HILLCREST HIGH SCHOOL
PHYSICAL SCIENCE
GRADE 12
PAPER 1- Physics

JUNE 2022 MEMO

TOTAL 100

1.1 C
1.2 A
1.3 B
1.4 B
1.5 C

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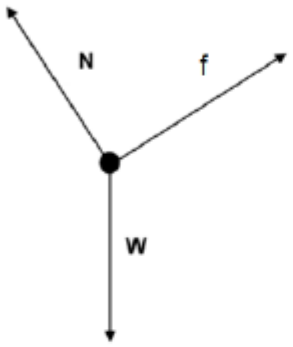
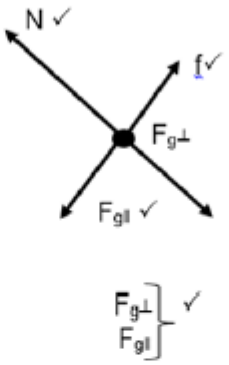
Question 2 – newton

2.1.1 The force or the component of a force which a surface exerts on an object with which it is in contact, and which is perpendicular to the surface. ✓✓
/Die krag of die komponent van die krag wat `n voorwerp op `n oppervlakte uitoefen waarmee dit in kontak is, en wat loodreg op die oppervlakte is.
2 or/*of 0* (2)

2.1.2



Accept



$F_{g\perp}$
$F_{g//}$ ✓

Accept the following symbols	
N ✓	F_N/Normal/Normal force *Normaal/Normaalkrag*
f ✓	F_f/frictional force / *Wrywingskrag*
w ✓	F_g/mg/weight/$F_{earth\ on\ suitcase}$/gravitational force *Gewig/*$F_{aarde\ op\ tas}$/*gravitasiekrag*

(3)

2.1.3 $F_f = F_{g//}$
$F_f = mg \sin\theta$ ✓Any one / *Enige een*
$F_f = 32 \times 9{,}8 \times \sin 30°$ ✓
$F_f = 156{,}8$ N✓ (3)

2.1.4 $f_s^{max} = \mu_s N$ ✓
$156{,}8 = \mu_s \times 32 \times 9{,}8 \cos 30°$ ✓
$\mu_s = 0{,}58$✓ (3)

2.2 When a resultant/net force acts on an object, the object will accelerate in the direction of the force and the acceleration is directly proportional to the force✓and inversely proportional to the mass of the object. ✓ (2)

2.2.2 **OPTION 1/*OPSIE 1***

$\sum \vec{F}=m\vec{a}$✓ **OR/*OF*** $\vec{F}_{net}=m\vec{a}$ **OR/*OF*** $F_{net}=ma$

Direction of motion as positive/*Rigting van beweging as positief*

Block A/*Blok A*

$T+f_k = m_A a$

$T- \mu k.N = m_A a$

$T-$ **0,3 (4 x 9,8)**✓ $= 4a$ (1)

✓Any one/*Enige een*

Block B/*Blok B*:

Fnet = ma

Fa - Ft - Fg = m.a

96 - Ft - (8x 9,8) = 8a

96 - Ft - 78 = 8a (2)

✓Any one/*Enige een*

Solving (1) and (2)/*Los (1) en (2) op:*

T-11,76-T-(8)(9,8)+96=4a+8a

T-11,76-T-78,4+96=12a

$a=0,49\ m\cdot s^{-2}$

✓Any one/*Enige een*

T-11,76= 4(0,49) ✓ **OR/*OF*** -T-78,4+96= 8(0,49)

T= 13,72 N✓ **OR/*OF*** T= 13,68 N✓ **OR/*OF*** T= 13,71 N✓

Question 3

3.1 An object that has been given an initial velocity and then it moves under the influence of the gravitational force only.

3.2.1

Marking criteria / Nasinkriteria:
Appropriate formula / *Toepaslike formule* ✓
Substitution of / *Vervanging van* 3,28 & 35 ✓
Final answer of / *Finale antwoord van* 26,396 $m\cdot^{-1}$ ✓
Range (26,397 to 26,41)

Downwards as positive/ *Afwaarts positief*	**Upwards as positive/ *Opwaarts positief***
OPTION 1/*OPSIE 1*	
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (3,28)^2 + 2(9,8)(35)$ ✓ $v_f = 26,396\ m\cdot s^{-1}$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $= (3,28)^2 + 2(9,8)(35)$ ✓ $v_f = 26,396\ m\cdot s^{-1}$ ✓
OPTION 2/ OPSIE 2	
$v_f = v_i + a\Delta t$ ✓ $= 3,28 + (9,8)(2,359)$ ✓ $v_f = 26,398\ m\cdot s^{-1}$ ✓	$v_f = v_i + a\Delta t$ ✓ $= -3,28 + (-9,8)(2,359)$ ✓ $v_f = 26,398\ m\cdot s^{-1}$ ✓
OPTION 3/ *OPSIE 3*	
$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $35 = \left(\frac{v_f + 3,28}{2}\right)(2,359)$ ✓ $v_f = 26,398\ m\cdot s^{-1}$ ✓	$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $35 = \left(\frac{v_f + 3,28}{2}\right)(2,359)$ ✓ $v_f = 26,398\ m\cdot s^{-1}$ ✓

(3)

3.2.2 **POSITIVE MARKING FROM QUESTION 3.2.1 / *POSITIEWE NASIEN VANAF 3.2.1***

Downwards as positive/ *Afwaarts positief*	**Upwards as positive/ *Opwaarts positief***
OPTION 1/*OPSIE 1*	
$v_f = v_i + a\Delta t$ ✓ $26{,}396 = 3{,}28 + (9{,}8)\Delta t$ ✓ $\Delta t = 2{,}359\ s$ ✓	$v_f = v_i + a\Delta t$ ✓ $-26{,}396 = 3{,}28 + (-9{,}8)\Delta t$ ✓ $\Delta t = 2{,}359\ s$ ✓
OPTION 2/*OPSIE 2*	
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $35 = 3{,}28\Delta t + \frac{1}{2}(9{,}8)\Delta t^2$ ✓ $\Delta t = 2{,}359\ s$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $-35 = -3{,}28\Delta t + \frac{1}{2}(-9{,}8)\Delta t^2$ ✓ $\Delta t = 2{,}359\ s$ ✓
OPTION 3/*OPSIE 3*	**OPTION 3/*OPSIE 3***
$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $35 = \left(\frac{26{,}396 + 3{,}28}{2}\right)\Delta t$ ✓ $\Delta t = 2{,}359\ s$ ✓	$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓ $35 = \left(\frac{-26{,}396 + (-3{,}28)}{2}\right)\Delta t$ ✓ $\Delta t = 2{,}359\ s$ ✓

(3)

3.2.3 Calculate velocity at t_2/ *Bereken snelheid by* t_2

$t_2 = 2{,}359 + 0{,}1$ ✓
$= 2{,}459\ s$

Time to max(**x**) = $3{,}86 - 2{,}459$ ✓
$= 1{,}40\ s$

$v_f = v_i + a\Delta t$ ✓
$0 = v_i + 9{,}8(1{,}40)$ ✓
$v_i = -13{,}73\ m\cdot s^{-1}$

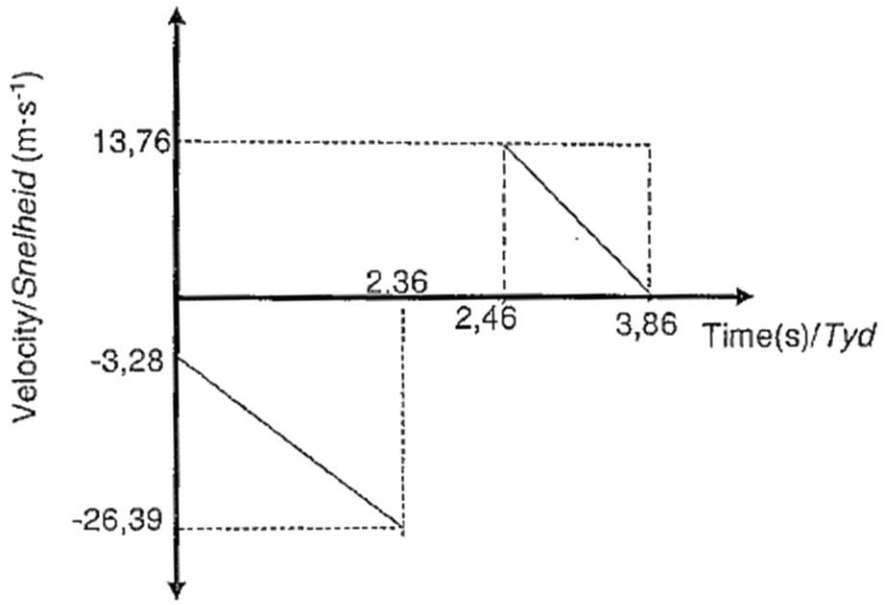
Downward as positive / ***Afwaarts positief***

Upward as positive / ***Opwaarts positief***

OPTION 1/ *OPSIE 1*	
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = (-13,73)^2 + 2(9,8)\Delta y$ ✓	$0 = (13,73)^2 + 2(-9,8)\Delta y$ ✓
$\Delta y = -9,62$ m	$\Delta y = 9,62$ m
∴ Height / *Hoogte* = 9,62 m ✓	∴ Height / *Hoogte* = 9,62 m ✓
OPTION 2/ *OPSIE 2*	
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= (-13,73)(1,4) + \frac{1}{2}(9,8)(1,4)^2$ ✓	$= (13,73)(1,4) + \frac{1}{2}(-9,8)(1,4)^2$ ✓
$\Delta y = -9,62$ m	$\Delta y = 9,62$ m
∴ Height / *Hoogte* = 9,62 m ✓	∴ Height / *Hoogte* = 9,62 m ✓
OPTION 3/ *OPSIE 3*	
$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓	$\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓
$= \left(\frac{(0 + (-13,73))}{2}\right)(1,4)$ ✓	$= \left(\frac{(0 + (-13,73))}{2}\right)(1,4)$ ✓
$\Delta y = -9,62$ m	$\Delta y = -9,62$ m
∴ Height / *Hoogte* = 9,62 m ✓	∴ Height / *Hoogte* = 9,62 m ✓

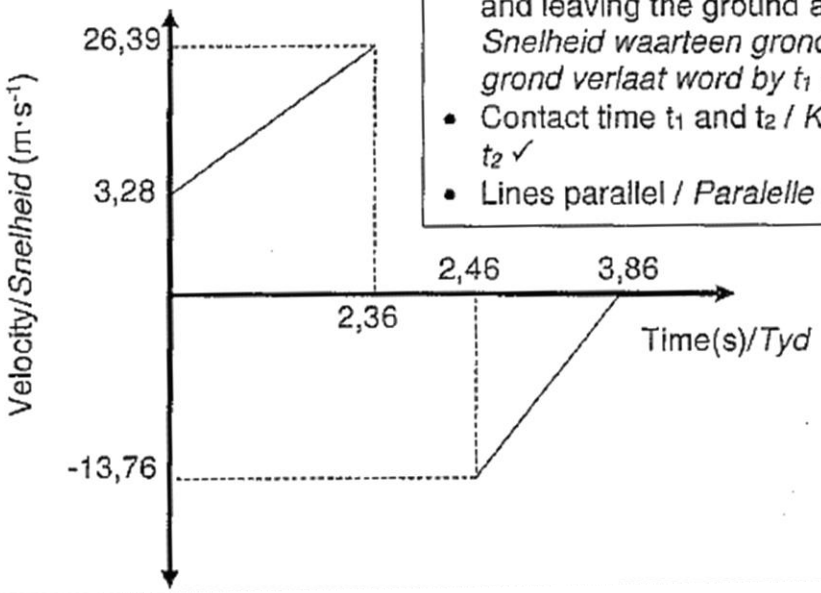
Note: No marks if the height is reported as NEGATIVE. (7)
***Let wel:** Geen punte as hoogte as negatief aangeteken word nie.*

OPTION 2: Upwards positive
***OPSIE 2:** Opwaarts positief*



(3)
[18]

OPTION 1: Downward Positive
OPSIE 1: Afwaarts Positief



Marking criteria / *Nasienkriteria:*

- Velocity striking the ground and leaving the ground at t_1 and t_2.✓ *Snelheid waarteen grond getref en grond verlaat word by t_1 en t_2*
- Contact time t_1 and t_2 / *Kontaktyd t_1 en t_2* ✓
- Lines parallel / *Paralelle lyne* ✓

Question 4

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4.1 The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the net/resultant force. ✓✓
(2 or 0)
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp in die rigting van die netto/resulterende krag. ***(2 of 0)*** (2)

4.2.1

OPTION 1 / *OPSIE 1*

Motion to the east (+) / *Beweging na oos* (+)

$\Sigma p_f = \Sigma p_i$
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$] Any/*Enige* ✓

$1085(+33) + 3450(-28)$ ✓ $= 1085(-5) + 3450v_{2f}$ ✓

$v_{2f} = -16,05$

$= 16,05\ m \cdot s^{-1}$ ✓ west / forward ✓
wes / voorwaarts

OPTION 2/ *OPSIE 2*

Motion to the east (-) / *Beweging na oos* (-)

$\Sigma p_f = \Sigma p_i$
$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$] Any/*Enige* ✓

$1085(-33) + 3450(+28)$ ✓ $= 1085(+5) + 3450v_{2f}$ ✓

$v_{2f} = +16,05$

$= 16,05\ m \cdot s^{-1}$ ✓ west / forward ✓
wes / voorwaarts

(5)

4.2.2 **POSITIVE MARKING FROM QUESTION 4.2.1/ *POSITIEWE NASIEN VANAF* 4.2,1**

OPTION 1: CAR B **Motion to the west (+)** ***OPSIE 1: KAR B*** ***Beweging na wes (+)*** Impulse = $\Delta p = m\Delta v$✓ $= 3450(16,05 - 28)$✓ $= -41\ 227,5$ $= 41\ 227,5$ N·s✓	**OPTION 2: CAR B** **Motion to the west (-)** ***OPSIE 2: KAR B*** ***Beweging na wes (-)*** Impulse = $\Delta p = m\Delta v$✓ $= 3450(-16,05 - (-28))$✓ $= 41\ 227,5$ N·s ✓
OPTION 3: CAR A **Motion to the west (+)** ***OPSIE 3: KAR A*** ***Beweging na wes (+)*** Impulse = $\Delta p = m\Delta v$✓ $= 1085(5 - (-33))$✓ $= 41\ 230$ N·s✓	**OPTION 4: CAR A** **Motion to the west (-)** ***OPSIE 4: KAR A*** ***Beweging na wes (-)*** Impulse = $\Delta p = m\Delta v$✓ $= 3450(-5 - (\div 33))$✓ $= -41\ 230$ $= 41\ 230$ N·s ✓

(3)

4.3.1 According to Newton's second law / ✓ / $F_{net} = \frac{\Delta p}{\Delta t}$

Air bag causes an increase in collision time ✓ which results in a lesser / smaller force✓ (for the driver/passenger).

Volgens Newton se twee wet / $F_{net} = \frac{\Delta p}{\Delta t}$

Lugsak veroorsaak 'n toename in botsingstyd wat aanleiding gee tot minder / kleiner krag (vir die bestuurder / passasier). (3)

4.3.2 Car A / *Kar A*✓ (1)

Question 5

5.1

$$(Ep + Ek)_A = (Ep + Ek)B$$

$$\tfrac{1}{2} mv^2 + mgh = \tfrac{1}{2} mv^2 + mgh$$
$$50\,(9,8)\,(5) + 0 = 1/2\,(50)v2 + 0$$
$$v_i = 9,899\ m\cdot s^{-1}\ \checkmark \qquad (4)$$

5.2 The total linear momentum of a closed system remains constant (is conserved). ✓✓ (2)

5.3.1
$$\Sigma_{p(before)} = \Sigma_{p(after)}$$
$$m_d v_d + m_w v_w = (m_d + m_w)v_c$$
$$50 \times 9,899 + 0\ \checkmark = (50 + 60)v_c\ \checkmark$$
$$v_c = 4,4995$$
$$v_c = 4,50\ m\cdot s^{-1}\ \checkmark \qquad (3)$$

5.3.2
$$F\Delta t = \Delta p$$
$$\Delta p = m_d \Delta v$$
$$= 50 \times (9,899 - 4,4995)\ \checkmark$$
$$= 270\ N.s\ \checkmark \qquad (2)$$

5.3.3
$$W_{net} = \Delta E_k = F_{net} \times \Delta x \cos\theta$$
$$E_{kf} - E_{ki} = F_{net} \times \Delta x \cos\theta\ \checkmark$$
$$0 - \tfrac{1}{2} \times 110 \times 4,50^2\ \checkmark = 60 \times \Delta x \cos 180^0\ \checkmark$$
$$\Delta x = 18,56\ m\ \checkmark \qquad (4)$$

Or Fnet = m.a
Ff = m.a
-60 = 110.a ✓
a = -0,5455 m.s-2

$vf^2 = vi^2 + 2a.\Delta x$ ✓
$0^2 = 4,5^2 + 2(-0,5455).\ x$ ✓
x = 18,56 m ✓

Question 6

6.1 The total mechanical energy (sum of the gravitational potential energy and kinetic energy) in an isolated system remains constant (is conserved). ✓✓
Die totale meganiese energie (som van die swaartekrag potensiële energie en kinetiese energie) in 'n geslote sisteem bly konstant (bly behoue). ✓✓ (2)

6.2

$(E_k + E_p)_B = (E_k + E_p)_A$
$(\frac{1}{2}mv^2 + mgh)_B = (\frac{1}{2}mv^2 + mgh)_A$ } ✓ Any one/*enige een*

$\frac{1}{2}mv^2 + m(9,8)(0)$ ✓ $= \frac{1}{2}m(0)^2 + m(9,8)(5)$ ✓

$\frac{1}{2}v^2 + 0 = 0 + 49$

$\therefore v = 9,8995\ m\cdot s^{-1}$ ✓

∴ The speed of the block/ *Die spoed van die blok* is $9,8995\ m\cdot s^{-1}$

Accept/*aanvaar*: $9,90\ m\cdot s^{-1}$ (4)

Or

$W_{net} = \Delta E_k$

$W_{F_g} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓

$-\Delta E_p = \frac{1}{2}m(v_f)^2 - 0$

$-[0 - m(9,8)(5)] = \frac{1}{2}mv_f^2 - 0$ ✓ ✓

$v_f = 9,9\ m\cdot s^{-1}$ ✓ (4)

6.3

OPTION 1/*OPSIE 1*

$W_{net} = \Delta E_k$

$W_w + W_{fk} + W_{FN} = \Delta E_k$

$mg\Delta x\cos\theta + f_k\Delta x\cdot\cos\beta + 0 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

✓ Any one/*enige een*

$mg\Delta x\cos\theta + \mu_k mg\cos\alpha\cdot\Delta x\cdot\cos\beta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$\underline{(9,8)\Delta x\cos 120^\circ}$✓ + $\underline{(0,35)(9,8)\cos 30^\circ\cdot\Delta x\cos 180^\circ}$✓ = $\underline{\frac{1}{2}(0)^2 - \frac{1}{2}(9,8995)^2}$✓

$\therefore (-4,9)\Delta x - (2,9705)\Delta x = -49$

$\therefore (-7,8705)\Delta x = -49$

$\therefore \Delta x = 6,2258$ m

But/*maar* $\frac{h}{\Delta x} = \sin 30^\circ$ ✓

$\therefore h = (\sin 30^\circ)(6,2258)$ ✓

$\therefore h = 3,113$ m

Or

6.3) $W_{net} = \Delta E_K$ ✓

$W_{Fg_{//}} + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$[F_{g//} \cdot \Delta x \cdot \cos\theta] + [F_f \cdot \Delta x \cdot \cos\theta] = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$\mu_k \cdot N \cdot \Delta x \cos\theta$

$mg \cdot \cos\theta$

$[m(9.8)\cdot\sin 30^\circ(\Delta x)\cdot(\cos 180^\circ)] + [0{,}35(m)(9.8)(\cos 30^\circ \cdot \Delta x \cdot (\cos 180^\circ)] = 0 - \frac{1}{2}m(9{,}9)^2 0$

$-4.9\Delta x - 2{,}9705\Delta x = -49{,}005$

$\Delta x = 6{,}2264\ m$

$\sin\theta = {}^{o}/_{h}$

$\sin 30^\circ = \frac{\text{height}}{6{,}2264}$ ✓ m

(6)

$h = 3{,}11\ m$ ✓

$W_{nc} = \Delta E_K + \Delta E_P$ ✓

6.3] $E_{mech(bottom)} + W_f = E_{mech(top)}$

$E_p + E_K + W_f = E_p + E_K$

W_f: $F_f \cdot \Delta x \cdot \cos\theta$

$mgh + \frac{1}{2}mv^2 + [\mu_K \cdot mg \cdot (\cos\theta \cdot \Delta x \cdot \cos\theta)] = mgh + \frac{1}{2}mv^2$

$0 + \frac{1}{2}(m)(9{,}9)^2 + [0{,}35(m)9{,}8\cdot(\cos 30^\circ \cdot \Delta x \cdot (\cos 180^\circ)] = m(9.8)(\sin 30^\circ \times \Delta x) + 0$

$49{,}005 + [-2{,}9705\Delta x] = 4{,}9\cdot\Delta x$

$49{,}005 = 7{,}8705\,x$

$\Delta x = 6{,}2264\ m$

$$\sin\theta = \frac{o}{h}$$

$$\sin 30^\circ = \frac{\text{height}}{6.2264}$$ ✓

(6)

$$h = 3{,}11\ m$$ ✓

Or

$$W_{nc} = \Delta E_p + \Delta E_k$$ ✓

$$E_{mech(bottom)} + W_f = E_{mech(top)}$$

$$E_p + E_k + W_f = E_p + E_k$$

$$mgh + \tfrac{1}{2}mv^2 + F_f.\Delta x.\cos\theta = mgh + \tfrac{1}{2}mv^2$$

$$0 + \tfrac{1}{2}(9.9)^2 + \left[0{,}35(9{,}8).\cos 30^\circ \left(\frac{h}{\sin 30}\right).\cos 180\right] = (9{,}8)h + 0$$

$$49{,}005 + \left[\frac{-2{,}9705.h}{0{,}5}\right] = 9{,}8h + 0$$

$$49{,}005 + [-5{,}941h] = 9{,}8h$$

$$\frac{49{,}005}{15{,}741} = \frac{15{,}741h}{15{,}741}$$

(6)

$$h = 3{,}11\ m$$ ✓

Or

$$W_{nc} = \Delta E_p + \Delta E_k \quad \checkmark$$

$$F_f \cdot \Delta x \cdot \cos\theta = [E_{pf} - E_{pi}] + [E_{kf} - E_{ki}]$$

$$\left[0{,}35(m)(9{,}8).\cos 30\left(\frac{h}{\sin 30}\right)\cos 180\right] = [m(9{,}8)h - 0] + \left[0 - \frac{1}{2}m(9{,}9)^2\right]$$

$$h = 3{,}11\ m \quad \checkmark$$

(6)

Question 7

7.1 Doppler effect ✓/*Doppler effek* (1)

7.2.1 LESS THAN ✓/*MINDER AS* (1)

7.2.2 STAYS THE SAME ✓/*BLY DIESELFDE* (1)

Marking Guidelines/*Nasienriglyne*

7.3

$$f_L = \frac{(v \pm v_L)}{(v \pm v_s)} f_s \quad \checkmark$$

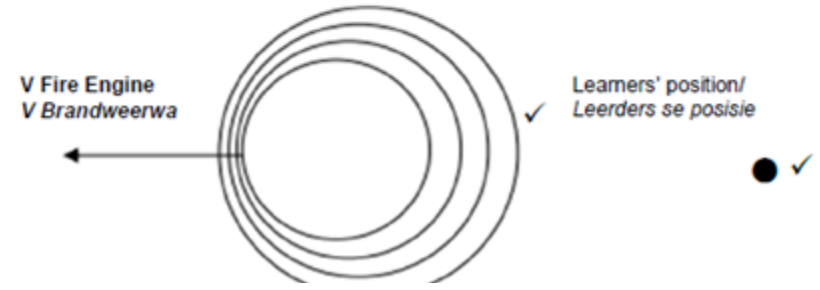
$$= \frac{340-0}{340+20} \checkmark \ 250 \checkmark$$

F_L = 236,11 Hz✓

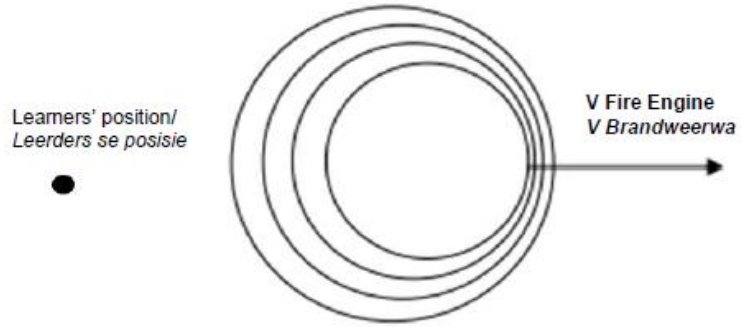
- ✓ Doppler Formula/*Doppler Formule*
- ✓ Substitution (velocities)/ *Vervanging (snelhede)*
- ✓ Substitution (f_s)/*Vervanging* (f_s)
- ✓ Answer with units/*Antwoord met eenhede*

(4)

7.4



OR/*OF*



(2)

7.5 Speed of sound in air is less than speed of light.✓ The velocity of the fire engine produces a noticeable Doppler shift in the frequency of the sound but is of no consequence when compared with the speed of light.✓✓

Spoed van klank in lug is minder as die spoed van lig. ✓ *Die snelheid van die brandweerwa produseer 'n waarneembare Doppler verskuiwing in die frekwensie van die klank, maar het geen effek wanneer dit vergelyk word met die spoed van lig nie.* ✓✓

OR/*OF*

Speed of sound in air is comparable with the speed of the fire engine✓ hence the noticeable difference in frequency ✓ whilst the speed of light is too high compared to the speed of the fire engine. ✓