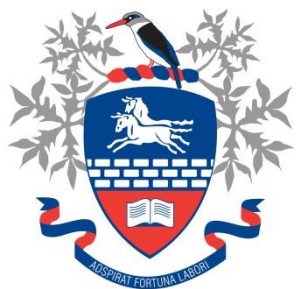


JUNE EXAM 2017



**HILLCREST HIGH SCHOOL**  
**PHYSICAL SCIENCE**  
**GRADE 12**  
**PAPER 1- PHYSICS**



**JUNE 2017**

**EXAMINER: M. GROBLER**

**TIME: 2 HRS**

**TOTAL 100**

## Instructions

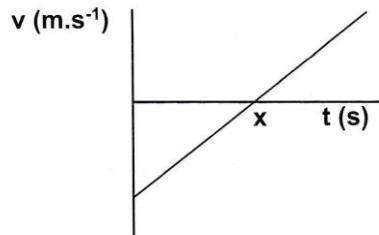
1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (10)  
SECTION B (90)  
  
Answer SECTIONS A and B in the ANSWER BOOK.
4. Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets and a periodic table are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to **two decimal** places

**SECTION A**

**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 (1.1-1.5) in the answer book.

1.1 A velocity versus time graph below shows the vertical motion of an object.



Which of the following correctly describes the displacement ( $\Delta y$ ) and acceleration of the object at point **X** indicated on the graph?

	Displacement (m)	Acceleration ( $\text{m.s}^{-2}$ )
A	Zero	-9.8
B	$\Delta y$	Zero
C	$-\Delta y$	9.8
D	$\Delta y$	9.8

(2)

1.2 A ball of mass  $m$  is thrown towards a wall with speed  $v$  and it rebounds with the same speed  $v$ . The force that the ball exerts on the wall is of magnitude  $F$ . If the collision lasts for time 't' seconds, what is the magnitude of the force that the wall exerts on the ball?

- A     $F$                       B     $mv$                       C     $\frac{mv}{t}$                       D     $\frac{\frac{1}{2}mv}{t}$

(2)

- 1.3 The weight of a man on the surface of the earth is  $w$ . If the man is in a spaceship whose distance from the surface of the earth is equal to the diameter of the earth, then the gravitational force of the earth on the man will be...

A  $\frac{w}{9}$       B  $\frac{w}{\sqrt{3}}$       C  $9w$       D  $\frac{w}{2}$

(2)

- 1.4 A net force  $F$  accelerates two isolated objects, **P** and **Q**, from rest on a straight line for time  $t$  as shown below. Object **P** experiences an acceleration of  $a$  and object **Q** an acceleration of  $2a$ .



If the amount of work done by the net force  $F$  on object **P** is equal to  $W$ , then the amount of work done on **Q** will be...

- A  $W$   
 B  $0.5 W$   
 C  $2 W$   
 D  $4 W$

(2)

- 1.5 A current is induced in a solenoid. Which of the following factors will not affect the potential difference induced across the ends of the solenoid?

- A The resistance of the solenoid.  
 B The number of turns of the solenoid  
 C The speed of the changing magnetic field used  
 D The strength of the magnetic field

(2)

**TOTAL SECTION A: [10]**

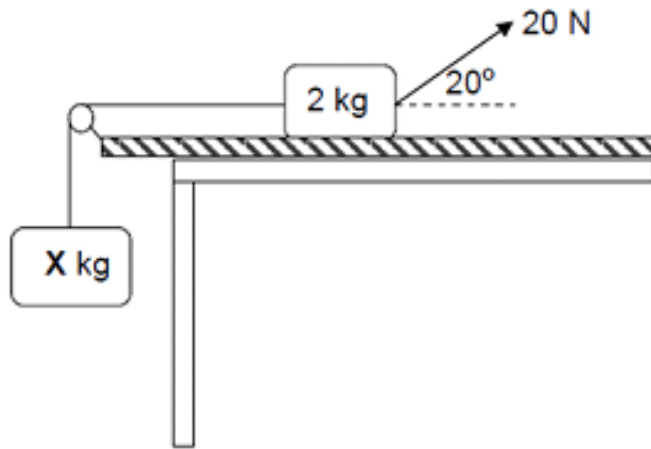
**SECTION B**

**INSTRUCTIONS**

1. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
2. Show the formulae and substitution in all calculations.
3. Round off your final numerical answers to TWO decimal places.

**QUESTION 2**

A block of mass 2 kg is connected with a light inextensible string that is hanging over a frictionless pulley, to another block of mass X kg. A force of 20 N is applied to the right at an angle of  $20^\circ$  to the horizontal on the 2 kg block while the block accelerates at  $4 \text{ m}\cdot\text{s}^{-2}$  to the left.



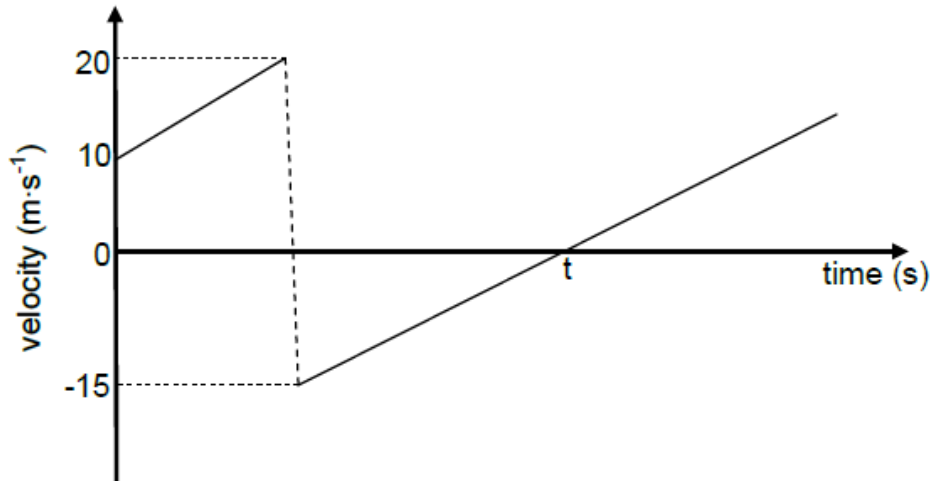
The coefficient of kinetic friction between the 2 kg block and the surface is 0,2. Ignore the effects of air friction.

- 2.1 State Newton's second law of motion in words (2)
- 2.2 Draw a labelled free-body diagram indicating ALL the forces acting on the 2 kg block. (4)
- 2.3 Calculate X, the mass of the hanging block. (8)

[14]

**QUESTION 3**

A ball of mass 0,15 kg is thrown vertically downwards from the top of a building to a concrete floor below. The ball bounces off the floor. The velocity versus time graph below shows the motion of the ball. Ignore the effects of air friction. TAKE DOWNWARD MOTION AS POSITIVE.



- 3.1 From the graph, write down the magnitude of the velocity at which the ball bounces off the floor. (1)
  - 3.2 Is the collision of the ball with the floor ELASTIC or INELASTIC? Refer to the data on the graph to explain the answer. (3)
  - 3.3 Calculate the:
    - 3.3.1 Height from which the ball is thrown (4)
    - 3.3.2 Magnitude of the impulse imparted by the floor on the ball (3)
    - 3.3.3 Magnitude of the displacement of the ball from the moment it is thrown until time  $t$  (4)
- [15]**

**QUESTION 4**

A car is travelling eastwards along a straight road. The driver sees an obstacle across the road, and then applies the brakes. Once applied, the brakes allow the car to slow down. Unfortunately, this is not sufficient, and the car crashes into the obstacle. The car hits the obstacle with a speed of  $4,674 \text{ m}\cdot\text{s}^{-1}$  and it takes  $0,2 \text{ s}$  for the car to come to a stop. The mass of the car and its driver is  $1100 \text{ kg}$ .



- 4.1 Define the term impulse. (2)
- 4.2 Calculate the change in momentum that the car experiences. (4)
- 4.3 Calculate the resultant force on the car during the collision. (3)

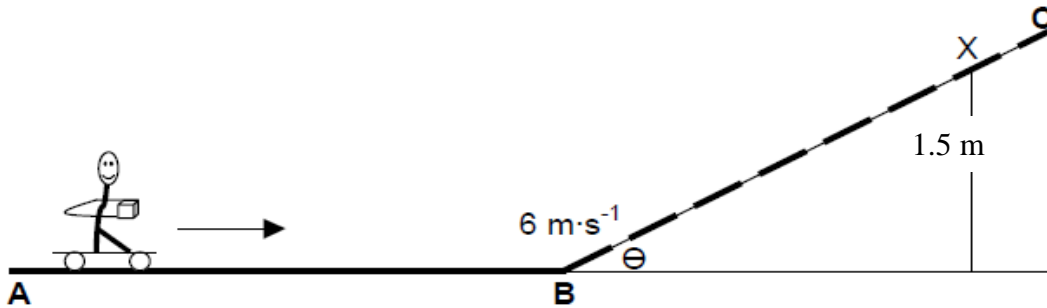
Luckily the driver is not injured in the collision. He is wearing a seatbelt, and as the car crashes into the obstacle, its airbags are deployed.

- 4.4 Using laws of Physics, explain how airbags can help to reduce the chance of injury in collisions such as this one. (3)

**[12]**

**QUESTION 5**

- 5.1 A boy on roller-skates moves at a constant velocity in an easterly direction along a frictionless horizontal part **AB** of a track carrying a parcel. He decides to increase his velocity by throwing the parcel horizontally away from him.

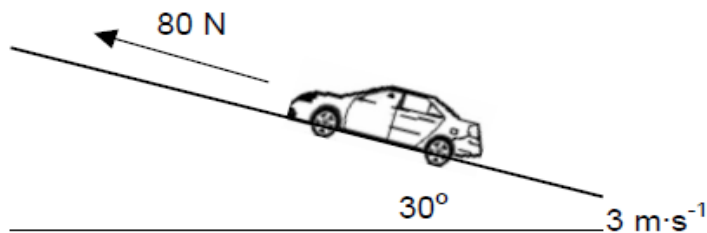


- 5.1.1 In which direction must the parcel be thrown to cause a maximum increase in the velocity of the boy? (1)
- 5.1.2 Name and define in words the law in physics that you have applied in QUESTION 5.1.1. (3)

On reaching point **B** at a velocity of  $6 \text{ m}\cdot\text{s}^{-1}$ , the boy on the roller-skates, with total mass  $57 \text{ kg}$ , continues to move up a rough section **BC** of the track and comes to rest at position **X**, height  $1.5 \text{ m}$ . The magnitude of the frictional force acting on the roller-skates, is  $40 \text{ N}$ .

- 5.1.3 Calculate value  $\Theta$  of the inclined plane. (6)

- 5.2 A remote controlled car is driven up an inclined plane at  $30^\circ$  to the horizontal as shown below. The car of mass  $4 \text{ kg}$ , experiences an average forward force of  $80 \text{ N}$ . A frictional force of  $15 \text{ N}$  is acting on the car as it moves up the plane. The speed of the car at the bottom of the inclined plane is  $3 \text{ m}\cdot\text{s}^{-1}$ .

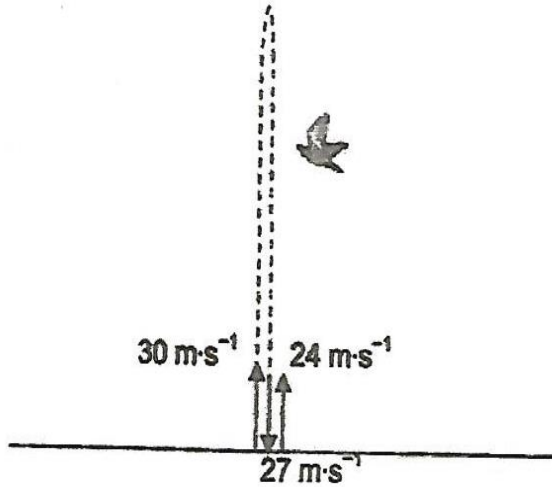


Use energy principles to calculate the speed of the car after it has travelled  $5 \text{ m}$  up the inclined plane.

(7)  
[17]

**QUESTION 6**

A cricket ball is hit vertically upwards at  $30 \text{ m}\cdot\text{s}^{-1}$  from the ground. After 4 s it strikes a bird flying by. The cricket ball then strikes the ground at  $27 \text{ m}\cdot\text{s}^{-1}$ . It bounces off the ground at a velocity of  $24 \text{ m}\cdot\text{s}^{-1}$  as illustrated below. Ignore the effects of friction.

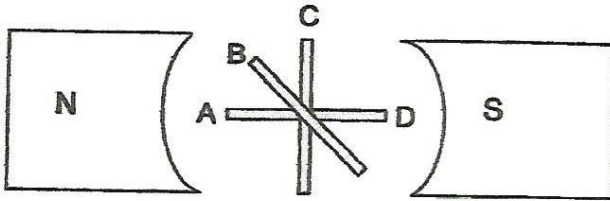


- 6.1 Calculate:
- 6.1.1 The time to reach the maximum height after it is hit upwards (3)
- 6.1.2 The height at which the cricket ball strikes the bird (4)
- 6.2 Sketch a position-time graph to represent the motion of the ball from the moment it is projected from the GROUND until it strikes the BIRD. Indicate the time  $t$  at which the ball strikes the bird. USE THE GROUND AS THE ZERO POSITION. (2)
- 6.3 Calculate the displacement of the cricket ball from the moment it strikes the bird till it reaches its maximum height after bouncing off the ground. (5)

[14]

**QUESTION 7**

7.1 The diagram below demonstrates the principle for the generation of electricity. Four positions of the coil, A, B, C and D are shown.



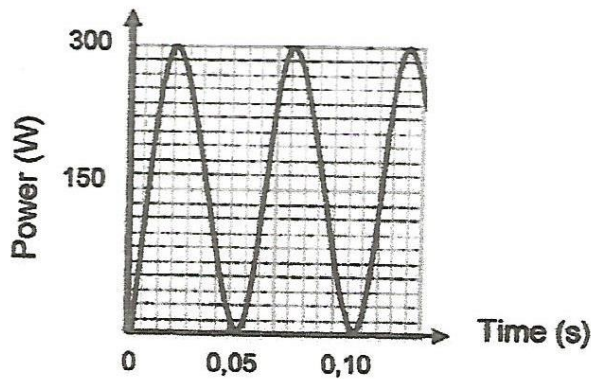
7.1.1 On what principle does a generator work? (1)

7.1.2 Is the magnetic flux passing through the coil at position C a MAXIMUM or a MINIMUM? (1)

7.1.3 At which position of the coil's rotation cycle will the maximum emf be induced? (Write only A, B or C.) Give an explanation to your answer. (3)

7.1.4 Sketch a graph of emf versus position of the coil for a clockwise rotation from A to D. Indicate the positions A, B, C and D on the graph. (4)

7.2 The graph below shows the power delivered by an AC source versus time. The peak/maximum voltage generated by the AC source is 80V.



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7.2.1 Name one advantage of alternating current. (1)

Calculate:

7.2.2 The rms current induced by the AC source. (5)

7.2.3 The frequency delivered by the AC source. (3)

**[13]**

**TOTAL SECTION B: [90]**

**GRAND TOTAL = 100**

**DATA FOR PHYSICAL SCIENCES GRADE 12  
PAPER 1 (PHYSICS)**

**GEGEWENS VIR FISIESTE WETENSAPPE GRAAD 12  
VRAESTEL 1 (FISIKA)**

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

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

**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**

$F_{\text{net}} = ma$	$p = mv$
$\mu_k = \frac{f_k}{N}$	$\mu_s = \frac{f_{s(\text{maks})}}{N}$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{r^2}$	$g = \frac{Gm}{r^2}$

**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 $E_k = \frac{1}{2} mv^2$	$W_{\text{net}} = \Delta K$ or/of $W_{\text{net}} = \Delta E_k$ $\Delta K = K_f - K_i$ or/of $\Delta E_k = E_{kf} - E_{ki}$
$W_{\text{nc}} = \Delta K + \Delta U$ or/of $W_{\text{nc}} = \Delta E_k + \Delta E_p$	$P_{\text{av}} = F v_{\text{av}}$ , $P_{\text{gemid}} = F v_{\text{gemid}}$
$P = \frac{W}{\Delta t}$	

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

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/of $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ $E = h \frac{c}{\lambda}$
$E = W_o + K_{\max}$ or/of $E = W_o + E_{k(\max)}$ where/waar $E = hf$ and/en $W_o = hf_o$ and/en $E_{k(\max)} = \frac{1}{2} m v_{\max}^2$ or/of $K_{(\max)} = \frac{1}{2} m v_{\max}^2$	

**ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE**

$R = \frac{V}{I}$	$\text{emf } (\epsilon) = I(R + r)$
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I \Delta t$
$W = Vq$ $W = VI \Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$

**ALTERNATING CURRENT/WISSELSTROOM**

$I_{\text{rms}} = \frac{I_{\text{max}}}{\sqrt{2}}$ / $I_{\text{wgk}} = \frac{I_{\text{maks}}}{\sqrt{2}}$ $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}}$ / $V_{\text{wgk}} = \frac{V_{\text{maks}}}{\sqrt{2}}$	$P_{\text{average}} = V_{\text{rms}} I_{\text{rms}}$ / $P_{\text{gemiddeld}} = V_{\text{wgk}} I_{\text{wgk}}$ $P_{\text{average}} = I_{\text{rms}}^2 R$ / $P_{\text{gemiddeld}} = I_{\text{wgk}}^2 R$ $P_{\text{average}} = \frac{V_{\text{rms}}^2}{R}$ / $P_{\text{gemiddeld}} = \frac{V_{\text{wgk}}^2}{R}$
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