Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

COMMON TEST

JUNE 2014

MARKS: 100

TIME: 2 hours

This question paper consists of 9 pages and 2 data sheets.

PHSCE1

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name in the appropriate spaces on the **ANSWER BOOK**.
2. This question paper consists of SEVEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between the subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, et cetera, where required.
11. 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 – 1.7) in the ANSWER BOOK, for example 1.8 E.

1.1 A ball is projected vertically upwards. If air friction is ignored, which ONE of the following statements about the motion of the ball is INCORRECT, at the instant the ball changes direction?

A The velocity of the ball is zero.
B The momentum of the ball is zero.
C The acceleration of the ball is zero.
D The kinetic energy of the ball is zero. (2)

1.2 Two identical spheres X and Y exert a force, F, on each other as shown in the following diagram:

The mass of sphere X is doubled. Which ONE of the following diagrams best represents the forces that X and Y exert on each other?

A

B

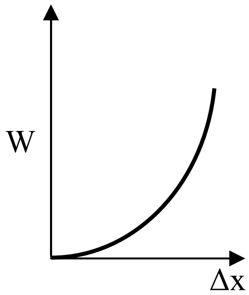
C

D

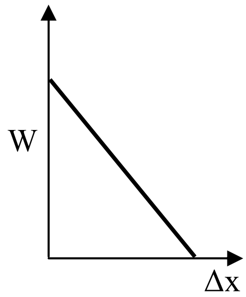
(2)

1.3 A constant net force acts on a body which is initially at rest. Which ONE of the following graphs best represents the net work done on the body as a function of the displacement of the body?

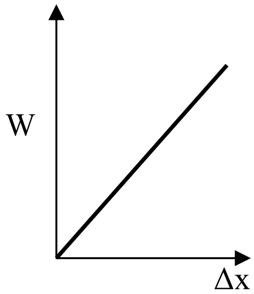
A



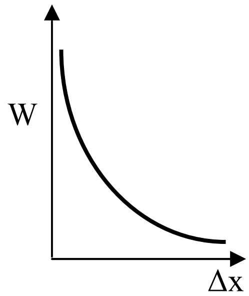
B



C



D



(2)

1.4 The product of mass and the rate of change in velocity of an object is known as ...

A net force.
B impulse.
C momentum.
D change in momentum. (2)

1.5 If the mechanical energy of a free falling body is conserved, then the ...

A frictional force acting on the body is zero.
B work done by the earth on the body is zero throughout its fall.
C gravitational potential energy is equal to the kinetic energy at any point in the motion.
D sum of the gravitational potential energy and kinetic energy at any point in the motion is zero. (2)

1.6 A taxi moves away with constant velocity from a man who is standing on the side of the road. The driver hoots as the taxi moves away. Which ONE of the following statements is correct?

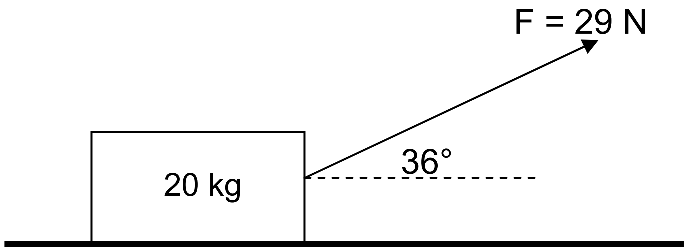
A The speed of the sound heard by the man is lower than the speed of the sound emitted by the taxi.
B The wavelength of the sound heard by the man is greater than the wavelength of the sound emitted by the taxi.
C The frequency of the sound heard by the man is higher than the frequency of the sound emitted by the taxi.
D Both the wavelength and the frequency of the sound heard by the man are less than the wavelength and frequency of the sound emitted by the taxi. (2)

1.7 An astronomer viewing light from distant galaxies observes a shift of spectral lines towards the red end of the visible spectrum. This shift provides evidence that the ...

A universe is expanding.
B temperature of the earth is increasing.
C earth is moving towards the distant galaxies.
D distant galaxies are moving closer towards the earth. (2)
[14]

QUESTION 2

A block of mass 20 kg is pulled at constant velocity to the right on a rough horizontal surface by a force, F, of magnitude 29 N. F acts at an angle of 36° to the horizontal as shown in the diagram below:



2.1 Draw a labelled free body diagram to show all the forces that act on the block as it moves to the right. (4)

2.2 Calculate the magnitude of the frictional force that acts on the block as it moves to the right. (3)

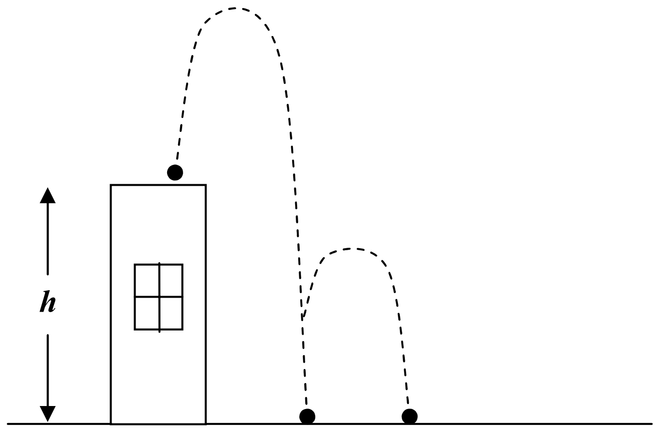
The force F now acts parallel to the surface.

2.3 Will the magnitude of the frictional force between the block and the surface INCREASE, DECREASE or REMAIN THE SAME. (1)

2.4 Give an explanation for your answer to QUESTION 2.3 by making reference to the relevant equation. (3)
[11]

QUESTION 3

A rubber ball is shot vertically upwards from the top of a building of height *h*. The ball strikes the ground below after 1,76 s. It then immediately bounces to a height of $\frac{1}{4}$ *h* and lands on the ground 2,9 s after it was shot.



Ignore the effects of air friction. (The time of contact of ball with the ground during the bounce may be neglected.)

3.1 Calculate the time taken for the ball to reach height $\frac{1}{4}$ *h* after it strikes the ground for the first time. (2)

3.2 Calculate *h*, the height of the building. (8)

3.3 Is the collision between the ball and the ground elastic or inelastic? Give a reason for your answer. (2)

3.4 Sketch the position-time graph for the motion of the rubber ball. Take the ground as reference. Clearly show the following on your graph:

- Height of building
- Height of first bounce
- The time when the ball strikes the ground the first time
- The time when the ball strikes the ground the second time (5)

[17]

QUESTION 4

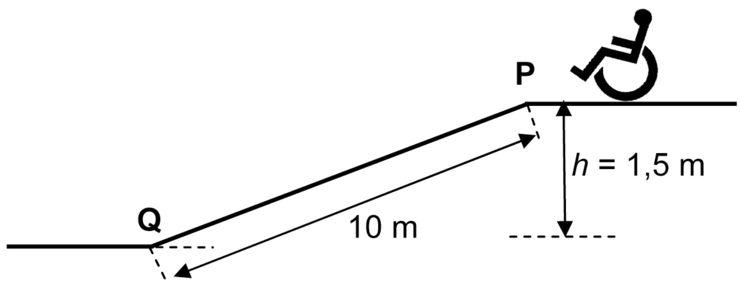
A boy in a wheelchair is moving to the right, as shown in the sketch below, at a constant speed of 3 $m.s^{-1}$ on a straight horizontal frictionless track. The combined mass of the boy and the wheelchair is 75 kg. A parcel of mass 2 kg is thrown horizontally, towards the boy with a speed of 5 $m.s^{-1}$.

4.1 Write down the *principle of conservation of linear momentum* in words. (2)

4.2 Calculate the velocity of the boy immediately after he catches the parcel. (4)
[6]

QUESTION 5

A health care worker, while pushing a patient on a wheelchair, approaches an incline plane of length 10 m and height 1,5 m, as shown in the diagram below.



The combined mass of the patient and the wheelchair is 120 kg.
A constant frictional force of 50 N acts on the wheelchair as it moves down the incline. The rotational effects of the wheels of the wheelchair may be ignored.

The worker exerts a force on the wheelchair, which is parallel to the plane, so that the wheelchair moves down the incline at a constant speed of 1,25 $m.s^{-1}$.

5.1 Is the mechanical energy of the wheelchair conserved while it moves down the incline? Give a reason for your answer. (3)

5.2 What is meant by a conservative force? (2)

5.3 Draw a labelled free body diagram showing the forces that act on the wheelchair as it moves down the incline. Indicate the following forces on your diagram:

- Normal force. Label this force A.
- Frictional force. Label this force B.
- The component of weight that acts parallel to the incline. Label this force C.
- The component of weight that acts perpendicular to the incline.
- Label this force D.
- The force exerted by the healthcare worker on the wheelchair parallel to the incline. Label this force E. (5)

5.4 Calculate the magnitude of the force C. (3)

5.5 Write down, without doing a calculation, the amount of work done on the wheelchair by force D. Give a reason for your answer. (2)

5.6 State, in words, the work-energy theorem. (2)

5.7 Calculate the work done on the wheelchair as it moves down the incline by the force labelled:

5.7.1 B (3)
5.7.2 C (2)

5.8 Use the work-energy theorem to calculate the work done on the wheelchair by the force labelled E. (4)

5.9 Determine the average power output of the health care worker as he takes the wheel chair down the incline. (6)
[32]

QUESTION 6

An ambulance with its siren on, is moving at a constant speed of 37,5 $m.s^{-1}$, towards an accident scene. A police officer, seated in his stationary car at the accident scene holds a detector in his hands. The detector can measure a maximum frequency of 580 Hz. Ignore the effects of wind when answering the following questions.

6.1 Calculate the frequency of the sound waves produced by the sound source in the ambulance so that the detector registers a maximum reading. Take the speed of sound in air as 340 $m.s^{-1}$. (4)

6.2 The phenomenon observed here, is the Doppler effect. Define the Doppler effect. (2)

6.3 The speed of the ambulance is increased to 41,5 $m.s^{-1}$. Will the detector now register a reading? Give a reason for your answer. (3)

6.4 How will the frequency of the sound wave observed by the driver in the ambulance compare to that emitted by the siren in the ambulance.
(Write down LESS THAN, EQUAL TO or GREATER THAN).
Give a reason for your answer. (2)

6.5 How is Doppler effect noticed with …

6.5.1 sound waves? (1)
6.5.2 light waves? (1)

6.6 Describe ONE positive impact of the Doppler effect in medicine. (3)
[16]

QUESTION 7

The sketch below shows a car travelling at a constant velocity of 140 $km.h^{-1}$ behind a truck travelling in the same direction at a constant velocity of 110 $km.h^{-1}$.

The driver of the car notices a red badge on the back of the truck that reads:

"If this badge is blue, you are driving too fast".

7.1 Use the Doppler effect to explain the claim made by the badge. (2)

7.2 By referring to the speed of light explain whether the claim made by the badge is possible. (2)
[4]

TOTAL SECTION B: 86
GRAND TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m\cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	G	$6,67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	$6,38 \times 10^6\ m$
Mass of the Earth *Massa van die Aarde*	M_E	$5,98 \times 10^{24}\ kg$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8\ m\cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}\ J\cdot s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^9\ N\cdot m^2\cdot C^{-2}$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$

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

FORCE/*KRAG*

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

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = F\Delta x\cos\theta$	$U = mgh$ or/*of* $E_P = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$	

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/*of* $E = h\frac{c}{\lambda}$
$E = W_o + E_k$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_k = \frac{1}{2}mv^2$	