Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

COMMON TEST

MARCH 2018

MARKS: 50

TIME : 1 hour

This question paper consists of 6 pages and a 1-page data sheet.

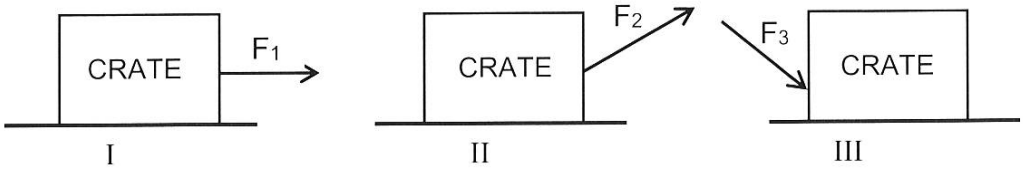
INSTRUCTIONS AND INFORMATION TO CANDIDATES

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 – 1.4) in the ANSWER BOOK, for example 1.5 D.

1.1 A heavy crate is at rest on a rough horizontal surface. Three different forces, each applied to the crate, attempt to move the crate as shown in the diagram.

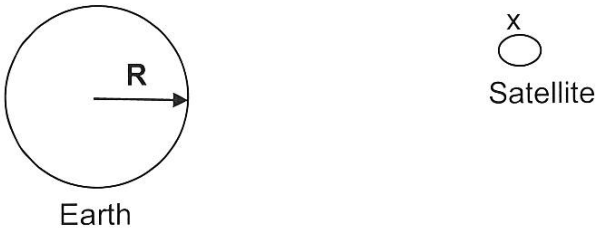


In each case, the crate is just at the point of moving.

The maximum force of static friction between the crate and surface is …

A Greatest in situation (I)
B Greatest in situation (II)
C Greatest in situation (III)
D Equal in all three situations. (2)

1.2 A satellite orbits Earth at a point x, where the gravitational force is a quarter (¼) of the gravitational force it experiences on the surface of the Earth.



If the radius of the Earth is **R**, then the height of the satellite ABOVE THE SURFACE of Earth will be …

A 4R
B 2R
C R
D ½R (2)

1.3 The net force acting on an object is a measure of the _____ of the object.

A Change in kinetic energy
B Rate of change of kinetic energy
C Rate of change of momentum
D Change in momentum (2)

1.4 Two balls **P** and **Q** are thrown into the air simultaneously from the same height above the ground. **P** is thrown vertically upwards and **Q** vertically downwards with the same initial speed. Neglect air resistance. Take downwards as the positive direction.

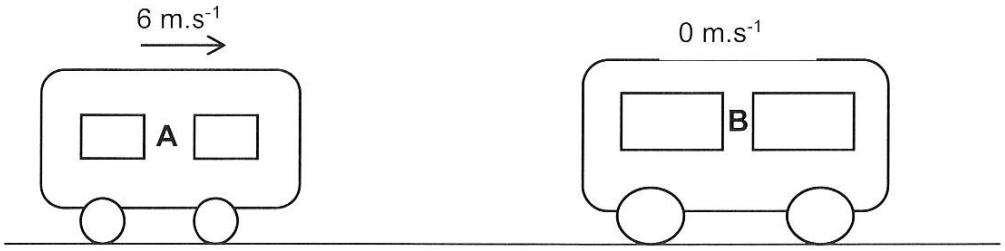
Which of the following is TRUE for **P** and **Q** when they hit the ground?

	VELOCITY	**ACCELERATION**
A	Both have the same velocity	Both have the same acceleration
B	**P** has a greater velocity than **Q**	**P** has a negative acceleration; **Q** has a positive acceleration
C	**P** has a greater velocity than **Q**	Both have the same acceleration
D	Both have the same velocity	**P** has a negative acceleration; **Q** has a positive acceleration.

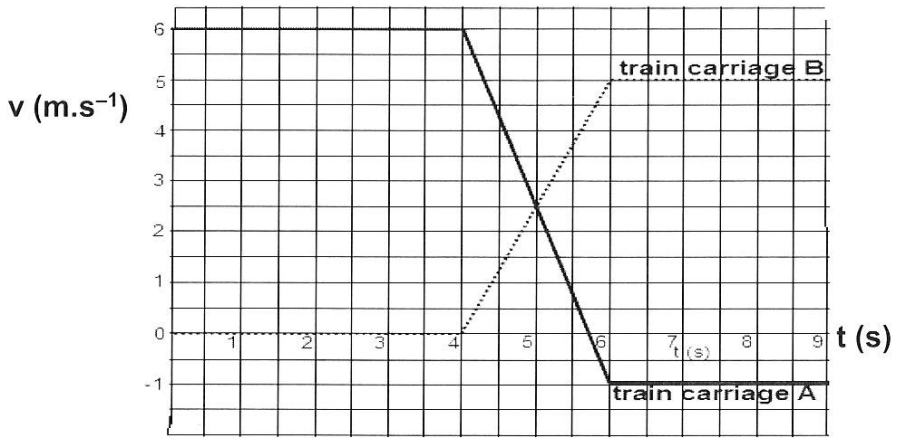
(2)
[8]

QUESTION 2

A train carriage **A** of mass 3000 kg is moving horizontally to the right at 6 $m.s^{-1}$. It collides with another train carriage **B** of mass 4200 kg that is initially at rest, as shown in the diagram below.



The graph below shows the variation with time *t* of the velocities of the two train carriages before, during and after the collision.



2.1 Define *momentum*. (2)

2.2 Determine, by means of appropriate calculations, whether the total momentum of the system is conserved or not after the carriages collided. (6)

2.3 Calculate the average net force exerted by train carriage A on B. (5)
[13]

QUESTION 3

A hot-air balloon is rising vertically upwards with a constant speed of 2.5 $m.s^{-1}$(Figure 1). When the balloon is at a certain height (h) above the ground, an object is accidentally dropped from the balloon. The object reaches the ground 4 s later.

Figure 2 shows the velocity time sketch graph (where **down is positive**) for the vertical motion of the object from the moment it is dropped until it hit the ground.

Neglect air resistance. (**g = 9,8 $m.s^{-2}$**)

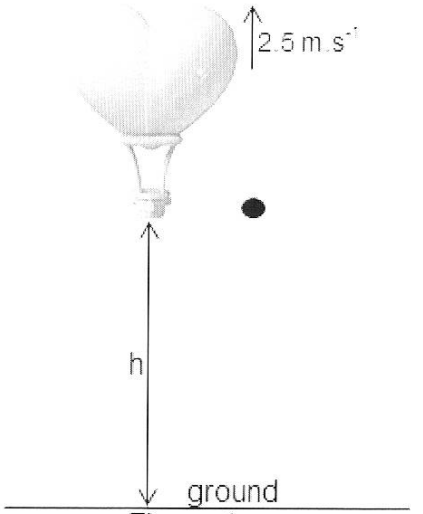


Figure 1

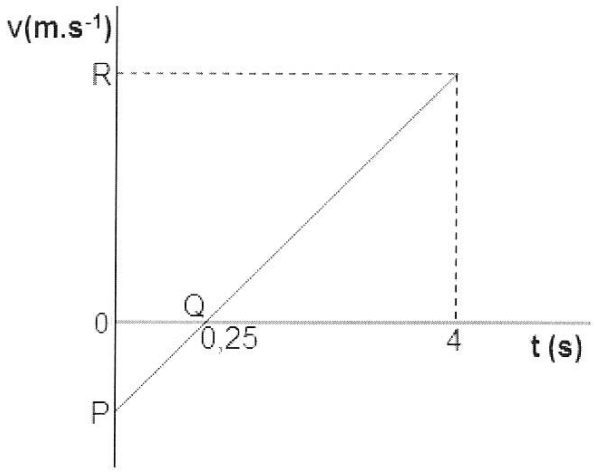


Figure 2

3.1 Define a *projectile*. (2)

3.2 What is the magnitude and direction of the velocity of the object at point **P**. (2)

3.3 What physical quantity does the gradient of the graph correspond to? (1)

3.4 What is the significance of point **Q** on the graph with respect to the motion of the object? (2)

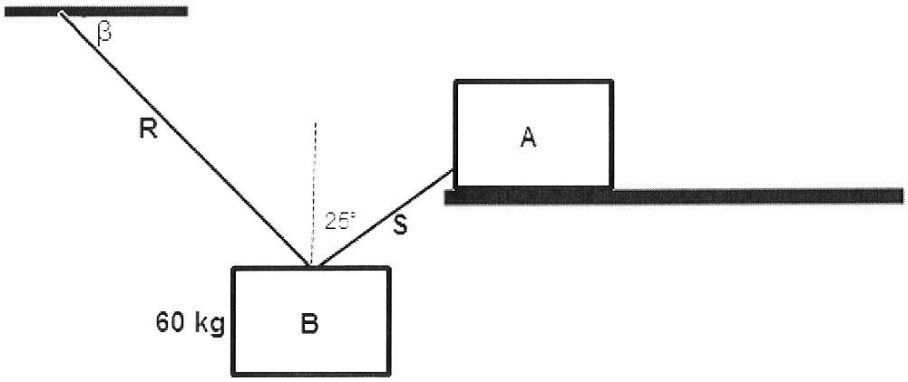
3.5 USING THE GRAPH ONLY (No equations of Motion), calculate:

3.5.1 The velocity of the object when it hits the ground. (5)

3.5.2 The height, h, from which the object was dropped. (4)
[16]

QUESTION 4

Block **A**, that is at rest on a horizontal rough surface, is used as an anchor to hold block **B**, of mass of 60 kg, in the air at a certain height above the ground. The two blocks are connected with rope **S** that makes an angle of 25° with the vertical. Block **B** is suspended from the ceiling by cable **R** that makes an angle of **β** with the ceiling.



Block **A** experiences a frictional force of magnitude 150 N. The entire system is in equilibrium . Neglect air resistance.

4.1 Define *frictional force*. (2)

4.2 What is the magnitude of the resultant force acting on block **B**? (1)

4.3 Draw a labelled free-body diagram indicating all the forces acting on block **B**. (3)

4.4 Calculate the vertical component of the force in cable **R**. (5)

4.5 Calculate the angle, **β**, between cable **R** and the ceiling. (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} $N.m^2.kg^{-2}$

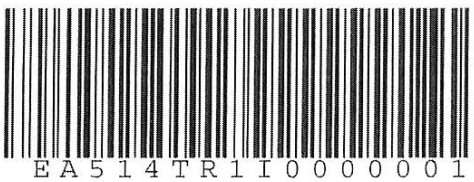
TABLE 2: FORMULAE/*TABEL 2: FORMULES*

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*

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

Department:
Education
PROVINCE OF KWAZULU-NATAL

PHYSICAL SCIENCES P1

MEMORANDUM

COMMON TEST

MARCH 2018

NATIONAL SENIOR CERTIFICATE

GRADE 12

N.B. This memorandum consists of 4 pages including this page.

PHYSICAL SCIENCES PAPER ONE

QUESTION 1

1.1 C✓✓ (2)
1.2 C✓✓ (2)
1.3 C✓✓ (2)
1.4 A ✓✓ (2)
[8]

QUESTION 2

2.1 The product of mass and velocity of the object. ✓✓ (2)

2.2 total $p_{before} = m_A v_A + m_B v_B$
$= (3000)(6) + (4200)(0)$ ✓
$= 18000$ kg.m.s^{-1} ,to the right ✓ any one ✓

total $p_{after} = m_A v_A + m_B v_B$
$= (3000)(-1) + (4200)(5)$ ✓
$= 18000$ kg.m.s^{-1} ,to the right✓
Total p_{before} = total p_{after}
Momentum is conserved ✓ (6)

2.3
$F_{net} = \frac{m(v_f - v_i)}{\Delta t}$ ✓
$= \frac{4200\checkmark(5 - 0)}{2\checkmark}$ ✓
$= 10500$ N to the right ✓

OR

$F_{net} = \frac{m(v_f - v_i)}{\Delta t}$ ✓
$= \frac{3000\checkmark(-1 - 6)\checkmark}{2\checkmark}$
$= -10500$ N (to the right)
$F_{net} = 10500$ N to the right ✓ (5)

[13]

QUESTION 3

3.1 An object upon which the only force acting is the force of gravity. ✓ ✓ (2)

3.2 2.5 m.s^{-1} ✓upwards ✓ (2)

3.3 (Gravitational) acceleration ✓ (1)

3.4 Maximum height reached by the object. ✓ ✓ (2)

3.5 **If equations of motion are used for the 3.5.1 and 3.5.2 subtract 2 marks for each question.**

3.5.1 gradient = $\frac{\Delta v}{\Delta t}$

$9,8 = \frac{v_R - v_P}{t_f - t_i}$ ✓

$9,8 = \frac{v_R + 2,5}{4 - 0}$ ✓ ✓ numerator and denominator

v_R = 36,70 m.s^{-1} ✓ (downwards) ✓

Note: If point R and Q are used the answer is 36,75 m.s^{-1} (5)

$V_f = V_i + at$ ✓
$= -2,5 + (9,8)(4)$ ✓
$= 36,70\ m.s^{-1}$ Down ✓
(3)

Positive marking from 3.5.1

3.5.2 Height = Area of Δ_1 + Area of Δ_2 ✓ 3,75

= (½) x (0,25) x (-2,5) + (½) x (4 – 0,25) x (36,7) ✓✓

= 68,69 m ✓

OR

Height = Area of trapezium of the v – t graph. ✓
= ½(2,5 + 36,7)(3,5) ✓✓
= 68,60m ✓ (4)

$\Delta y = v_i t + \frac{1}{2} a t^2$
$= (-2,5)(4) + 4,9(16)$
$= 68,4\ m$ ✓ (2 M)

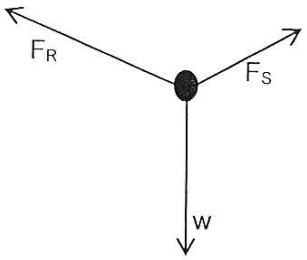
[16]

QUESTION 4

4.1 The force that opposes the motion of an object ✓and acts parallel with the surface. ✓ (2)

4.2 0 N✓ (Accept 0 / Zero) (1)

4.3



Notes : Accepted Labels		Mark
w	weight / F_G / F_g	✓
F_R	Tension force in cable / T_R	✓
F_S	Tension force in rope / T_S	✓
	Any additional force: deduct 1 mark (maximum ⅔)	
	Lines must touch object otherwise (maximum ⅔)	
	Subtract one mark if arrows are not shown (maximum ⅔)	

(3)

4.4

$\Sigma F_X = 0$
$F_S.\sin 25° - 150 = 0$ ✓
$F_S = 354.93$ N
Any one ✓

$\Sigma F_Y = 0$
$F_{R,Y} + F_{S,Y} = mg$
$F_{R,Y} + (354.93).\cos 25°$ ✓ $= (60)(9.8)$ ✓
$F_{R,Y} = 266.32$ N ✓

OR

$\tan 25° = \frac{150}{F_{s,v}}$ ✓
$F_{S,V} = 321,68$
Then, $\Sigma F_Y = 0$ ✓
$F_{R,V} = 60 \times 9,8$ ✓ $- 321,68$ ✓
$= 266,32$ N ✓

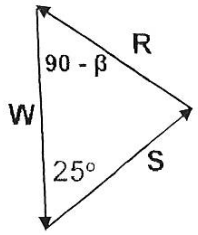
(5)

Positive marking from 4.4

4.5

$\tan \beta = \frac{266,32}{150}$ ✓
$\beta = 60,61°$ ✓

OR



W = 588N
S = 354,93 N
R = ?

$R^2 = W^2 + S^2 - 2WS\cos 25°$
$R^2 = 588^2 + 354,93^2 - 2(588)(354,93)\cos 25°$ ✓
R = 305,66

$305,66\sin(\mathbf{90° - \beta}) = \mathbf{354,93\sin 25°}$
β = 60,61°✓

(2)
[13]

TOTAL MARKS: 50