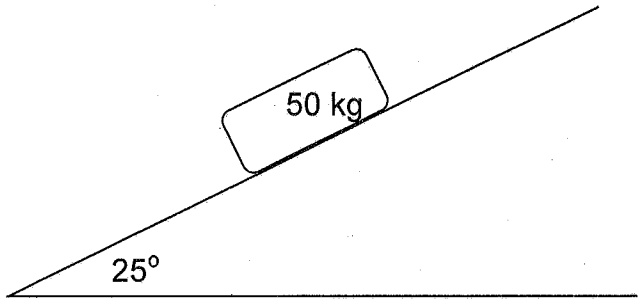
1.3 A spaceship has a mass of X on Earth. It is sent into space and lands on a planet which has a mass twice that of the Earth and a radius ½ that of the Earth. The mass of the spaceship on this planet is . . .

A ¼ X
B ½ X
C X
D ⅛ X (2)

[6]

QUESTION 2 (Start on a new page)

A block of mass 50 kg accelerates at 2,50 $m \cdot s^{-2}$ down a rough surface that makes an angle of 25° with the horizontal as shown in the diagram below:



The block moves down the incline. Ignore the effects of air resistance.

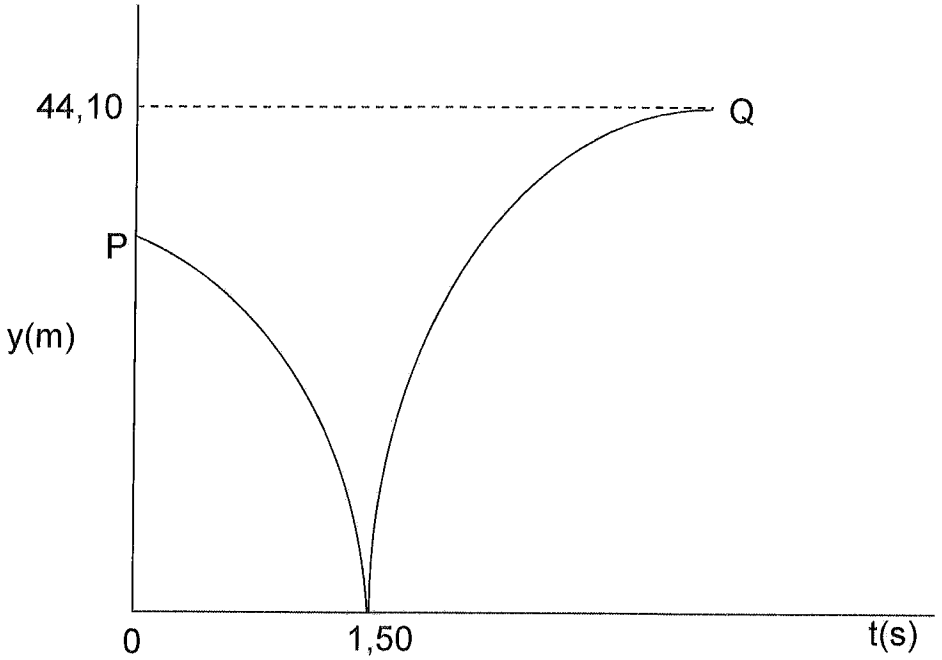
2.1 Draw a labelled force diagram showing all the forces acting on the block as it accelerates down the rough surface. (3)

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

2.3 Calculate the co-efficient of kinetic friction between the 50 kg block and the rough surface. (7)
[12]

QUESTION 3 (Start on a new page)

The position-time graph (not drawn to scale), represents the motion of a ball of mass 0,20 kg that was projected vertically downwards from a point, P above the ground. The ball hits the ground and immediately bounces to a maximum height of 44,10 m.(point Q)



The collision of the ball with the ground is ELASTIC.
Ignore the effects of air resistance.

3.1 How long, in seconds, does the ball take to hit the ground from point P? (1)

3.2 Calculate the velocity with which the ball bounced off the ground. (4)

3.3 Write down, without performing a calculation, the magnitude of the velocity with which the ball hit the ground from point P.
Give a reason for your answer. (2)

3.4 Calculate the magnitude of the velocity with which the ball was initially projected downwards from point, P. (4)

3.5 Sketch a velocity-time graph to show the motion of the ball from point P to point Q . Indicate the following on the graph:

(a) initial velocity of the ball.
(b) time taken by the ball to reach the ground from point P.
(c) velocity with which the ball strikes the ground.
(d) velocity with which the ball bounces off the ground.

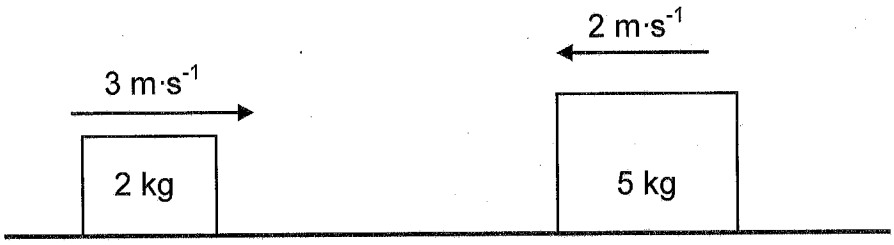
(5)

3.6 Use the graph that you have sketched in question 3.5 above to determine the height P from which the ball was thrown.
(You may <u>not</u> use equations of motion) (3)

[19]

QUESTION 4 (Start on a new page)

Two blocks of masses 2 kg and 5 kg respectively move towards each other on a horizontal frictionless surface, with velocities of 3 $m \cdot s^{-1}$ to the right and 2 $m \cdot s^{-1}$ to the left, as shown below:



The blocks collide. After the collision, the 2 kg block moves to the left at 1 $m \cdot s^{-1}$.

4.1 State the Principle of Conservation of Linear Momentum. (2)

4.2 Calculate the velocity of the 5 kg block after the collision. (4)

4.3 During the collision the 5 kg block exerts a force of magnitude 10 N on the 2 kg block.

Calculate the contact time for the collision. (4)

4.4 Write down the magnitude of the force that the 2 kg block exerts on the 5 kg block. (1)

4.5 How does the impulse of the 5 kg block compare with that of the 2 kg block. Give a reason for the answer. (2)

[13]

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*

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p = mv_f - mv_i$	$F_g = mg$
$F = \frac{Gm_1m_2}{r^2}$	
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$

Paper 1 + 2

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MARKING MEMORANDUM

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 50

TIME : 1 hour

This memorandum consists of 5 pages.

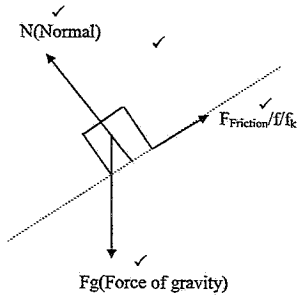
QUESTION 1

1.1 A✓✓
1.2 C✓✓
1.3 C✓✓

3 X 2 = [6]

QUESTION 2

2.1



-1 for any additional forces.

Accept components of weight for force of gravity Both components must be shown✓(1 mark)

(3)

2.2 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. ✓✓

OR

The net force acting on an object is equal to the rate of change of momentum of the object. ✓✓ (2or 0)

2.3

$F_{net} = ma$✓
$Fg_{parallel} + (-F_f) = ma$
$mg\sin\theta + (-F_f) = ma$
$50 \times 9,8 \times \sin 25°$✓ $- F_f = 50 \times 2,5$✓
$F_f = 82,08$ N
$F_f = u_kN$✓
$= u_kmg\cos\theta$
82,08 ✓ $= u_k \times 50 \times 9,8 \cos 25°$ ✓
$u_k = 0,18$✓

(7)

Note: Do not award final mark if a unit is written

Note: If $F_f = -82,08$ N then the angle should be $(90 + 25)° = 115°$

[12]

QUESTION 3

3.1 1,5 s✓ (1)

3.2 $v_f^2 = v_i^2 + 2a\ y$✓
0^2✓ $= v_i^2 + 2(-9,8)(44,1)$✓
$v_i = 29,4\ m.s^{-1}$ upwards ✓

OR

$v_f^2 = v_i^2 + 2a\ y$✓
0^2✓ $= v_i^2 + 2(9,8)(-44,1)$✓
$v_i = 29,4\ m.s^{-1}$ upwards

Note for this option max.:3/4 as from the graph downward motion is taken as negative.

(4)

3.3 29,4 $m.s^{-1}$ ✓
Collision is elastic✓OR
Velocity with which the ball hits the ground is equal to velocity with which it bounces✓OR the kinetic energy before the ball strikes the ground is equal to he kinetic energy after the ball strikes the ground (2)

3.4 $v_f = v_i + a\Delta t$✓
$-29,4$✓ $= v_i + (-9,8)(1,5)$✓
$v_i = -14,7\ m.s^{-1}$
$v_i = 14,7\ m.s^{-1}$ downwards ✓

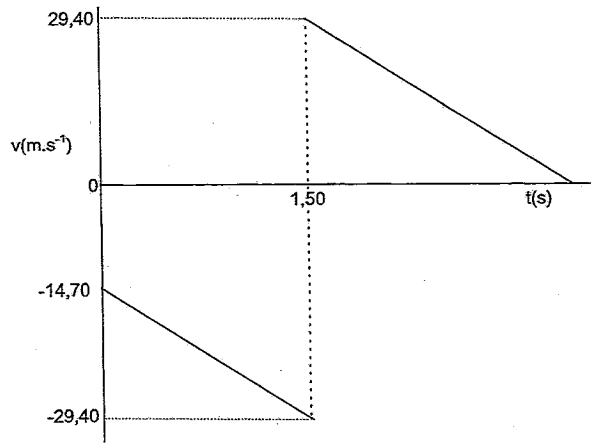
OR

$v_f = v_i + a\Delta t$✓
$29,4$✓ $= v_i + (9,8)(1,5)$✓
$v_i = -14,7\ m.s^{-1}$
$v_i = 14,7\ m.s^{-1}$ downwards ✓

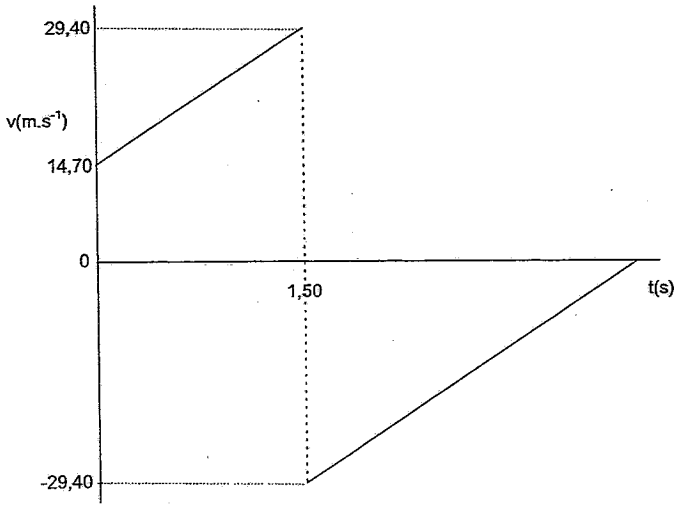
Donot penalise for direction again

(4)

3.5



OR



(1) Initial velocity -14,70 $m.s^{-1}$✓
(1) Both velocities(29,40 and -29,40) must be shown✓
(2) time (1,5 s)✓
(3) correct shape from 0 to 1,5 s✓
(4) correct shape from 1,5 s until v = 0, parallel to (3 above) ✓

3.6 Use of equations of motion zero marks

displacement = area under the graph

= ½ (sum of the parallel sides) x h

= ½(-14,70 + (-29,40)) ✓ x 1,5✓

= -33,075 m

Height of P above the ground = 33,075 m✓

OR

Dispalcement = (l x b) + (½b x h)

= (-14,70 x 1,5) ✓ + (½ x 1,5 x -14,70) ✓

= -33,075 m.

Height of P above the ground = 33,075 m✓ (3)

[19]

QUESTION 4

4.1 Total linear momentum of an isolated system remains constant in magnitude and direction/total linear momentum of an isolated system is conserved. ✓✓ (2 or 0)

4.2 Total p before = Total p after

$(mv_i)_{2kg} + (mv_i)_{5kg} = (mv_f)_{2kg} + (mv_f)_{5kg}$ ✓

(2 x 3) + (5 x -2) ✓ = (2 x -1) + 5vf ✓

Vf = 0,4 $m.s^{-1}$ to the left ✓ (4)

4.3 $F_{net}\Delta t = m(v_f - v_i)$ ✓

$-10\Delta t$✓ = 2(-1 - (+ 3)) ✓

Δt = 0,8 s✓

OR

$F_{net}\Delta t = m(v_f - v_i)$ ✓

$10\Delta t$✓ = 5(-0,4 - (- 2)) ✓

Δt = 0,8 s✓ (4)

4.4 10 N✓ (1)

4.5 equal in magnitude ✓ force of the same magnitude acts on both blocks for the same period of time. ✓ (2)

[13]

TOTAL MARK: [50]