Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES (PHYSICS) P1

COMMON TEST

MARCH 2018

NATIONAL SENIOR CERTIFICATE

GRADE 11

TIME: 1 hour

MARKS: 50

This question paper consists of 8 pages and one 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 SHEET.

9. Show ALL formulae and substitutions in ALL calculations.

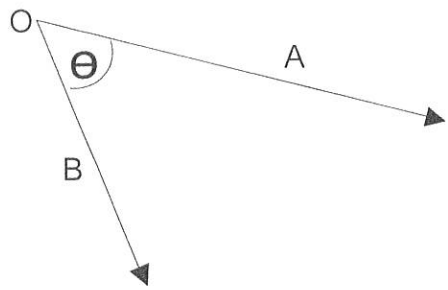
10. Round off your final numerical answers to a minimum of TWO decimal places.

11. Give brief motivations, discussions, et cetera where required.

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 1.5 D.

1.1 Two forces A and B act at the same point O as shown in the sketch below.



When the angle Θ between the forces changes, the resultant force obtained varies between 12 N and 6 N. What is the possible magnitude of the larger applied force?

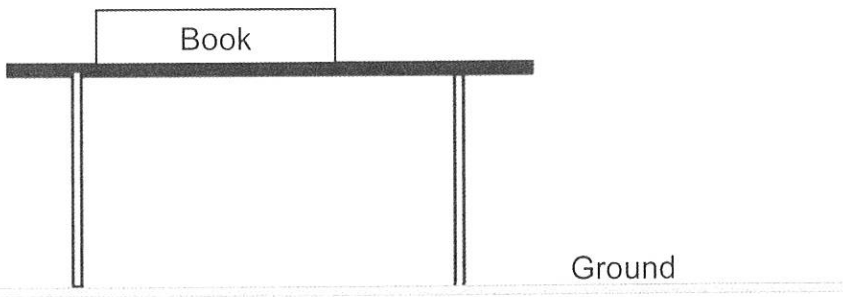
A 3 N

B 18 N

C 6 N

D 9 N (2)

1.2 A book of mass 80 g is at rest on a horizontal table.



The Reaction force to the book's weight is .....

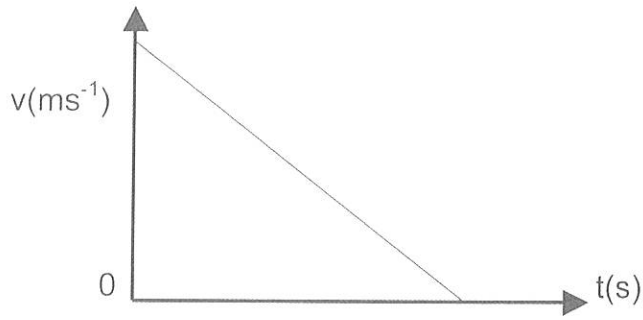
A The force exerted by the book on the table.

B The force exerted by the table on the book.

C The force of the Earth on the book

D The force of the book on the Earth. (2)

1.3 The velocity-time graph below represents the motion of a body along a frictionless horizontal surface.



Which one of the statements below is **INCORRECT** for this motion?

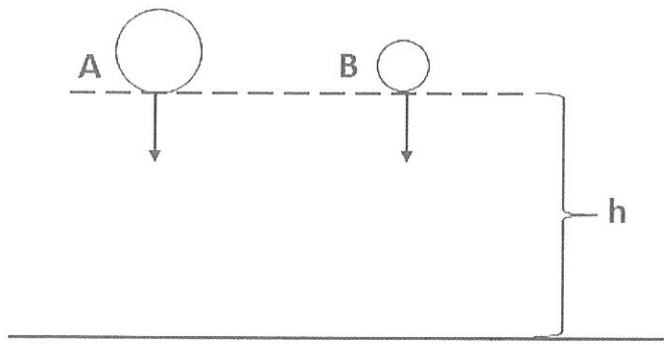
A The acceleration is constant, and is opposite to the direction of motion.

B The acceleration is constant, and in the same direction to the motion.

C A constant net force acts on the body but in the opposite direction to the motion.

D A constant applied force acts on the body in the opposite direction to the motion. (2)

1.4 Two objects A and B are released from the same height(h) at the same time. The weight of A is twice that of B.



If we ignore the effects of air resistance, we would notice that:

A Object A strikes the ground first.

B Object B strikes the ground first.

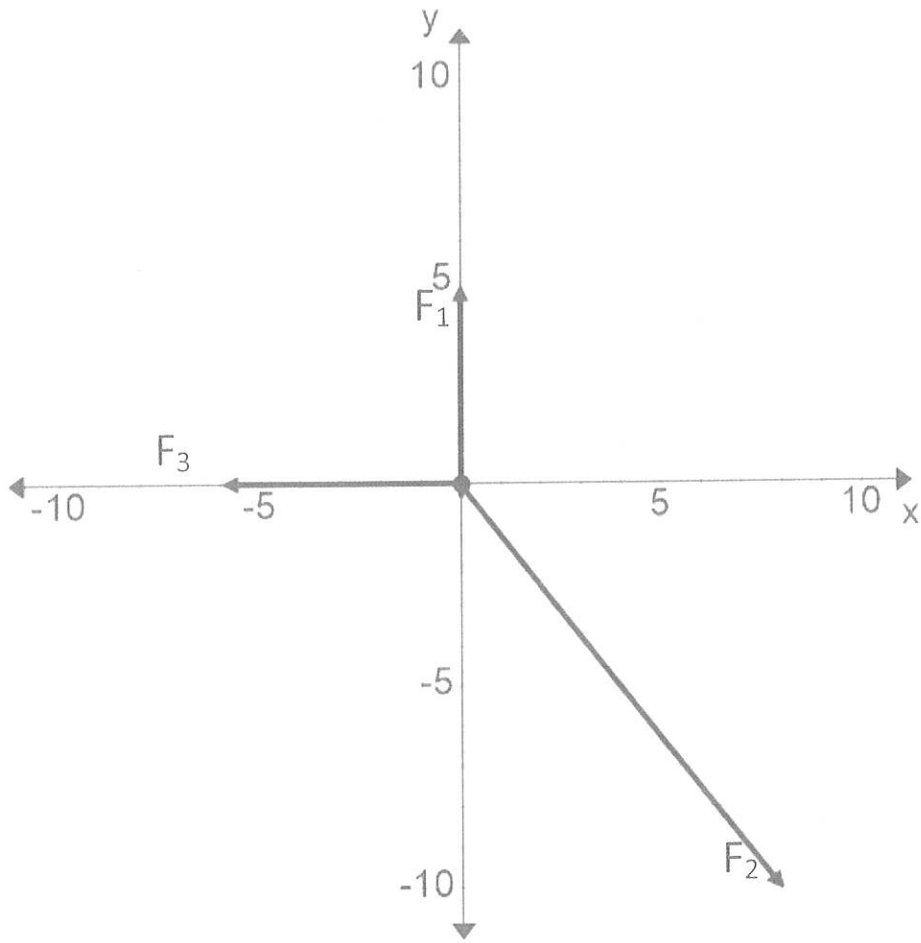
C They both strike the ground at the same time.

D They both strike the ground at the same time, but with different velocities.

(2)
[8]

QUESTION TWO

Three forces F_1, F_2 and F_3 act at a point, as shown on the Cartesian plane in the diagram below.



Scale: 1 square unit represents 1 N

2.1 Define the "resultant vector" (2)

2.2 Write down the X-component and Y-component for force F_2. (2)

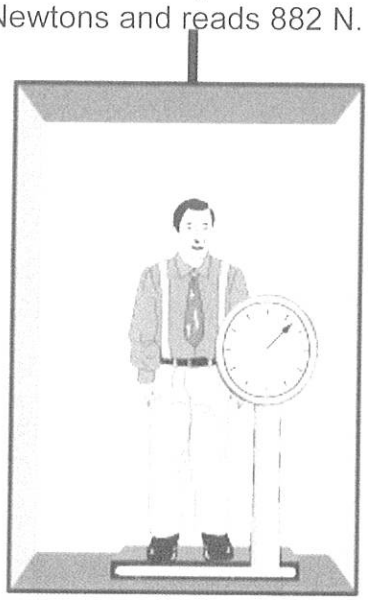
2.3 Calculate the NET horizontal component for the forces F_1, F_2 and F_3 (1)

2.4 Calculate the NET vertical component for the forces F_1, F_2 and F_3 (1)

2.5 Calculate the magnitude and direction of the resultant force of these three forces. (4)
[10]

QUESTION THREE

A man stands on the scale in a stationary lift as shown in the diagram below.
The scale is calibrated in Newtons and reads 882 N.



(Image adapted from **Fundamentals of Physics Extended** -10th edition)

3.1 Calculate the mass of the man. (2)

3.2 Draw and label a free body diagram to show the forces acting on the man. (2)

The Lift begins to move.

3.3 Calculate the reading on the scale when the lift is moving:

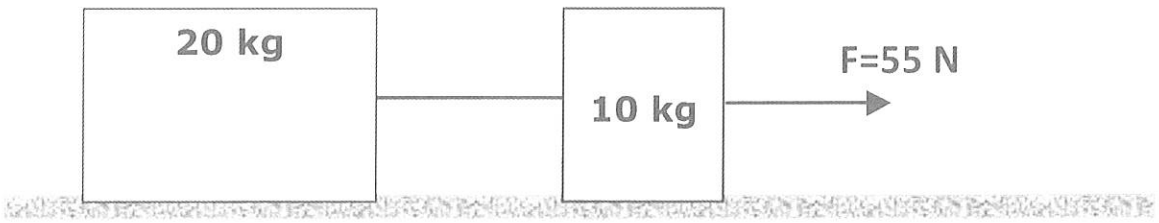
3.3.1 Downwards at constant velocity of 4 $m \cdot s^{-1}$. (2)

3.3.2 Upwards with a uniform acceleration of 2 $m \cdot s^{-2}$ (3)

[9]

QUESTION FOUR

Two wooden blocks of mass 20 kg and 10 kg are placed on a rough horizontal surface. A rope connects the two blocks.
When a horizontal force, F, of magnitude 55 N is applied to the blocks as shown, the blocks accelerate to the right at 0,36 $m \cdot s^{-2}$.



The kinetic frictional force between the 20 kg block and the surface is **TWICE** that between the 10 kg block and the surface.

4.1 State Newton's Second law of motion in words. (2)

4.2 Draw a labeled free body diagram to show all the **HORIZONTAL FORCES** acting on the 10 kg block as it moves. (3)

4.3 By applying Newton's 2nd law of motion separately to each of the blocks, calculate:

4.3.1 The magnitude of the frictional force between the 10 kg block and the surface. (5)

4.3.2 μ_K, the coefficient of kinetic friction between the blocks and the surface. (3)

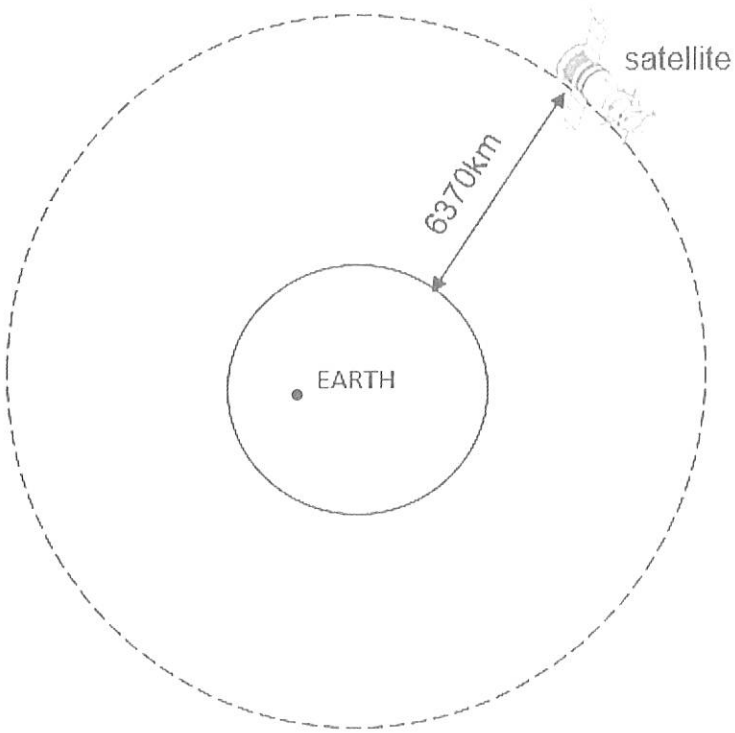
The rope connecting the two blocks is now cut.

4.4 How will this affect the acceleration of the 10 kg block?
(Choose from: INCREASES, DECREASES or REMAINS THE SAME.)
Explain. (3)
[16]

QUESTION FIVE

5.1 State Newton's Law of Universal Gravitation in words. (2)

5.2 A satellite of mass 225 kg orbits the Earth at an altitude of 6370 km.



If the gravitational force of attraction between the Earth and the satellite is 551,33 N, calculate the mass of the Earth. (5)
[7]

TOTAL MARKS :50

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m\cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6,67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	$6,38 \times 10^{6}\ m$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$\mu_s = \frac{f_{s(max)}}{N}$
$\mu_k = \frac{f_k}{N}$	

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MARKING GUIDELINE

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This marking guideline consists of 5 pages.

QUESTION ONE

1.1 D ✓✓
1.2 D ✓✓
1.3 B ✓✓
1.4 C ✓✓

4x2=[8]

QUESTION TWO

2.1 It is a single vector that can represent a number of vectors acting on an object in both magnitude and direction. ✓✓ (2 or 0) (2)

2.2 X- component : 8 N ✓

Y- component : –10 N ✓ (2)

2.3 $R_X = F_{1x} + F_{2x} + F_{3x} = 0+8+(-6) = 2$ N✓ **(Positive marking from Q2.2)** (1)

2.4 $R_Y = F_{1y} + F_{2y} + F_{3y} = 5 + (-10) + 0 = -5$ N ✓**(Positive marking from Q2.2)** (1)

2.5 $R_{NET}^2 = R_X^2 + R_Y^2$
$= (2)^2 + (-5)^2$ ✓ **(Positive marking from Q2.3 and Q2.4)**

$R_{NET} = 5,39$ N ✓

$\tan \Theta = \frac{O}{a} = \frac{5}{2}$ ✓

$\Theta = 68,20^0$ with respect to the positive x-axis.✓ (4)

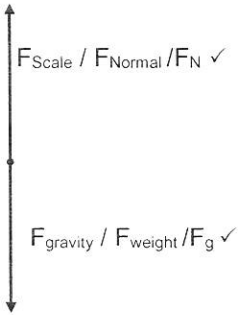
or Θ =21,80 with respect to the negative y-axis. ✓

[10]

QUESTION THREE

3.1 $W = m \cdot g$
$882 = m \cdot 9,8$ ✓
$m = 90$ kg ✓ (2)

3.2



$F_{Scale} / F_{Normal} / F_N$ ✓

$F_{gravity} / F_{weight} / F_g$ ✓ (2)

Take downward motion as positive

3.3.1 $F_{NET} = m \cdot a$
$F_g + (-F_{scale}) = m \cdot a$
$882 - F_{scale} = 0$ ✓
$F_{scale} = 882$ N ✓ (2)

NB : $F_{scale} = m \cdot g$
$= 90 \cdot 9,8$
$= 882$ N✓
Max mark : 1/2

3.3.2 Take upward motion as positive
$F_{NET} = m \cdot a$
$F_{scale} + (-F_g) = m \cdot (a)$ ✓ (any one)
$F_{scale} + (-882) = 90(2)$✓
$F_{scale} = 1062$ N ✓ (3)

[9]

QUESTION FOUR

4.1 If a non zero NET force acts on an object, then the object accelerates in the direction of the NET force where the acceleration of the object is directly proportional to the NET force and inversely proportional to the mass of the object.✓✓ (2 or 0) (2)

4.2 **10kg block**

1 mark - label and vector (3)

4.3.1 **Consider the 10kg mass**

$F_{NET} = m \cdot a$
$F + (-T) + (-f_B) = m \cdot a$ ✓ (any one)
$55 - T - f = 10(0,36)$
$T = 51,4 - f$ ✓.....(1)

If masses are added , then maximum 3/5

Consider the 20kg mass

$F_{NET} = m \cdot a$
$T + (-2f) = 20(0,36)$
$T = 7.2 + 2f$ ✓.....(2)

Equating (1) and (2)

$51,4 - f_K = 7.2 + 2f$ ✓ (1 mark for equating the two equations)
$f_K = 14,73$ N
The Kinetic frictional force on the 10kg block = 14,73N ✓ / $f_{k10kg} = 14,73$N ✓ (5)

4.3.2 $f_K = \mu_K \cdot N$
$f_K = \mu_K \cdot m \cdot g$ ✓ (any one) ⊕
$2(14,73) = \mu_K \cdot (20)(9,8)$ ✓ or $14,73 = \mu_K \cdot (10)(9,8)$ ✓
$\mu_K = 0,15$✓ $\mu_K = 0,15$ ✓ (3)

4.4 Increase ✓ , ⊖
When the string is cut, the accelerating mass decreases ✓and since the acceleration is inversely proportional to mass, the acceleration increases.✓

or the mass of the system decreases✓ and by Newton's second law, the acceleration will increase✓ (3)

[16]

QUESTION FIVE

5.1 Everybody in the universe attracts every other body with a gravitational force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres. ✓✓ (2 or 0) (2)

5.2 $F = \frac{G.m_1.m_2}{r^2}$

$551,33 = \frac{6,67 \times 10^{-11} \times m_1 \times 225}{(6,38 \times 10^6 + 6,37 \times 10^6)^2}$

$m_1 = 5,97 \times 10^{24}$ kg✓ (5)
[7]