HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 12
PAPER 1- PHYSICS

JUNE 2019

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 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

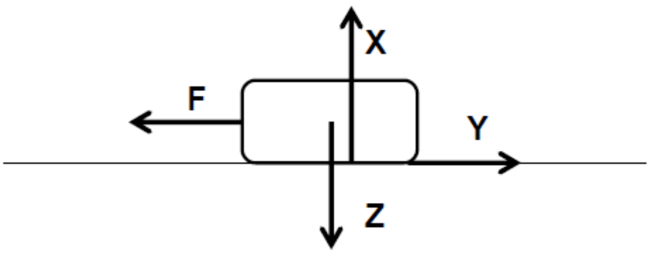
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK.

1.1 Acceleration due to gravity (g), at a particular point, on earth is 9,8 m.s^{-2}. If the radius of the earth were to be **halved** and its mass were to remain the same, then the acceleration due to gravity will be:

A 4,9 m.s^{-2}
B 9,8 m.s^{-2}
C 19,6 m.s^{-2}
D 39,2 m.s^{-2}

(2)

1.2 A learner pulls a block at a CONSTANT SPEED over a rough horizontal surface with a force **F**. The force diagram below shows all the forces acting on the block.



Which ONE of the following relationships between the magnitudes of the forces **F**, **X**, **Y** and **Z** is true?

A **F** > **Y** and **X** = **Z**

B **F** > **Y** and **X** < **Z**

C **F** = **Y** and **X** = **Z**

D **F** = **Y** and **X** < **Z** (2)

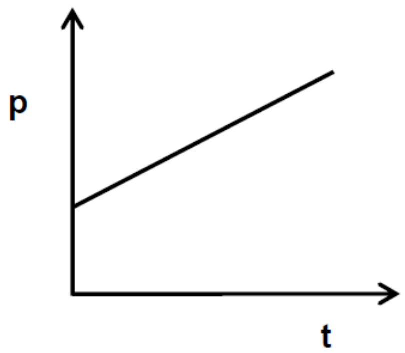
1.3 The **same force** is applied to trolley A and trolley B as shown in the sketch below.

The mass of A is **TWICE** the mass of B. If the rate of change of momentum of A is **x**, then the rate of change of momentum of B will be:

A ½ **x**
B **x**
C 2**x**
D 4**x**

(2)

1.4 The graph below represents the relationship between momentum (**p**) and the time (**t**) for a body travelling in a straight line.

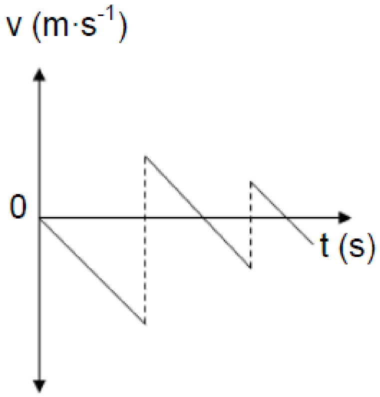


Which **ONE** of the following conclusions, based on the above graph, is TRUE about the resultant (net) force acting on the body? The resultant (net) force is ……

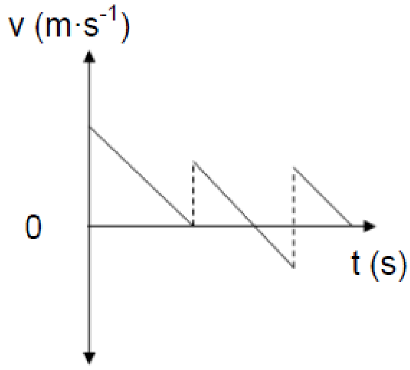
A zero
B uniformly increasing
C constant
D uniformly decreasing

(2)

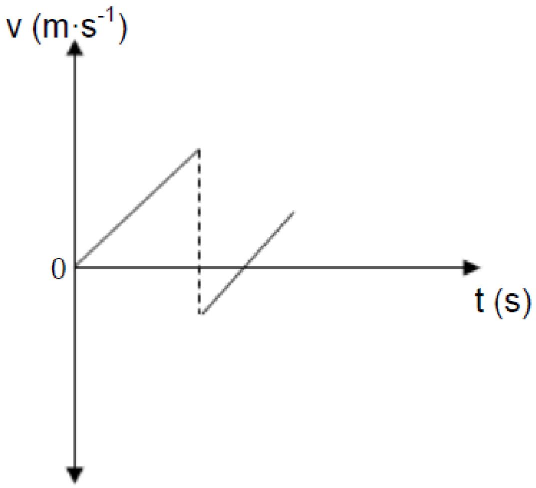
1.5 A ball is dropped from a height. Which ONE of the following velocity vs time graphs best represents the motion of the ball dropped and then bouncing vertically upwards twice?



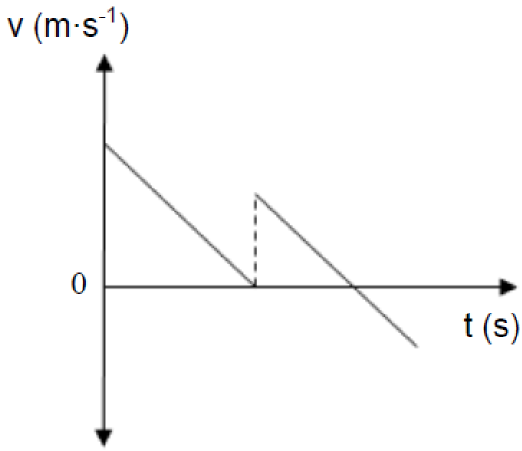
A



B



C



D

(2)

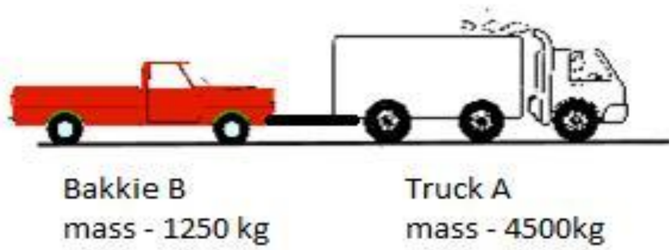
[2 X 5 = 10]

SECTION B
Instructions

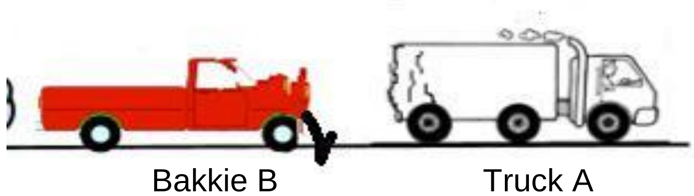
1. Leave ONE line between two sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
2. Show the formulae and substitution in all calculations.
   Round off your final numerical answers to TWO decimal places

Question 2

2.1 Truck A, of mass 4 500 kg travels at a CONSTANT VELOCITY OF 50 km·h^{-1} while towing Bakkie B, of mass 1 250 kg.



Truck A suddenly stops. Unfortunately Bakkie B has no brakes and slams into the rear of Truck A and Bakkie B comes to an immediate stop. As a result of the collision, the tow rope breaks.



2.1 Write down the Law of Conservation of Momentum in words. (2)

2.2 Calculate the speed of Truck A immediately after the collision. (4)

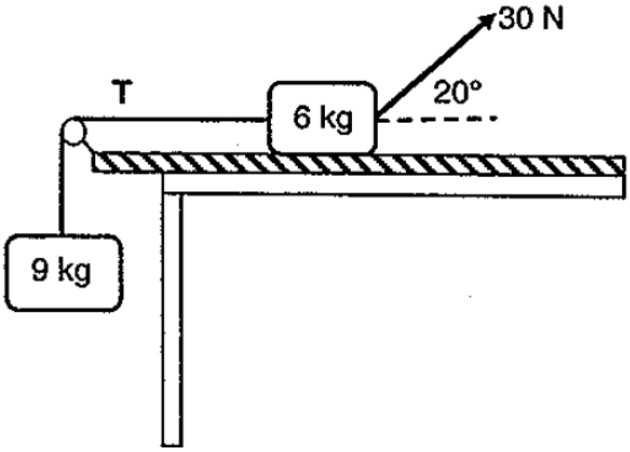
2.3 Using Newton's First Law of motion explain why it is always advisable to tow with a solid bar instead of a tow rope. (2)

[8]

Question 3

A block of mass 6 kg rests on a rough horizontal table. It is connected by a light inextensible string T which passes over a light frictionless pulley to another block of mass 9kg hanging vertically as shown below.

When a 30 N force is applied to the 6kg block at an angle of 20^0 to the horizontal, the 6kg block accelerates at $3{,}35 m.s^{-2}$ TO THE LEFT.



The coefficient of kinetic friction between the 6kg block and the surface of the table is (μ_k)
Ignore the effects of air friction.

3.1 Draw a labelled free-body diagram that shows ALL the forces acting on the 6kg block. (5)

3.2 Write down Newton's SECOND law in words. (2)

Calculate the:

3.3 Normal force on the 6kg block. (3)

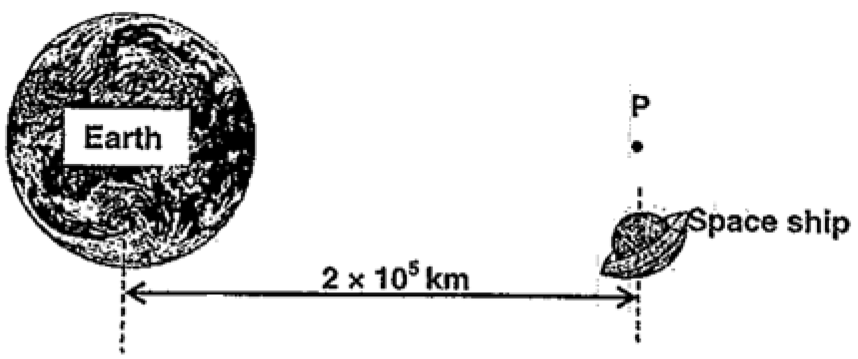
3.4 Tension on string T. (2)

3.5 Coefficient of kinetic friction (μ_k) between the 6kg block and the table. (5)

[17]

Question 4

A space ship, mass 3500kg, is at rest at point P, 2 X 10^5 km from the centre of the earth.

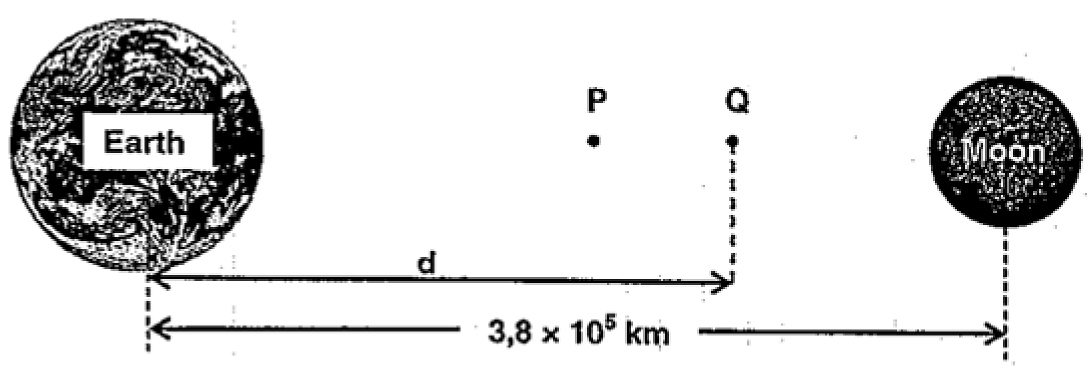


4.1 State Newton's Law of Universal Gravitation in words. (2)

4.2 Calculate the magnitude of gravitational force that the space ship experiences at point P. (4)

Point Q is a point on a straight line between the moon and the earth. Point Q is a distance d from the centre of the earth. The space ship experiences a ZERO net force when it is at rest at point Q. The mass of the moon is 7,35 x 10^{22} kg and it is at average 3,8 x 10^5 km from earth.

The above diagram is redrawn below (with additional information.)

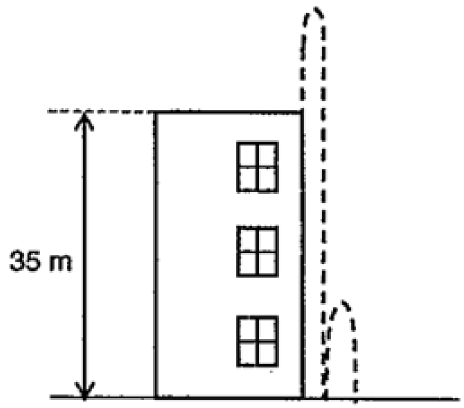


4.3 Calculate the distance between points P and Q. (5)

[11]

Question 5

A ball is projected vertically upwards from the roof of a 35 m high building at a velocity of 15 $m.s^{-1}$. The ball reaches the ground and bounces back.



5.1 Define the term projectile. (2)

5.2 Calculate the:

5.2.1 Maximum height the ball reaches above the ground. (4)

5.3 Sketch a velocity-time graph for the motion of the ball, from the time it was projected until it reaches the ground after the bounce.

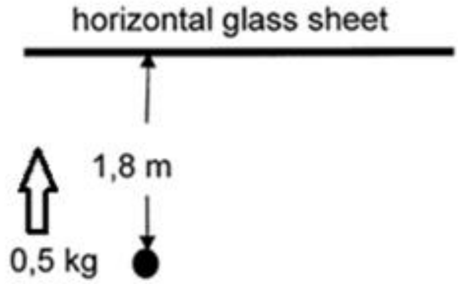
Show the following clearly on the graph.

- The initial velocity of the ball. (3)

[9]

Question 6

The horizontal roof of a gymnasium is fitted with a horizontal glass (sky light).A player throws a ball of mass 0,5 kg vertically upwards at 10 m.s^{-1}. The ball leaves the player's hand vertically at a distance of 1,8 m below the glass sheet. The ball breaks the glass sheet and carries on moving vertically upwards. It reaches the highest point of its motion 0,7 s after leaving the player's hand. Air friction should be ignored.



6.1 Show by calculation that the speed with which the ball hits the glass sheet is 8 m.s^{-1}. (4)

6.2 Show by calculation that the speed of the ball immediately after breaking the glass sheet is 5 m.s^{-1}. (7)

6.3 Calculate the magnitude and direction of the change in the ball's momentum when it breaks the glass sheet. (4)

6.4 What is the magnitude and direction of the impulse which the ball exerts on the glass sheet when the ball hits it? (2)

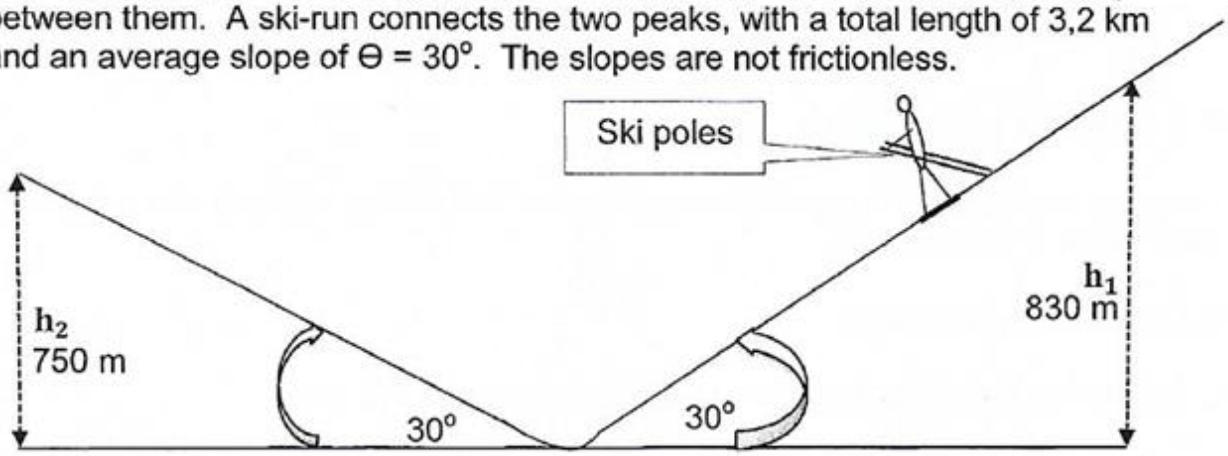
6.5 Calculate the work done by the window to slow down the ball. (5)

6.6 Was the mechanical energy of the ball conserved during its upward movement? Briefly explain your answer. (3)

[25]

Question 7

Two snowy peaks are at heights $\mathbf{h_1}$ = 830 m and $\mathbf{h_2}$ = 750 m above the valley between them. A ski-run connects the two peaks, with a total length of 3,2 km and an average slope of $\Theta = 30°$. The slopes are not frictionless.



Jack starts skiing from rest at a height of 830 m on the higher peak, not using his ski poles.

7.1 Draw a labelled free-body diagram of the forces acting on Jack as he skis down the slope. (3)

7.2 Jack came to rest exactly at the top of the lower peak. Jack, with his skis, have a combined mass of 80 kg.

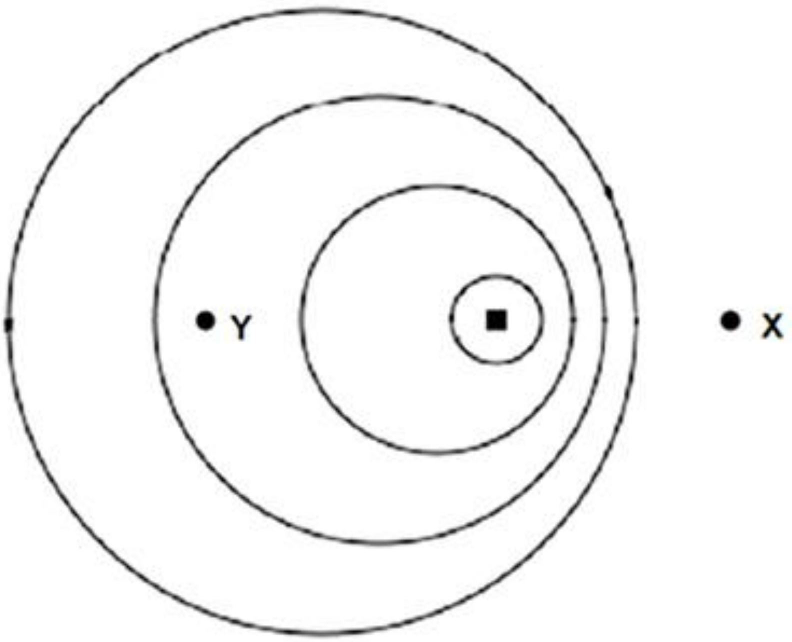
Calculate the average kinetic friction coefficient between the snow and the skis. (6)

[9]

Question 8

An ambulance is travelling towards a hospital at a constant velocity of 30 $m \cdot s^{-1}$. The siren of the ambulance produces sound of frequency 400 Hz. Take the speed of sound in air as 340 $m \cdot s^{-1}$.

The diagram below shows the wave fronts of the sound produced from the siren as a result of this motion.



8.1 At which side of the diagram, **X** or **Y**, is the hospital situated? (1)

8.2 Explain the answer to QUESTION 8.1 (2)

8.3 Calculate the frequency of the sound of the siren heard by a person standing at the hospital. (5)

8.4 A nurse is sitting next to the driver in the passenger seat of the ambulance as it approaches the hospital. Calculate the wavelength of the sound heard by the nurse. (3)

[11]

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* $E_k = \frac{1}{2}mv^2$	