MEMORANDUM

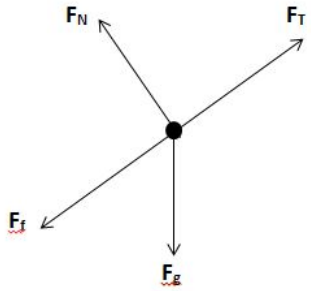
PHYSICAL SCIENCES/FISIESE WETENSKAPPE **AUGUST 2019**

CW PLC COMMON PAPER 1/GEMEENSKAPLIKE VRAESTEL 1

QUESTION 1

1.1	D	(2)
1.2	B	(2)
1.3	D	(2)
1.4	A	(2)
1.5	D	(2)
1.6	C	(2)
1.7	A	(2)
1.8	A	(2)
1.9	C	(2)
1.10	D	(2)

[20]

QUESTION 2 (Start on a new page.)			
2.1	When a resultant force is exerted on an object, the object accelerates in the direction of the resultant force. The acceleration is directly proportional to the resultant force and inversely proportional to the mass of the object. ✓✓ *Wanneer 'n netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die netto krag. Die versnelling is direk eweredig aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.* ✓✓		(2)
2.2	 (Accept any other correct symbol or name for each force) (*Aanvaar enige ander aanvaarbare simbool of naam vir elke krag)* One mark for each force correctly drawn and labelled. *Een punt vir elke krag wat korrek geteken en benoem is.*		(4)
2.3	$f_k = \mu_k F_N$ ✓ =(0,3)(3)(9,8)cos(60) ✓✓ =4,41 N ✓		(4)
2.4	2.4.1	**<u>Up the plane as positive/Op teen skuinsvlak as positief</u>** $F_{net} = ma$ ✓ 3 kg: $T - (3)(9,8)cos(30) - 4,41 = 3a$ ✓ $T - 29,87 = 3a$ 2 kg: $70 - T - 1,96 - (2)(9,8)cos(30) = 2a$ ✓ $51,07 - T = 2a \quad 21,2 = 5a$ $a = 4,24\ m.s^{-2}$ ✓	(4)
	2.4.2	$T = 3(4,24) + 29,87$ $= 42,59\ N$ ✓✓ OR/OF $T = 51,07 - 2(4,24)$ $= 42,59\ N$ ✓✓ Positive marking from 2.4.1	(2)
			[16]

<table>
<tr><td colspan="3">QUESTION 3 (Start on a new page.)</td><td></td></tr>
<tr><td>3.1.</td><td colspan="2">An Object upon which the only force acting is the force of gravity. ✓
'n Voorwerp waarop slegs gravitasiekrag inwerk. ✓</td><td>(1)</td></tr>
<tr><td>3.2</td><td>3.2.1</td><td>
<u>UPWARD POSITIVE/</u>
<u>OPWAARTS POSITIEF</u>
$\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
$-(48)$ ✓ $= v_i \times 2,8 + \frac{1}{2} \times (-9,8) \times 2,8^2$ ✓
$V_i = -3,42$
$V_i = 3,42\ m.s^{-1}$ ✓

<u>DOWNWARD POSITIVE /</u>
<u>AFWAARTS POSITIEF</u>
$\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓
(48) ✓ $= v_i \times 2,8 + \frac{1}{2} \times 9,8 \times 2,8^2$ ✓
$V_i = 3,42\ m.s^{-1}$ ✓
</td><td>(4)</td></tr>
<tr><td></td><td>3.2.2</td><td>
OPTION/OPSIE 1

<u>UPWARD POSITIVE/</u>
<u>OPWAARTS POSITIEF</u>
$V_f = V_i + a\Delta t$ ✓
$V_f = -3,42 + (-9,8)(2,8)$ ✓
$V_f = -30,86\ m.s^{-1}$
$V_f = 30,86\ m.s^{-1}$ ✓

<u>DOWNWARD POSITIVE /</u>
<u>AFWAARTS POSITIEF</u>
$V_f = V_i + a\Delta t$ ✓
$V_f = 3,42 + (9,8)(2,8)$ ✓
$V_f = 30,86\ m.s^{-1}$ ✓

OPTION/OPSIE 2

<u>UPWARD POSITIVE/</u>
<u>OPWAARTS POSITIEF</u>
$V_f^2 = V_i^2 + 2a\Delta x$ ✓
$V_f^2 = -3,42^2 + 2(-9,8)(-48)$ ✓
$V_f = 30,86\ m.s^{-1}$ ✓

<u>DOWNWARD POSITIVE /</u>
<u>AFWAARTS POSITIEF</u>
$V_f^2 = V_i^2 + 2a\Delta x$ ✓
$V_f^2 = 3,42^2 + 2(9,8)(48)$ ✓
$V_f = 30,86\ m.s^{-1}$ ✓

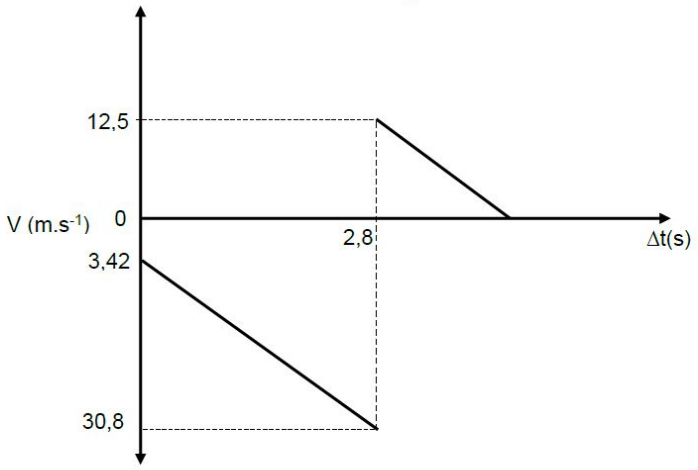
OPTION/OPSIE 3

<u>UPWARD POSITIVE/</u>
<u>OPWAARTS POSITIEF</u>
$\Delta x = \frac{V_f+V_i}{2}\Delta t$ ✓
$-(48) = \frac{V_f-3,42}{2} \times 2,8$ ✓
$V_f = -30,87$
$V_f = 30,87\ m.s^{-1}$ ✓

<u>DOWNWARD POSITIVE /</u>
<u>AFWAARTS POSITIEF</u>
$\Delta x = \frac{V_f+V_i}{2}\Delta t$ ✓
$48 = \frac{V_f+3,42}{2} \times 2,8$ ✓
$V_f = 30,87\ m.s^{-1}$ ✓

OPTION/OPSIE 4

$E_{Mi} = E_{Mi}$
$mgh_1 + \frac{1}{2}mv_i^2 = mgh + \frac{1}{2}mv_f^2$
$gh_1 + \frac{1}{2}v_i^2 = gh_2 + \frac{1}{2}v_i^2$
Any one ✓ / Enige een
$9,8 \times 48 + \frac{1}{2} \times 3,42^2 = 0 + \frac{1}{2}v_i^2$ ✓
$V_f = 30,86\ m.s^{-1}$ ✓
</td><td></td></tr>
</table>

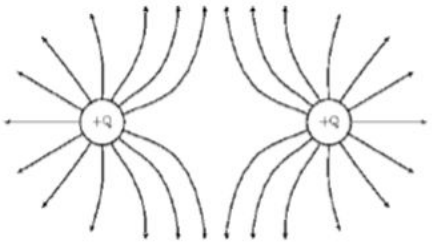
		OPTION/*OPSIE* 5 $F_{net}\,\Delta t = \Delta p$ $F_{net}\,\Delta t = m(v_f - v_i)$ $mg\Delta t = m(v_f - v_i)$ $g\,\Delta t = v_f - v_i$ Any one *Enige een* ✓ $9,8 \times 2,8 = v_f - 3,42$ ✓ $V_f = 30,86\ m.s^{-1}$ ✓	(3)
	3.2.3	**UPWARD POSITIVE/** ***OPWAARTS POSITIEF*** $V_f^2 = V_i^2 + 2a\Delta X$ ✓ $0 = V_i^2 + 2(-9,8)(8)$ ✓ $V_I = 12,52\ m.s^{-1}$ upwards. ✓ (Ignore direction in answer) **DOWNWARD POSITIVE /** ***AFWAARTS POSITIEF*** $V_f^2 = V_i^2 + 2a\Delta x$ ✓ $0 = V_i^2 + 2(9,8)(--8)$ ✓ $V_I = 12,52\ m.s^{-1}$ $V_I = 12,52\ m.s^{-1}$ upwards. ✓	(3)
3.3	**CRITERIA FOR MARKING/*KRITERIA VIR MERK*** (i) Initial velocity with which the ball was thrown. ✓ *Beginsnelheid waarmee bal gegooi is.* (ii) Final velocity with which the ball hit the ground ✓ *Eindsnelheid waarmee die bal die grond tref.* (iii) Time taken to hit the ground. ✓ *Tyd om die grond te tref.* (iv) The velocity with which the ball bounces off the ground. ✓ *Die snelheid waarmee die bal van die grond af bons.* Positive marking from/Positiewe merk vanaf 3.1.1, 3.1.2, 3.1.3  	(4) **[15]**

QUESTION 4 (Start on a new page.)		
4.1	The total linear momentum of a closed system ✓ remains constant/is conserved. ✓	(2)
4.2	$\Sigma p_i = \Sigma p_f$ $m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$ ✓ (any one) $(5)(4) + (2)(-1)$ ✓ $= (5 + 2) v_f$ ✓ $v_f = 2{,}57\ m.s^{-1}$ ✓	(4)
4.3	$F_{net} \Delta t = \Delta p = m v_f - m v_i$ ✓ $F_{net}(0{,}3)$ ✓ $= 7(-1) - 7(2{,}57)$ ✓ Positive marking from Q 4.2 $F_{net} = -59{,}97$ N ✓	(4)
4.4	Arrestor beds decreases a truck's momentum to zero over a long time interval, ✓ and so the force exerted on the truck is small enough ✓ not to harm the truck driver. Die sandput verminder die trok se momentum tot zero oor 'n lang tydperk ✓ sodat die krag wat op die trok uitgeoefen word klein genoeg is ✓ om nie die insittendes te beseer nie.	(2)
		[12]

QUESTION 5 (Start on a new page.)		
5.1	E_p / U = mgh ✓ = (70)(9,8)(30) ✓ = 20 580 J ✓	(3)
5.2	In an isolated/closed system, ✓ the total mechanical energy is conserved / remains constant ✓ *In 'n geïsoleerde/geslote sisteem bly die totale meganiese energie behoue / bly konstant.* **OR/*OF*** The total mechanical energy of a system is conserved/ remains constant ✓ in the absence of friction.✓ *Die totale meganiese energie van 'n sisteem bly behoue/bly konstant in die afwesigheid van wrywing.* **OR/*OF*** The total mechanical energy of a system remains constant ✓provided the net work done by external non conservative forces is zero.✓ *Die totale meganiese energie van 'n sisteem bly konstant, mits die arbeid verrig deur eksterne nie-konserwatiewe kragte, nul is.* **OR/*OF*** In the absence of a non-conservative force, ✓the total mechanical energy is conserved/remains constant ✓ *In die afwesigheid van 'n nie-konserwatiewe krag, bly die totale meganiese energie behoue / konstant* **OR/*OF*** In an isolated/closed system, ✓ the sum of kinetic and gravitational potential energy is conserved / remains constant ✓ *In 'n geïsoleerde/geslote sisteem bly som van kinetiese en gravitasionele*	(2)
5.3	***POSITIVE MARKING FROM QUESTION 5.1.3/ POSITIEWE NASIEN VANAF 5.1.3*** **OPTION 1/ OPSIE 1** $E_{\text{mech before/window A/venster A}} = E_{\text{mech after/window C/venster C}}$ $(E_k + E_p)_{\text{mech before/window A/venster}} = (E_k + E_p)_{\text{mech after/window C/venster C}}$ $(\frac{1}{2} mv^2 + mgh)_{\text{before/voor}} = (\frac{1}{2} mv^2 + mgh)_{\text{after/na}}$ [0 + 20 580] ✓ = [½(70)(10^2) + (70)(9.8)h] ✓ h = 25 m ✓ Any one/ Enige een ✓ **OPTION 2/ OPSIE 2** $E_{\text{mech before/window A/venster A}} = E_{\text{mech after/window C/venster C}}$ $(E_k + E_p)_{\text{mech before/window A/venster}} = (E_k + E_p)_{\text{mech after/window C/venster C}}$ $(\frac{1}{2} \cancel{m}v^2 + \cancel{m}gh)_{\text{before/voor}} = (\frac{1}{2} \cancel{m}v^2 + \cancel{m}gh)_{\text{after/na}}$ [0 + (9.8)(30)] ✓ = [½(10^2) + (9.8)h] ✓ h = 25 m ✓ Any one/ Enige een ✓ **(h=24,9 m)**	

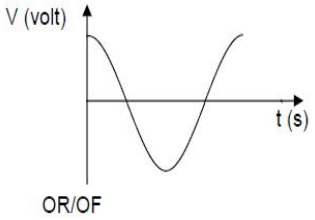
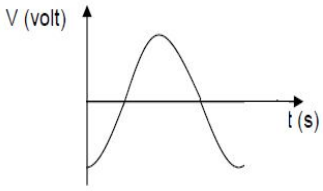
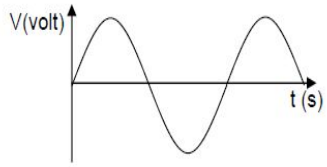
	OPTION 3/ OPSIE 3 $W_{nc} = \Delta E_p + \Delta E_k$ $0 = \Delta E_p + \Delta E_k$ $\Delta E_p = - \Delta E_k$ Any one/ Enige een ✓ $[mgh_{\text{window C/venster C}} - mgh_{\text{window A/venster A}}] = - [\frac{1}{2}mv^2_{\text{window C/venster C}} - \frac{1}{2}mv^2_{\text{window A/venster A}}]$ $[(70)(9.8)h - 20\,580] = - [\frac{1}{2}(70)(10^2) - 0]$ $h = 25$ m	(4)
5.4	$P = \frac{W}{\Delta t}$ ✓ $= \frac{4.8 \times 10^5}{120}$ ✓ $= 4\,000$ W or/of J·s ✓	(3)
5.5	$P_{ave/gem} = Fv_{ave/gem}$ ✓ $4\,000 = F(10)$ ✓ $F = 400$ N ✓	(3)
		[15]

QUESTION 6 (Start on a new page.)		
6.1	The apparent change in the detected frequency (or pitch)(or wavelength) ✓ as a result of the relative motion between a source and an observer (listener). ✓ *Die skynbare verandering in waargenome frekwensie (of toonhoogte)(of golflengte)* ✓ as gevolg van *die relatiewe beweging tussen die bron en waarnemer/luisteraar.* ✓	(2)
6.2	$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ **OR/*OF*** $f_L = \frac{v + v_L}{v - v_s} f_s$ $f_L = \frac{(340 + 30)280}{340}$ ✓ ✓ ✓ = 304,71Hz ✓	(5)
6.3	SMALLER/*KLEINER* ✓ **(negative marking, below)** λ increases OR frequency decreases. ✓ *λ neem toe OF frekwensie neem af.* ✓ **OR/*OF*** $\lambda \alpha \frac{1}{f}$ or/*of* $f \alpha \frac{1}{\lambda}$ ✓	(2)
6.4	Determines the rate at which blood flow. ✓ Monitor and measures the heartbeat of a foetus. (Any ONE) *Bepaal die tempo waarteen bloed vloei.* ✓ *Monitor en meet die hartklop van 'n fetus. (Enige EEN)*	(1)
6.5	AWAY/*WEG* ✓ **(negative marking, below)** Light from a star is shifted towards a longer wavelength/towards the red end of the spectrum. ✓ *Die ster se lig word verskuif na 'n langer golflengte/na die rooi kant van die spektrum.* ✓	(2) **[12]**

QUESTION 7 (Start on a new page.)		
7.1	The magnitude of the electrostatic force exerted by one point charge on another point charge is directly proportional to the product of the magnitude of the charges ✓ and inversely proportional to the square of the distance between them. ✓ Die grootte van die elektrostatiese krag wat een puntlading op 'n ander puntlading uitoefen, is direk eweredig aan die produk van die groottes van die ladings ✓ en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle ✓	(2)
7.2	 **Criteria for field pattern/*Kriteria vir veldpatroon:*** — **Marks/ *Punte*** Correct direction away from the spheres. *Korrekte vorm weg vanaf sphere.* — ✓ Correct shape of field pattern. *Korrekte vorm vir veldpatroon.* — ✓ Field lines not crossing/ not drawn inside the sphere *Veldlyne kruis nie/ nie binne-in spheer geteken.* — ✓	(3)
7.3	$F_{ZY} = \frac{kQ_PQ_Q}{r^2}$ ✓ $= \frac{9\times10^9\times6\times10^{-9}\times6\times10^{-9}}{0,2^2}$ ✓ ✓ $= 8,1 \times 10^{-6}$ N✓	(4)
7.4	$E_{net} = \frac{kQ_P}{r^2}$ ✓+ $\frac{kQ_Q}{r^2} + \frac{kQ_R}{r^2}$ $= \frac{9\times10^9\times6\times10^{-9}}{0,5^2}$ ✓+ $\frac{9\times10^9\times6\times10^{-9}}{0,3^2}$ ✓- $\frac{9\times10^9\times2\times10^{-9}}{0,1^2}$ ✓ $= -9,84 \times 10^2$ N.C^{-1} $= 9,84 \times 10^2$ N.C^{-1} ✓, left ✓*links*	(6)
		[15]

QUESTION 8 (Start on a new page.)			
8.1	V_1 = 12V ✓ V_2 = 0V ✓		(2)
8.2	8.2.1	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R_p} = \frac{1}{20} + \frac{1}{30}$ ✓ $\frac{1}{R_p} = \frac{3+2}{60} = \frac{5}{60} = \frac{1}{12}$ $R_p = 12\Omega$ ✓ $R_T = R_p + R_s$ $R_T = 12 + 11 = 23\Omega$ ✓	(3)
	8.2.2	$I_{20} = \frac{30}{20} x\ 0,2 = 0,3$ A ✓ $I_{Tot} = 0,2 + 0,3 = 0,5$ A ✓ $\varepsilon = IR + Ir$ ✓ $12 = (0,5)(23) + (0,5)(r)$ ✓ **Positive marking** from Q 8.2.1 $r = 1\Omega$ ✓	(5)
8.3	Increase/Toeneem ✓ **(negative marking)** Total external resistance increase/Totale eksterne weerstand neem toe ✓ Current decrease/Stroom neem af ✓ Lost Volts decrease/Verlore volts neem toe ✓		(4)
			[14]

QUESTION 9 (Start on a new page.)		
9.1	Current ✓ (For Afr paper - Potensiaalverskil/interne weerstand/emk)	(1)
9.2	Temperature/*Temperatuur* ✓	(1)
9.3	9 V ✓ (Except/aanvaar 8,8 - 9.0)	(1)
9.4	Gradient/*Helling* = $\frac{y2-y1}{x2-x1}$ ✓ = $\frac{1-8.5}{15-0.8}$ (any two points on graph/*enige 2 punte op grafiek*) ✓ = -0.528 ✓ r = 0.53 Ω ✓ (If formula used/Indien formule gebruik - max 2/4)	(4)
		[7]

QUESTION 10 (Start on a new page.)			
10.1.	10.1.1	AC generator / WS generator ✓ OR/OF Alternator/Alternator ✓ Slip rings / Sleepringe ✓	(2)
	10.1.2	X to/na Y ✓	(1)
	10.1.3	 OR/OF  **Checklist/Kontrolelys** — Criteria for sketch graph / *Kriteria vir sketsgrafiek*: Marks/*Punte* Correct labelling of axes / *Korrekte benoeming van asse*: ✓ Shape of graph – at least one cycle / *Vorm van grafiek- ten minste een siklus*: ✓ Accept / *Aanvaar* 	(2)
10.2	10.2.1	$V_{rms/wgk} = \frac{V_{max}}{\sqrt{2}}$ ✓ ∴ 200 ✓= $\frac{V_{max}}{\sqrt{2}}$ = ∴ $V_{max/maks}$ = 282,84 V✓	(3)
	10.2.2	$P_{ave} = \frac{V^2_{rms}}{R}$ ✓∴ 1 200 = $\frac{220^2}{R}$ ✓∴ R = 40,33 Ω OR/*OF* At 200 V: $P_{ave} = \frac{V_{rms}^2}{R} = \frac{200^2}{40,33}$ ✓ = 991,82 W ✓ $P_{ave} = V_{rms}I_{rms}$ 1200 = (220)I_{rms} I_{rms} = 5,45 A ✓ V = IR 220 = (5,45)R ✓ R = 40,33 Ω OR/OF $P_{ave} = V_{rms}I_{rms}$ ∴ 1200 = (220)I_{rms} ∴ I_{rms} = 5,45 A ✓ Using ratio's: 220 V uses current of 5,45 A ∴ 200 V uses current of 4,95 A } ✓ $P_{ave} = V_{rms}I_{rms}$ ∴ = (200)(4,95) ✓ ∴ = 990,91 W✓	(4) **[12]**

QUESTION 11 (Start on a new page.)			
11.1	11.1.1	The minimum frequency (of a photon/light) needed ✓ to emit electrons from (the surface of) a metal. ✓ (substance) Die minimum frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) vry te stel OR The frequency (of a photon/light) needed to emit electrons from (the surface of) a metal ✓ (substance) with zero kinetic energy ✓ Die frekwensie (van 'n foton/lig) benodig om elektrone vanaf die (oppervlakte van)'n metaal (stof) ✓ met nul/geen kinetiese energie ✓ vry te stel	(2)
	11.1.2	Silver/Silwer ✓ Threshold/cutoff frequency (of Ag) is higher/Drumpel/afsnyfrekwensie (van Ag) is hoër ✓ ✓ OR/OF W_0 α f_0 / $W_0 = hf_0$ ✓ ✓ OR/OF To eject electrons with the same kinetic energy from each metal, light of a higher frequency/energy is required for silver. Om elektrone met dieselfde kinetiese energie van elke metal vry te stel,is lig van hoër frekwensie benodig vir silwer. ✓ ✓ OR/OF Since $E = W_0 + E_k(max)$ (and E_k is constant), the higher the frequency/energy of the photon/light required, the greater the work function/W_0. Aangesien E = Wo + Ek(maks) (en Ek(maks) is konstant) word fotone/lig van hoër frekwensie/energie benodig, dus is arbeidsfunksie hoër ✓ ✓	(3)
	11.1.3	Planck's constant/Planck se konstante ✓	(1)
	11.1.4	Sodium/Natrium ✓	(1)

11.2	✓ ✓ Energy radiated per second by the blue light =(5/100)(60 x 10^{-3}) /Energie per sekonde uitgestraal deur die blou lig = 3 x 10^{-3} J·s^{-1} E_{photon} = hc/λ ✓ = (6,63 x 10^{-34})(3 x 10^{8})/470 x 10^{-9} = 4,232x10^{-19} J ✓ Total number of photons incident per second = 3 x 10^{-3}/4,232 x 10^{-19} J /Totale aantal fotone wat per sekonde inval = 7,09 x 10^{15} ✓	(5)
		[12]

TOTAL/TOTAAL:

150