LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (Vr1)

SEPTEMBER 2015
MEMORANDUM

MARKS: 150

TIME: 3 hours

This memorandum consists of 10 pages.

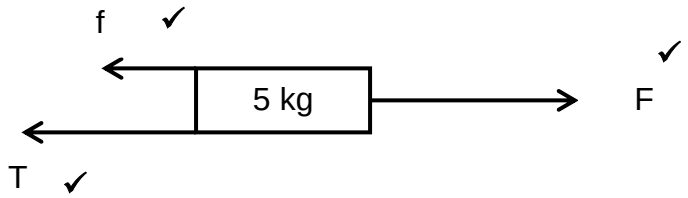
QUESTION / VRAAG 1

1.1 B✓✓ (2)
1.2 A✓✓ (2)
1.3 D✓✓ (2)
1.4 C✓✓ (2)
1.5 B✓✓ (2)
1.6 D✓✓ (2)
1.7 A✓✓ (2)
1.8 C✓✓ (2)
1.9 A✓✓ (2)
1.10 C✓✓ (2)
[20]

QUESTION / VRAAG 2

2.1 When a net force (F_{net}) is applied to an object (of mass, m) it accelerates in the direction of the (net) force. The acceleration (a) is directly proportional to the (net) force ✓and inversely proportional to the mass of the object. ✓*II Wanneer 'n netto krag op 'n voorwerp toegepas word, sal die voorwerp versnel. Die versnelling is direl eweredig aan die krag en omgekeerd eweredig aan die massa* (2)
OR/OF
The net force acting on an object is equal to the rate of change of momentum of the object (in the direction of the force). ✓✓ *// Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp* (2 or 0)

2.2

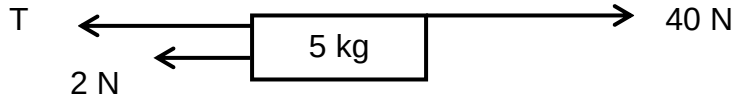


(3)

f (friction / f_w) T (tension/*spankrag*) and F (40 N)

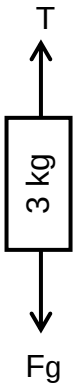
2.3 Let the acceleration of the 3 kg mass and trolley be **a** and let **T** represent tension. Take **right** as positive (**+**)

2.3.1 Consider the 5 kg trolley:



$F_{net} = ma$ ✓
$40 + (-T) + (-f) = ma$
$\underline{40 - T - 2}$ ✓ $= 5a$ ✓
$T = 38 - 5a$ ✓ …….. equation 1

Similarly, consider the 3 kg suspended block:



$F_{net} = ma$
$T + F_g = 3a$ ✓
$T - (3 \times 9,8) = 3a$
$T = 3a + 29,4$ …….. equation 2

(NB: one mark for <u>38 – 5a</u> OR <u>3a + 29,4</u>)

Since T is the same:
$3a + 29,4 = 38 - 5a$ ✓
$8a = 8,6$
$a = 1,075 \text{ m.s}^{-2}$ ✓ (7)

2.3.2 From eq 1: $T = 38 - 5a$ ✓ ✓
$= 38 - 5 \times 1,075 = 32,625 \text{ m.s}^{-2}$ (2)

[14]

QUESTION / VRAAG 3

3.1 displacement of the brick ✓/height of scaffolding/final height above the ground // *verplasing van die baksteen/ hoogte van steier bokant grond/* (1)

3.2 1,4 – 0,6 = 0,8 s ✓ Motion is parabolic, therefore t_x = 1,4 + 0,8 = 2,2 s ✓
OR 2,8 – 0,6 = 2,2 s ✓ (2)

3.3 1,4 s ✓ (1)

3.4 3.4.1 Take downward motion as NEGATIVE.
(Other option: take downwards as positive)

$v_f = v_i + a\Delta t$ ✓
0 ✓ $= v_i + (-9,8)\ (1,4)$ ✓
$v_i = -13,72\ m{\cdot}s^{-1}$
$= 13,72\ m{\cdot}s^{-1}$, upwards ✓ */opwaarts* (4)

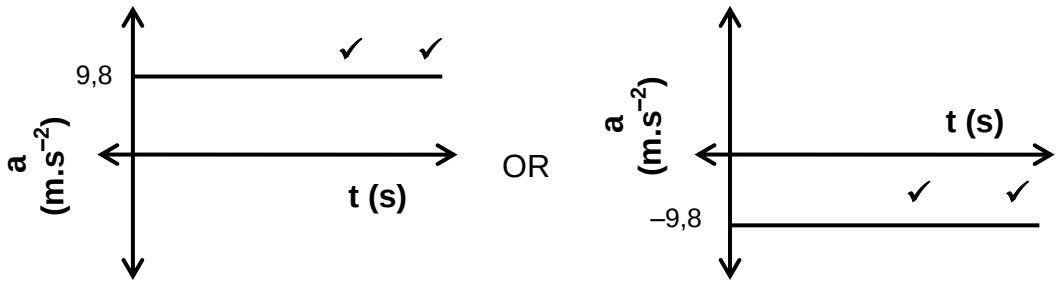
3.4.2 $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$= (13,72)$ ✓ $(2,2)$ ✓ $+ ½\ (-9,8)\ (2,2)^2$ ✓
$= 6,47\ m$ ✓

OR/OF

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= 0 + ½\ (-9,8)\ (0,8)^2$ ✓
$= 3,136\ m$

$y_1 = 9,6 - 3,136 = 6,46\ m$ ✓ ✓ (4)

3.5

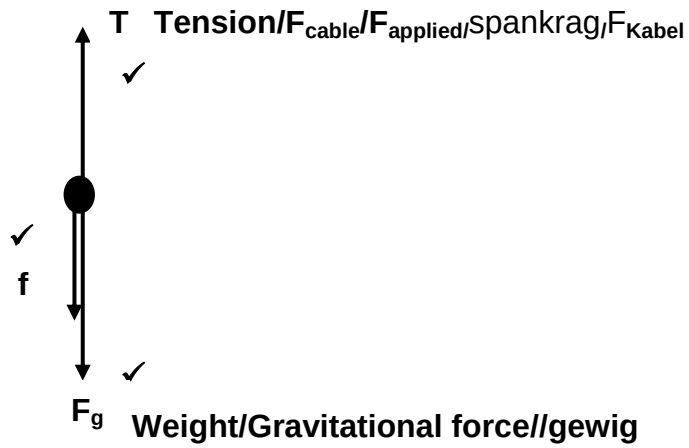


(2)

[14]

QUESTION / VRAAG 4

4.1



(3)

4.2 Work done = $F_{applied}\ \Delta x \cos\Theta$ = (800) (12) (1) = 9600 J ✓ (3)

4.3 Work Energy theorem states that, the net/total work done on an object is equal to the change in the object's kinetic energy OR the work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. ✓ // *Die netto arbeid verrig is gelyk aan die verandering in kinetiese energie/ die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie* (2)

4.4
$$W_{NET} = \Delta E_K$$
$$W_G + W_A + W_f = \tfrac{1}{2} mv_f^2 - \tfrac{1}{2} mv_i^2$$
$$120 \times 9{,}8 \times 12 \cos 180 + (9600) + W_f = \tfrac{1}{2} (120) (5^2) - \tfrac{1}{2} (120) 0^2$$
$$W_f = 1500 - 9600 + 14112$$
$$= 6012 \text{ J}$$

OR/ OF

$$W_{NC} = \Delta E_K + \Delta E_P$$
$$W_A + W_f = (\tfrac{1}{2} mv_f^2 - \tfrac{1}{2} mv_i^2) + (mgh_f - mgh_i)$$
$$9600 + W_f = (\tfrac{1}{2} (120)(5^2) - \tfrac{1}{2} (120) 0) + (120 \times 9{,}8 \times 12 - 0)$$
$$W_f = 6012 \text{ J}$$ (4)

4.5 tension in the cable OR air friction//*spankrag OF lugweerstand* (1)

[13]

QUESTION / VRAAG 5

5.1 impulse EQUALS change in momentum //*gelyk aan* (1)

5.2 Yes. The system is isolated / closed with no external forces acting on person and ball. ✓ / *Ja dis 'n geslote/geisoleerde sisteem/geen eksterne kragte werk in op die person of die bal nie* (2)

5.3

OPTION 1	**OPTION 2**
Take direction towards player as negative / na speler is -	**Take direction towards player as positive / na speler is+**
$F_{net}\Delta t = m\Delta v = mv_f - mv_i$	$F_{net}\Delta t = m\Delta v = mv_f - mv_i$
$F\ (0{,}02) = (0{,}5)\ ((9) - (-6)) = 7{,}5$	$F\ (0{,}02) = (0{,}5)\ ((-9) - (6)) = -7{,}5$
$F = 375$ N	$F = -375$ N
	$= 375$ N

(4)

5.4 Greater. The change in momentum for the ball will be the same but the time of contact will be smaller. ✓ // *Groter Verandering in momentum dieselfde maar kontaktyd kleiner* (3)

[10]

QUESTION / VRAAG 6

6.1

6.1.1 The Doppler Effect is the change in the observed 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.✓✓ *die verandering in die waargenome frekwensie/ toonhoogte/ klank waargeneem deur die luisteraar omdat die klankbron en die luisteraar verskillende snelhede het relatief tot die medium van klank voortplanting*

OR/ OF

The change in the (observed) frequency when there is relative motion between the source and the observer.✓✓ **//** *die verandering in die waargenome frekwensie wanneer daar relatiewe beweging is tussen die bron en die waarnemer* (2)

6.1.2 Movement towards: $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

$50 \times 1000 = \frac{1560 + 0}{1560 - v_s} \times f_s$ ✓✓

$v_s = 1560 - \frac{1560 f_s}{50000}$ ✓ ……equation 1

Movement away: $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$

$49 \times 1000 = \frac{1560 - 0}{1560 + v_s} \times f_s$ ✓

$v_s = \frac{1560 f_s}{49000} - 1560$ ✓ ……equation 2

eq 1 ✓= eq 2

$1560 - \frac{1560 f_s}{50000} = \frac{1560 f_s}{49000} - 1560$

$f_s = 49494{,}95$ Hz ✓ (8)

6.1.3 $v_s = 1560 - \frac{1560 f_s}{50000}$

$v_s = 1560 - \frac{1560 \times 49494{,}95}{50000}$ ✓

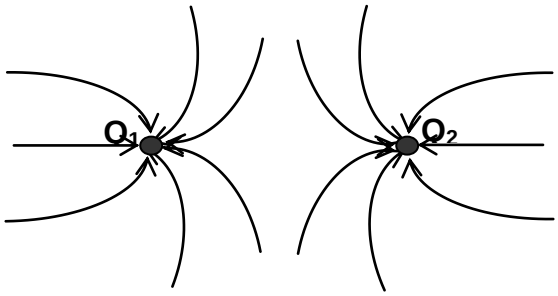
$= 15{,}76 \text{ m.s}^{-1}$ ✓ (2)

6.2 Emission spectra occurs when a light source gives off light and absorption spectra occurs when white light is observed through a cold gas ✓ // *Emissiespektra vorm wanneer 'n ligbron lig afgee terwyl absorbsiespektra vorm wanneer wit lig deur 'n koue gas waargeneem word* (2)

[14]

QUESTION / VRAAG 7

7.1



✓	Direction/ rigting
✓	Pattern/ vorm
✓	field lines do not touch / veldlyne raak nie

(3)

7.2 Charges can neither be created nor destroyed but transferred from one body to another. ✓✓ *// ladings kan nie geskep of vernietig word nie maar slegs van een voorwerp na 'n ander oorgedra word*
The net charge of an isolated system remains constant during any physical process. ✓✓*// die netto lading in 'n geslote sisteem bly constant tydens enige fisiese proses* (2)

7.3 same position ✓ / *dieselfde posisie* (1)

7.4
$$E = \frac{kQ}{r^2} \checkmark$$
$$= \frac{9 \times 10^9 (7{,}5 \times 10^{-9})}{(10 \times 10^{-3})^2} \checkmark \checkmark$$
$$= 675000 \text{ N.C}^{-1} \text{ to the right or } 6{,}75 \times 10^5 \text{ N.C} \quad (3)$$

7.5

7.5.1
$$Q_1 = -7{,}5 + (-12{,}5) = -20 \text{ n C} \quad \checkmark \checkmark$$
$$Q_2 = -7{,}5 - (-12{,}5) = +5 \text{ n C} \quad \checkmark \checkmark \quad (4)$$

7.5.2 Positive marking from QUESTION 7.5.1

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$
$$F = \frac{9 \times 10^9 \times 20 \times 10^{-9} 5 \times 10^{-9}}{(30 \times 10^{-2})^2} \checkmark \checkmark$$
$$F = 0{,}001 \text{ N (attraction)} \checkmark \quad (4)$$

7.5.3 No ✓ *// nee* (1)

[18]

QUESTION / VRAAG 8

8.1 Yes. V_2 will be in series to the circuit / no current in the circuit / no energy use in the circuit / V_2 is effectively across the battery – no current in the circuit. // *Ja V_2 sal in serie verbind wees in die stroombaan/ daar is geen stroom in die stroombaan/ geen energie verbruik in die stroombaan nie* (2)

8.2

8.2.1 Zero or 0 V ✓ // *nul* (1)

8.2.2

OPTION 1

$V_{1\Omega} = I_{Total}R = (2,5)(1) = 2,5$ V

$V_{//} = 7,5 - 2,5 = 5$ V

$R_{//} = \frac{V_{//}}{I_{tot}} = \frac{5}{2,5} = 2\Omega$

$\frac{1}{R_p} = \frac{1}{r_1} + \frac{1}{r_2}$

$\frac{1}{2} = \frac{1}{6} + \frac{1}{R}$

$R = 3\ \Omega$

OPTION 2

$I_{6\Omega} = \frac{V}{R} = \frac{5}{6}$A

$I_R = 2,5 - \frac{5}{6} = \frac{5}{3}$

$R = \frac{V}{I} = \frac{5}{5/3} = 3\Omega$

(7)

8.2.3 Internal resistance is the opposition to the flow of charge within a cell ✓✓ // *die teenstand teen die vloei van lading binne-in die battery* (2)

8.2.4

OPTION 1

$V_{lost} = V_{tot} - V_1 = 10 - 7,5 = 2,5$ V

$V_{lost} = Ir$

$I = \frac{(2,5)}{2,5} = 1\ \Omega$

OPTION 2

$R_{//} = \frac{V_{//}}{I_{tot}} = \frac{10}{2,5} = 4$

$R_{ext} = 2 + 1 = 3$ Therefore, $r = 1\ \Omega$

OPTION 3

$emf = I(R + r)$

$10 = 2,5(3 + r)$

$r = 1\ \Omega$

(3)

8.3 Decrease ✓ //*afneem* (1)

[16]

QUESTION / VRAAG 9

9.1 Temperature. Temperature affects resistance // *temperatuur omdat temperatuur die weerstand beinvloed* (2)

9.2 emf or total potential difference ✓// *emk of totale potensiaalverskil* (1)

9.3

9.3.1 7V ✓ (allow 6,9 – 7,1) (1)

9.3.2 r can be found by finding the gradient of the graph

$$\text{gradient} = \frac{\Delta V}{\Delta I}$$
$$= \frac{6 - 0}{0{,}05 - 0{,}3} \checkmark$$
$$= \frac{1}{-0{,}05} \checkmark$$
$$= -20$$
$$R_{int} = 20\ \Omega \checkmark$$

(other correct values from the graph can be used for the calculation) (4)

[8]

QUESTION / VRAAG 10

10.1 10.1.1 (split – ring) commutator ✓**//(***splitring) kommutator* (1)

10.1.2 A – North ✓ /*Noord* B – South ✓/ *Suid* (2)

10.2 10.2.1 $I_{rms} = \frac{I_{max}}{\sqrt{2}} \checkmark = \frac{10{,}6}{\sqrt{2}} \checkmark = 7{,}495\text{A} \checkmark$ (3)

10.2.2 $P_{ave} = V_{rms}I_{rms} \checkmark$
$= \frac{V_{max}}{\sqrt{2}} \text{x} 7{,}495 = \frac{300}{\sqrt{2}} \text{x} 7{,}495 \checkmark$
$= 1589{,}93\ \text{W} \checkmark$ (3)

10.2.3 maximum ✓ // *maksimum* (1)

[10]

QUESTION / VRAAG 11

11.1 threshold frequency ✓ // *drumpelfrekwensie* (1)

11.2 $E = \frac{hc}{\lambda} = W_o + E_{k\,(max)}$

$\frac{(6{,}63 \times 10^{-34} \times 3 \times 10^{8})}{429 \times 10^{-9}}$ ✓ = $3{,}5 \times 10^{-19}$ ✓ + $E_{k(max)}$

$E_{k(max)} = \frac{(6{,}63 \times 10^{-34} \times 3 \times 10^{8})}{429 \times 10^{-9}} - 3{,}5 \times 10^{-19}$

$= 4{,}64 \times 10^{-19} - 3{,}5 \times 10^{-19}$

$= 1{,}14 \times 10^{-19}$ J ✓ (5)

11.3.1 same ✓ // *dieselfde* (1)

11.3.2 same ✓ // *dieselfde* (1)

11.3.3 increase (or double) ✓ //*verhoog/ verdubbel* (1)

11.4 $q = I \Delta t$ ✓ = $3.2 \times 10^{-7} \times 4 = 12{,}8 \times 10^{-7}$ C ✓

$n = \frac{Q}{e} = \frac{12{,}8 \times 10^{-7}}{1{,}6 \times 10^{-19}}$ ✓ = 8×10^{12} electrons ✓ (4)

[13]

Grand total: 150