HILLCREST HIGH SCHOOL

PHYSICAL SCIENCE

GRADE 12

PAPER 1- Physics

JUNE 2016
TIME: 2 HRS

Total 100

Instructions

1. Answer ALL the questions.

2. This question paper consists of TWO sections:

3. SECTION A (8)
   SECTION B (92)

   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

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and write down **A**, **B**, **C** or **D** next to the question number (1.1–1.10) on your ANSWER BOOK.

1.1 A builder throws a brick vertically upwards with an initial velocity of 7,35 $m \cdot s^{-1}$. When the brick reaches its maximum height, then the …

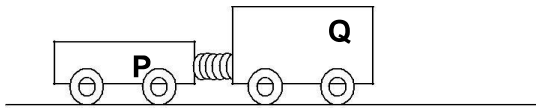
A. acceleration of the brick is 7,35 $m \cdot s^{-2}$ and its potential energy is a maximum.

B. velocity of the brick is 0 $m \cdot s^{-1}$ and its potential energy is a minimum.

C. velocity of the brick is 9,8 $m \cdot s^{-1}$ and its potential energy is a maximum.

D. acceleration of the brick is 9,8 $m \cdot s^{-2}$ and its kinetic energy is a minimum. (2)

1.2. Two trolleys, **P** and **Q**, of mass *m* and 2*m* respectively are at rest on a frictionless horizontal surface. The trolleys have a compressed spring between them.



The spring is released and the trolleys move apart. Which ONE of the following statements is TRUE?

A **P** and **Q** have equal kinetic energies.

B The speed of **P** is less than the speed of **Q**.

C The sum of the final kinetic energies of **P** and **Q** is zero.

D The sum of the final momentum of **P** and **Q** is zero. (2)

1.3. A spaceship experiences a weight 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 weight of the spaceship will be ...

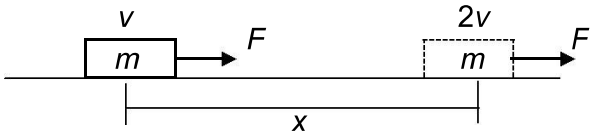
A 8X

B ½X

C X

D ¼X (2)

1.4. An applied force F accelerates an object of mass m on a horizontal frictionless surface from a velocity v to a velocity $2v$.



The net work done on the object is equal to **...**

A. $\frac{1}{2}mv^2$.

B. mv^2.

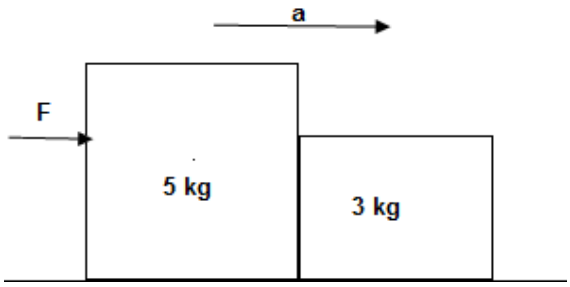
C. $\frac{3}{2}mv^2$

D $2mv^2$. (2)

[8]

Question 2

A system of two blocks, in contact with each other accelerates to the right as shown in the diagram below. The coefficient of friction between the surface and each block is 0, 1. The applied force F = 25 N.



2.1. State Newton's second law in words. (2)

2.2. Draw a free-body diagram showing all **horizontal** forces acting on a 5kg block? (3)

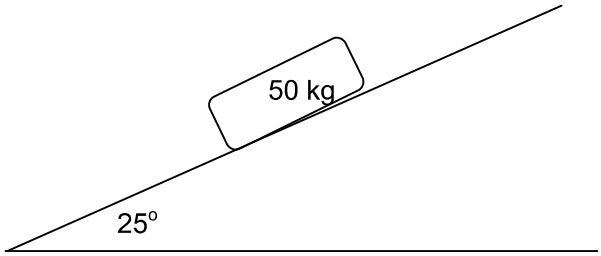
2.3. Calculate the magnitude of the acceleration (a) for the whole system.(5)

2.4. If the horizontal surface was replaced by an inclined surface of the same material. How will the coefficient of friction change? Only write INCREASE, DECREASE OR REMAIN THE SAME. Explain your answer (2)

[12]

QUESTION 3

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



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

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

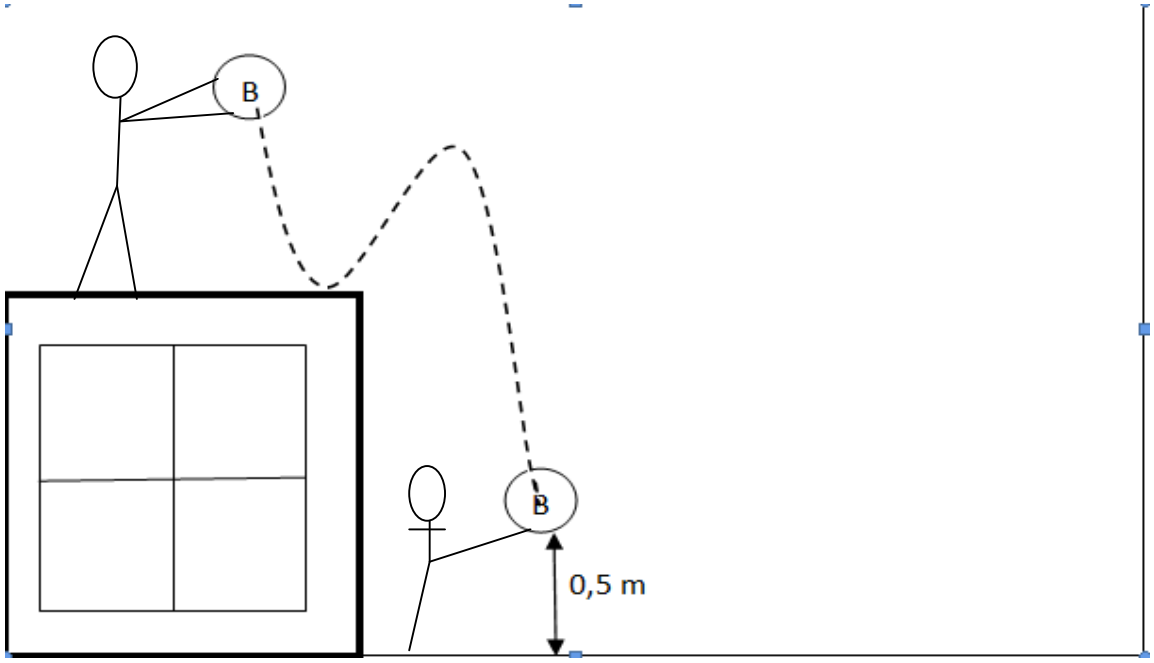
3.2 Calculate the co-efficient of kinetic friction between the 50 kg block and the rough surface. (7)

[10]

Question 4

A ball is kicked vertically upwards from a distance of 0,5 m above the ground. The initial velocity of the ball is 15 $m.s^{-1}$, the ball continues moving in the upward direction until it reaches maximum height. On its way down it hits the flat roof of the building and bounces up once before Linda catches it at maximum height, which is 0,1 m above the roof. It takes 2,53 s for the ball to reach the top of the building.

The diagram bellow shows the path travelled by the ball during the motion (NOT DRAWN TO SCALE)



For all calculations ignore the effects of air friction and take downwards as negative.

4.1. The ball is in free-fall motion, explain the term free-fall (2)

4.2. At maximum height the velocity of the ball is zero, how will the acceleration of the ball at maximum height compare to the acceleration on top of the building. Only write GREATER THAN, LESS THAN OR EQUAL TO. Explain your answer.(2)

4.3. Calculate the height of the building. (4)

4.4. Calculate the velocity at which the ball hits the top of the building. (4)

4.5. Calculate the velocity at which the ball leaves the roof after the first bounce.(3)

4.6. Draw a velocity time graph that represent the entire motion of the ball. Show the following coordinates. Ignore the impact time with the ground. (6)

- The initial velocity
- The velocity at which the ball hits the roof.
- The velocity at which the ball leaves the roof.

[21]

Question 5

A delivery truck of mass 5000 kg moving at 10m.s^{-1} to the right collides with a car of mass 2000 kg moving at 15m.s^{-1} in the opposite direction. Immediately after the collision, the car moves at 5m.s^{-1} to the right.

5.1. Write down the principle of conservation of momentum in words. (2)

5.2. Calculate the velocity of the delivery truck immediately after the collision. (4)

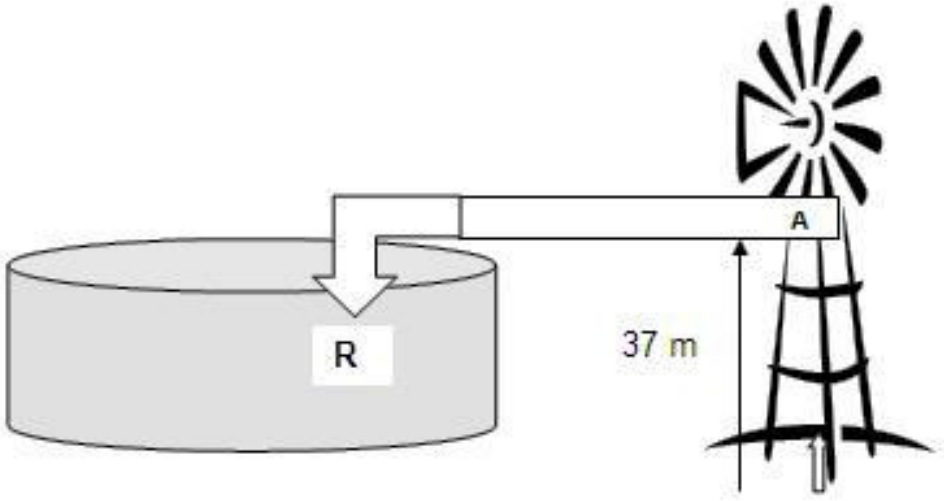
5.3. How will the force exerted by a delivery truck on a car compare to the force exerted by the car on a delivery truck? Only write GREATER THAN, EQUAL TO OR LESS THAN. Explain your answer. (2)

5.4. Passengers in a delivery truck will sustain less injuries than those in the car, use physics to explain why this statement is true. (3)

[11]

QUESTION 6

A windmill is used on a farm to pump water out of a well that is 37 m deep. The water flows past point A, 37 m above the well to the dam with a constant velocity of 2 m•s^{-1}.



6.1. Calculate how much energy is necessary to pump 90 kg of water out of the well to point **A**. (4)

6.2 It is necessary to pump 90 kg of water per minute. What is the maximum power that the windmill must produce? (3)

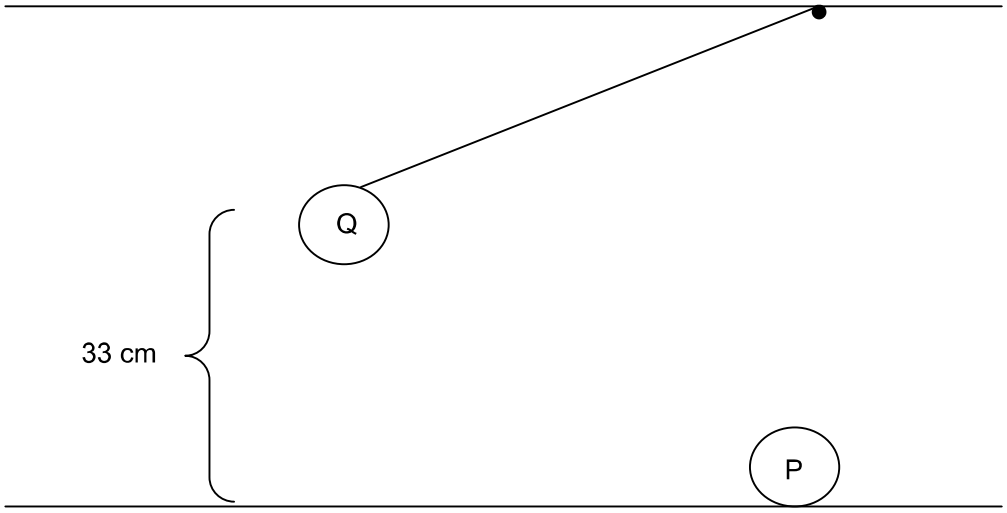
6.3. The farmer wants to modernise the farm. The farmer decides to buy a 0,5 kW petrol water pump.

6.3.1. State whether the petrol water pump will be able to produce the required power? Only write YES or NO (1)

6.3.2. Why would you advise the farmer to rather use a windmill instead of a petrol water pump? (1)
[9]

QUESTION 7

The diagram below shows a metal ball, P, of mass 65 g lying stationary on a level frictionless surface on the ground. A second metal ball, Q, of mass 110 g which is suspended from a point directly above ball P, by a strong cord, is pulled to the left and held stationary at a point 33 cm above the surface of the table.



When ball Q is released it collides with ball P, causing ball P to roll away to the right.

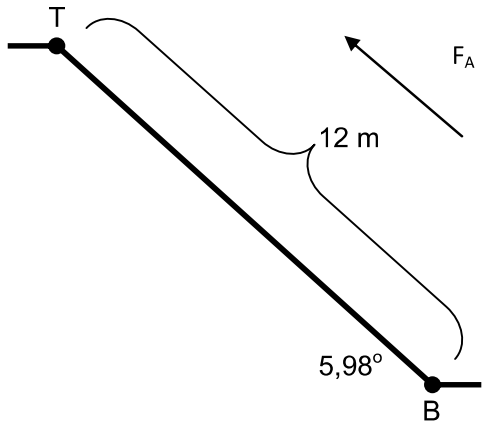
7.1 Use energy principles to calculate the speed of ball Q immediately before it collides with ball P. (5)

The impulse on ball P is 0.098 kg.m.s^{-1} as a result of the collision with ball Q.

7.2 Calculate the speed of ball Q immediately after the collision. (7)
(12)

QUESTION 8

Kylan applies a force, F_A, to help his friend, Ryan, in a wheelchair to move from rest (point T on the diagram) down a ramp which has a length of 12 m and is inclined at an angle of 5,98 ° to the horizontal as shown in the diagram below. The combined mass of Ryan and the wheelchair is 125 kg. The frictional force between the wheels of the wheelchair and the surface of the ramp is 27,60 N. The rotational effects of the wheels of the wheelchair can be ignored. The wheelchair does not have a braking system.

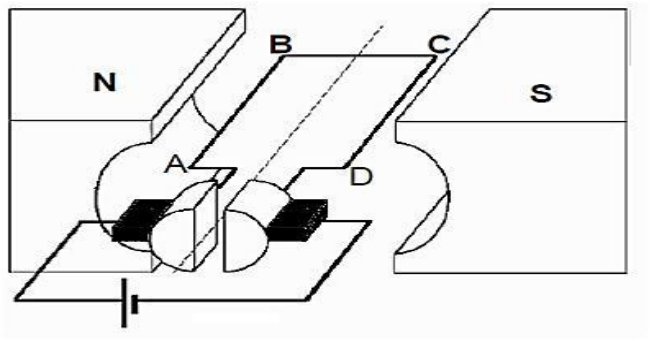


The wheelchair with Ryan in it reaches the bottom of the ramp (point B) with a speed of 1,39 $m.s^{-1}$. The net work-done on a system is 120, 76J.

8.1. Use the work-energy theorem to calculate the magnitude of the force exerted on the wheel chair by Kylan. (9)
(9)

QUESTION 9

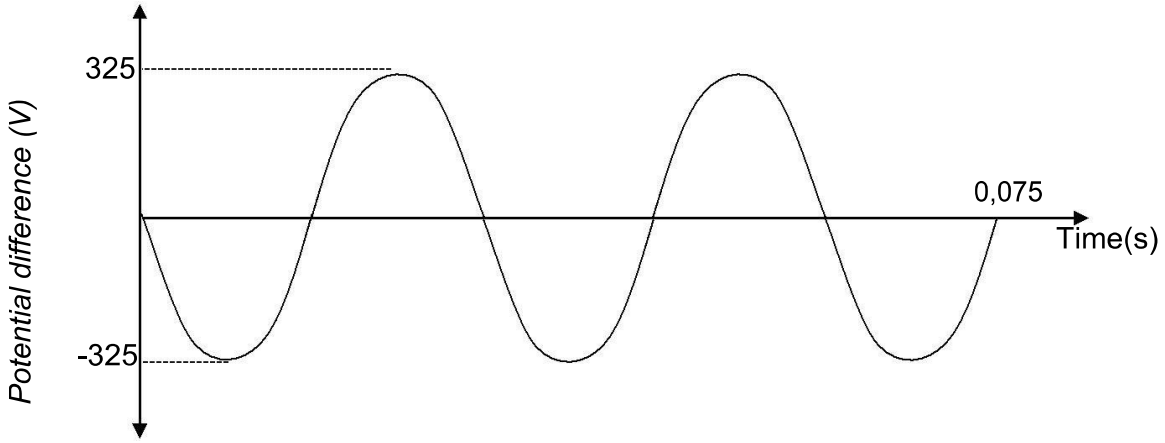
The simplified sketch below represents a DC motor.



9.1. Give a reason why section BC in the above diagram does NOT experience a magnetic force whilst the coil is in the position as shown. (1)

9.2. In which direction will the coil rotate, CLOCKWISE or ANTI-CLOCKWISE? (1)

9.3. The graph below shows how the alternating voltage, produced by the AC generator, varies with time.



9.3.1. The generator's average power output is 2,7 kW. Calculate the maximum current that the generator produces. (4)

[6]

100 Marks

DATA FOR PHYSICAL SCIENCES GRADE 10
PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	G	$6{,}67 \times 10^{-11}\ N \cdot m^2 \cdot kg^{-2}$
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	$9{,}11 \times 10^{-31}\ kg$
Mass of earth *Massa op aarde*	M	$5{,}98 \times 10^{24}\ kg$
Radius of earth *Radius van aarde*	R_E	$6{,}38 \times 10^{3}\ km$

TABLE 2: FORMULAE

MOTION

$v_f = v_i + a\,\Delta t$	$\Delta x = v_i\,\Delta t + \frac{1}{2}a\Delta t^2$ 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

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm\,m_2}{d^2}$	$g = G\frac{M}{d^2}$

WORK, ENERGY AND POWER

$W = F\Delta x\cos\theta$	$U = mgh$ 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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = Fv$	

WAVES, SOUND AND LIGHT

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

ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{V}{d}$	$E = \frac{F}{q}$
$V = \frac{W}{q}$	$n = \frac{Q}{q_e}$

ELECTRIC CIRCUITS

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

ALTERNATING CURRENT

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