HILLCREST HIGH SCHOOL

PHYSICAL SCIENCE

GRADE 12

PAPER 1- Physics

TRIALS 2021 MEMO
TIME: 3 HRS

Total 150

1.1 B

1.2 B

1.3 B

1.4 C

1.5 B

1.6 D

1.7 D

1.8 B

1.9 B

1.10 A

Question 2

2.1 The force that opposes the motion of a moving object relative to a surface. ✓✓ (2)

2.2 It is a ratio of two forces. ✓/It is a quotient of two force magnitudes. ✓ (1)
Dit is die verhouding van 2 kragte

2.3 $\mathbf{F}_{net} = 0$ N. ✓ (1)

2.4 A body will remain in the state of rest or motion at constant velocity✓ unless a (non-zero) resultant/net force✓acts on its. //

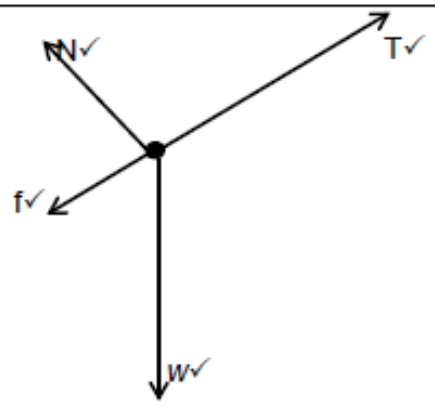
OR

Everybody continues in its state of rest or of uniform motion in a straight line✓ unless a (non-zero) resultant/net force✓ acts on its.

OR

An object at rest remains at rest or a moving object continues to move with constant velocity✓ if there is zero net force ✓ acting on it. (2)

2.5

Accept labels // ***aanvaar byskrifte***	
w	F_g/ weight/ mg/ Gravitational force //*gewig / gravitasiekrag*
T	F_T/ tension //*spanning*
f	F_f/ friction/ frictional force // *wrywing /wrywingskrag*
N	F_N/ F_{normal}/ normal force/ $F_{surface\ on\ block}$/ *normaalkrag / F oppervlak*
	

(4)

2.6

$\text{Sin } \Theta = \frac{6}{10}$ ✔

$\cos \Theta = \frac{8}{10}$ ✔

$\tan \Theta = \frac{6}{8}$ ✔

Fnet = m.a ✔

Ft- Fgll – fk ✔ =m.a

Ft – m.g.sin Θ – μk.N = m.a

Ft – (50)(9,8)sin 36,8699 ✔ – 0,7(m.g.cos Θ) = 70 (0)

Ft – (50)(9,8)sin 36,8699 – 0,7(50x9,8.cos 36,8677) ✔ = 70 (0) ✔

Ft = 568,4 N (no marks awarded, since learners had to prove)

Question 3

3.1

The gravitational force that one body exerts on the other body is inversely proportional to the square of the distance between their centres.

3.2

$F = G\frac{m_1 m_2}{r^2}$ ✓

$|F_{A \text{ on } S}| = |F_{B \text{ on } S}|$

$\therefore \frac{G M_A m}{(0,6r)^2}$ ✓ $= \frac{G M_B m}{(0,4r)^2}$ ✓

$\therefore \frac{M_A}{(0,6r)^2} = \frac{M_B}{(0,4r)^2}$

$\therefore \frac{M_A}{M_B} = \frac{0,36r^2}{0,16r^2}$

$\therefore M_A : M_B = 0,36 : 0,16$ ✓

$\therefore M_A : M_B = 9 : 4$ (4)

Question 4

4.1. An object moving under the force of gravity only/*'n Voorwerp wat slegs onder die invloed van gravitasiekrag beweeg.* ✓ ✓ (2)

4.2. $v = \frac{\Delta x}{\Delta t} \Rightarrow 4{,}8 = \frac{20}{\Delta t}$ ✓ $\Delta t = 4{,}17$ s

$\Delta y = v_i \cdot \Delta t + \frac{1}{2} \cdot a \cdot t^2$ ✓ $= 0 + 0{,}5 \cdot 9{,}8 \cdot 4{,}17^2$ ✓ = 85,07 - 85,21 m ✓

(Range: 85,07 - 85,21) (4)

4.3. The product of the resultant/net force acting on an object and the time the resultant/net force acts on the object. ✓ ✓ */Die produk van die netto krag en die tyd wat die krag op die voorwerp inwerk.* ✓ ✓ (2)

4.4. $v_f = v_i + a \cdot \Delta t$ ✓ $= 0 + 9{,}8 \cdot 4{,}17$ ✓ $= 40{,}87\ m \cdot s^{-1}$

$F_{net}\Delta t = m\Delta v = m(v_f - v_i)$ ✓

$F_{net} \cdot 1{,}2$ ✓ $= 90(0 - 40{,}87)$ ✓

$F_{net} = -3065{,}25$ N

$F_{net} = 3065{,}25$ N ✓ (Range: 3065,25 – 3065,95) (6)

4.5 The contact time increases ✔
Thus the Fnet decreases, since force is inversely proportional to the time ✔
since Δp stays constant ✔

Question 5

5.1 many options were possible. Below are the possible steps 1 to 4 that could have been used.

UPWARDS POSITIVE/ *OPWAART POSITIEF*:	**DOWNWARDS POSITIVE / *AFWAARTS POSITIEF*:**
(1) $v_f^2 = v_i^2 + 2a\Delta y$	$v^2 = v_i^2 + 2a\Delta y$
$v_f^2 = (0)^2 + 1(2,20)\ (555)$ ✓	$v_f^2 = (0)^2 + (2)\ (-2,20)\ (-555)$ ✓
$v_f^2 = 2442$	$v_f^2 = 2442$
∴ $v_f = 49,4166\ m\cdot s^{-1}$	$v_f = -49,4166\ m\cdot s^{-1}$
(2) $v_f = v_i + g\cdot\Delta t$ ✓	$v_f = v_i + g\cdot\Delta t$
$0 = 49,4166 + (-9,8)\ \Delta t$ ✓	$0 = -49,4166 + (9,8)\ \Delta t$ ✓
∴ $\Delta t = 5,042515$	∴ $\Delta t = 5,042515$ s
(3) $\Delta y = v_i\Delta t + \frac{1}{2}\ a\ (\Delta t)^2$	$\Delta y = v_i\ \Delta t + \frac{1}{2}\ a\ (\Delta t)^2$ ✓
$= (49,4166)(5,04251) + \frac{1}{2}(-9,8)(5,04251)^2$ ✓	$= (-49,4166)(5,04251) + \frac{1}{2}(9,8)(5,04251)^2$ ✓
$= 249,1837 - 124,5918$	$= -249 + 124,5918$
$= 124,5919$ m ∴ height above launch pad/ *hoogte bo* lanseervlak	$= -124,5919$ m ∴ Height above launch pad/ *hoogte bo* lanseervlak
(4) $= 555 + 124,5919$ m✓ $= 679,592$ m	$= 555 + 124,5919$✓ $= 679,592$ m

(5)

Or alternative steps 2 and 3

(2+3) $vf^2 = vi^2 + 2g\Delta y$ ✔

0^2 ✔ $= 49,4166^2 + 2(-9,8)(\Delta y)$ ✔

$\Delta y = 124,5918$m

(3) $\Delta y = \frac{vf+vi}{2}.\Delta t$

$\Delta y = \frac{0+49,4166}{2}.\Delta t$

$\Delta y = 124,5916$ m

5.2

POSITIVE MARKING

$\Delta y = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$ ✓

$-555 = 49{,}4166t + \frac{1}{2} (-9{,}8) (\Delta t)^2$ ✓

$t = 16{,}82$ s✓

OR **breaking the motion up into 2 parts**

Up $v_f = v_i + g \cdot \Delta t$

$0 = 49{,}42 + (-9{,}8)\, t$

$T = 5{,}04$ s

Down $\Delta y = v_i \Delta t + \frac{1}{2} a (\Delta t)^2$ ✓

$-679{,}592 = 0 + \frac{1}{2} (-9{,}8) (\Delta t)^2$ ✓

$t = 11{,}78$ s

(3)

Thus total time = 5,04 + 11,78 = 16,82 s✓

Or looking at the motion as a whole

$v_f^2 = v_i^2 + 2g\Delta y$ ✔

v_f^2 ✔ $= 49{,}4166^2 + 2(-9{,}8)(-555)$

$= 115{,}4123 \text{m.s}^{-1}$

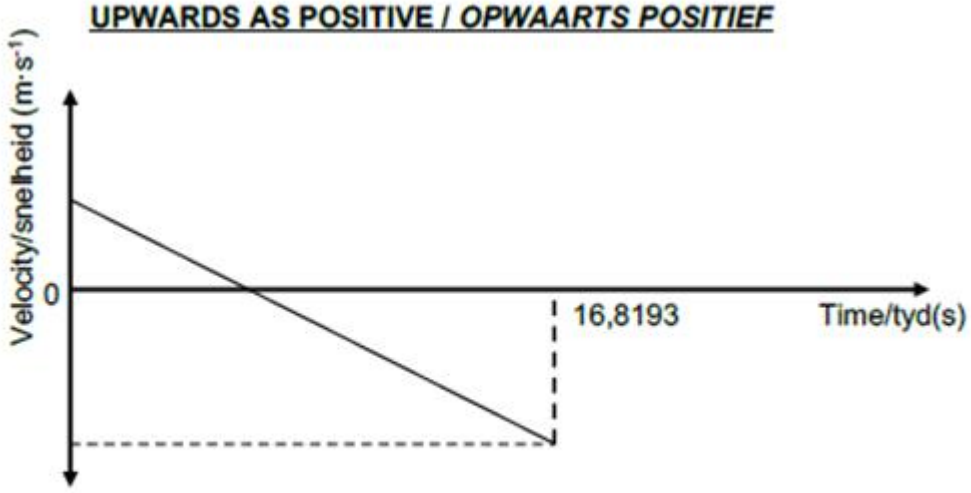
$V_f = v_i + g.\Delta t$

$-115{,}4123 = 49{,}4166 + (-9{,}8)\Delta t$

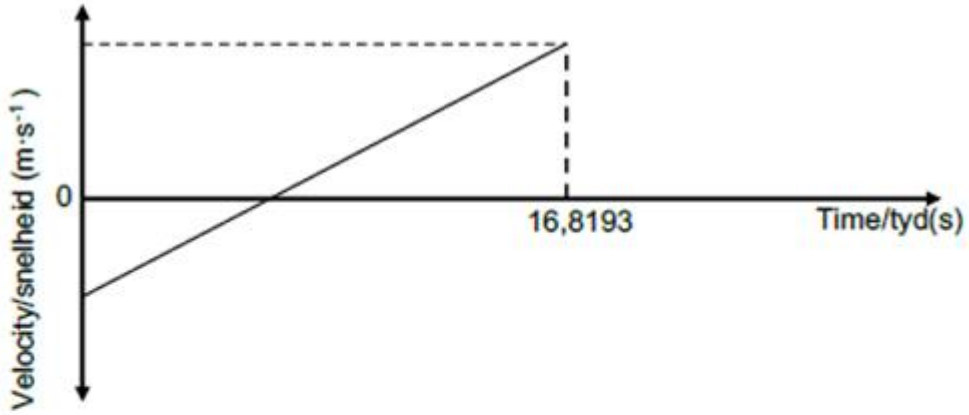
$\Delta t = 16{,}82$ s

5.3

UPWARDS AS POSITIVE / *OPWAARTS POSITIEF*



DOWNWARDS AS POSITIVE / AFWAARTS POSITIEF



Marking criteria for the graph / *Nasienriglyne vir die grafiek*	
Correct shape/Straight line not through the origin / *korrekte vorm/ reguit lyn, nie deur oorsprong nie*	✓
Time, t = 16,8193 s correctly shown / *tyd*, t = 16,8193 s korrek aangetoon	✓

Question 6

6.1

The total linear momentum in a closed system remains constant./is conserved /
Die totale lineêre momentum in 'n geslote stelsel bly konstant/bly behoue. ✓✓

OR/*OF*

In a closed/isolated system, the total momentum before a collision is equal to the total momentum after the collision./*In 'n geslote/geïsoleerde stelsel is die totale momentum voor 'n botsing gelyk aan die totale momentum na die botsing.*

(2)

6.2.1

$\sum p_i = \sum p_f$ ✓
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$
$(m_1 + m_2)v_i = m_1v_{1f} + m_2v_{2f}$

0 ✓ $= (0,4)v_{1f} + 0,6\,(4)$ ✓
$v_{1f} = -6\ m{\cdot}s^{-1}$
$= 6\ m{\cdot}s^{-1}$ to the left/*na links* ✓

(4)

6.2.2

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$\Delta p = F_{net}\Delta t$ ✓ $[(0,6)(4) - 0]$ ✓ $= F_{net}\,(0,3)$ ✓ $F_{net} = 8$ N ✓ **OR/*OF*** $m(v_f - v_i) = F_{net}\Delta t$ ✓ $0,6(4 - 0)$ ✓ $= F_{net}(0,3)$ ✓ $F_{net} = 8$ N ✓	$v_f = v_i + a\,\Delta t$ $4 = 0 + a(0,3)$ $a = 13,33\ m{\cdot}s^{-2}$ $F_{net} = ma$ $= 0,6(13,33)$ $F_{net} = 8$ N ✓
OPTION 3/*OPSIE 3*	**OPTION 4/*OPSIE 4***
$\Delta p = F_{net}\Delta t$ ✓ $[(0,4)(6) - 0]$ ✓ $= F_{net}\,(0,3)$ ✓ $F_{net} = 8$ N ✓	$v_f = v_i + a\,\Delta t$ $6 = 0 + a(0,3)$ $a = 20\ m{\cdot}s^{-2}$

6.3

Greater than ✓

(1)

[11]

Question 7

7.1

(2)

7.2 Gravitational force✓ // *Gravitasiekrag* (1)

7.3 The net/total work done on an object is equal✓ to the change in the object's kinetic energy.✓

7.4 Take clockwise as positive

For block **B**

$F_{net} = ma$

$w + (-T)m = ma$ ✓

$mg - T = ma$

$(10)(9,8) - T = 10 \cdot a$✓

$98 - T = 10 \cdot a$... (1)

For block **A**

$F_{net} = ma$

$\therefore T = (-w) = ma$

$\therefore T - mg = ma$

$\therefore T - (4,0)(9,8) = (4,0) \cdot a$ ✓

$\therefore T - 39,2 = (4,0) \cdot a \ldots (2)$

$\therefore 98 - T = (10)\, a \ldots (1)$

$\therefore -39,2 + T = (4,0)\, a$

(1) + (2) : $58,8 = (14)\, a$

$\therefore a = 4,2 \text{ m} \cdot 5^{-2}$

From (2): $T - 39,2 = (4,0)(4,2$

$\therefore T - 39,2 = 16,8$

$\therefore T = 56 \text{ N}$

7.5

$$W_{net} = \triangle k \checkmark$$

$$W_w + W_T = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$mg \cdot \triangle x \cdot \cos\theta + T \cdot \triangle x \cdot \cos\beta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\underline{(10)(9,8)(4,0)(\cos 0°) + (56)(4,0)(180°)} \checkmark = \underline{\frac{1}{2}(10)v_f^2 - 0} \checkmark$$

$$392 + (-224) = 5v_f^2$$

$$1.68 = 5v_f^2$$

$$\therefore \ v_f^2 = 33,6$$

$$\therefore \ v_f = \sqrt{33,6} = 5,797 \text{ m·s}^{-1} \checkmark$$ (7)

7.6 **POSITIVE MARKING FROM QUESTION** 7.5

$$\triangle t(\mathbf{A}) = \triangle t(\mathbf{B})$$

$$\therefore v_f = v_i + \cdot \triangle t \checkmark$$

$$\underline{5,797 = 0 + (4,2) \cdot} \triangle t \checkmark$$

$$\therefore \triangle t = 1,38 \text{ s} \checkmark$$ (3)

[15]

Question 8

8.1 It is the change in frequency (or pitch) of the sound detected by a listener ✓ because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓ (2)

8.2 $f_L = \left(\frac{v \pm v_L}{v \pm v_s}\right) f_s$ ✓ **OR/*OF*** $f_L = \left(\frac{v}{v \pm v_s}\right) f_s$

$f_L = \left(\frac{343-0}{343+40}\right)$ ✓ 320 ✓

$f_L = 286{,}58$ Hz

$f = \frac{v}{\lambda}$ ✓

$286{,}58 = \frac{343}{\lambda}$ ✓

$\lambda = 1{,}2$ m ✓ (6)

8.3 **Any ONE of the following/**
To determine the heartbeat of a foetus./

To determine the rate of blood flow in arteries./

(1)
[9]

Question 9

9.1.1 AC ✓ Uses slip rings. ✓ (2)

9.1.2 From X to W ✓ (1)

9.1.3 Electromagnetic induction ✓ (1)

9.2.1 $P_{ave} = \frac{V_{rms}^2}{R}$ ✓

$1500 = \frac{(240)^2}{R}$ ✓

$R = 38,4\ \Omega$ ✓ (3)

9.2.2 $P_{ave} = V_{rms} I_{rms}$ ✓

$1500 = 240 I_{rms}$ ✓

$I = 6,25$ A

$P_{ave} = I_{rms}^2 R_{rms}$ ✓

$1500 = I_{rms}^2 (38,4)$ ✓

$I = 6,25$ A

I_{rms} ✓ $= \frac{I_{max}}{\sqrt{2}}$

✓ $6,25 = \frac{I_{max}}{\sqrt{2}}$

$I_{max} = 8,84$ A ✓ (5)

[12]

Question 10

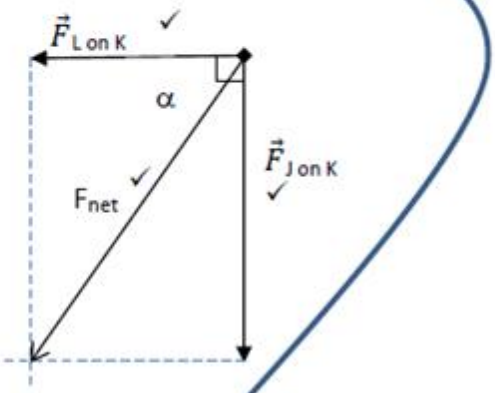
10.1 The force of attraction or repulsion between two charges is directly proportional to the product of their charges ✓ and inversely proportional to the square of the distance between them/ their centres. ✓ (2)

10.2 $F_{J\text{ on }K} = \frac{kQ_JQ_K}{r^2}$ ✓

$= \frac{9 \times 10^9 \times 4 \times 10^{-6} \times 2 \times 10^{-6}}{(0{,}05)^2}$ ✓

$= 28{,}8\text{ N}$ + ve (4)

10.3



(3)

10.4 **MAGNITUDE:**

$F_{KL} = \frac{kQ_1Q_2}{r^2}$ = 14,4N ✓

$\therefore F_R = \sqrt{28{,}8^2 + (14{,}4)^2}$ ✓m

$= 32{,}20\text{ N}$ ✓

DIRECTION

$\tan \alpha = 2$,

$\therefore \alpha = 63{,}43°$ ~~✓Angle (show tan or other method)~~ / BEARING 206,57° ✓

(4)

10.5 The electric field at a point is the electrostatic force experienced per unit positive charge ✓ placed at that point. ✓ (2)

+ ve

10.6 $E = \frac{F}{q}$ ✓

$= \frac{32{,}20}{2 \times 10^{-6}}$ ✓

$= 1{,}61 \times 10^7\text{ N} \cdot \text{C}^{-1}$ ✓ (3)

[18]

Question 11

11.1.1 emf (ε) = $IR_{ext} + Ir$ ✓ $V = Ir$

When the current increases, Ir (lost volts) increases ✓

emf (ε) is the same /constant ✓

∴ IR_{ext} (terminal voltage/pd)(voltage of the load) decreases V_{ext} (3)

11.1.2 Group 2 ✓ (1)

11.1.3

gradient = $-\frac{\Delta V}{\Delta I}$ ✓

gradient = $-\frac{4-12}{4-0}$ ✓

= 2 Ω ✓

gradient = $\frac{\Delta V}{\Delta I}$ ✓

gradient = $\frac{4-12}{4-0}$ ✓

= - 2 Ω

-r = - 2 Ω

r = 2 Ω ✓

(3)

11.2.1 The battery supplies 18 J of energy ✓ per coulomb of charge ✓ **OR**

The battery supplies 18 J ✓ per unit charge ✓ **OR**

18 J of work is done ✓ in moving 1 C of charge ✓ through the battery

OR

ACCEPT:

The potential difference of the battery in an open circuit is 18 V. ✓✓

18V is the maximum voltage supplied by the battery. ✓ 1 mark only

OR

Maximum work done by the battery per unit charge is 18 J. ✓✓

OR

Maximum energy supplied by the battery per unit charge is 18 J. ✓✓

(2)

11.2.2 (a) $V_P = V_{R2} = IR$ ✓

= 12 V

(b) P_{R1} = VI ✓

6 = (12)I_{R1} ✓

I_{R1} = 0,5 A

(c) V_2 = IR

3,8 = (0,5 + 1,2)X ✓

X = 2,24 Ω ✓

(6)

ACCEPT OTHER OPTIONS!!!!! * see below

11.2.3 (a) INCREASES ✓ (1)

(b) DECREASES ✓ (1)

[17]

* 11.2.2 $V_p = IR = 1,2 \times 10 = 12$ V ✓ ✓

$V_t = V_s + V_p + V_{int}$ ✓

$18 = 3,8 + 12 + V_{int}$ ✓

$V_{int} = 2,2$ V

Ir = 2,2

I = 2,2 / 1,29 = 1,71 A ✓

X = V / I = 3,8 / 1,71 = 2,22 Ω ✓ (6)

Other options:

2x formula marks

3x working steps

1x final answer

6