education

Department of Education
FREE STATE PROVINCE

EXAMINATION / *EKSAMEN*

GRADE 12 / *GRAAD 12*

PHYSICAL SCIENCES PAPER 1
FISIESE WETENSKAPPE VRAESTEL 1

MEMORANDUM

JUNE 2022 / *JUNIE 2022*

MARKS: 150 / *PUNTE: 150*

TIME: 3 HOURS / *TYD: 3 UUR*

This memorandum consists of 14 pages.
Hierdie memorandum bestaan uit 14 bladsye.

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QUESTION 1 / *VRAAG 1*

1.1 B✓✓ 1.2 C ✓✓ 1.3 A ✓✓

1.4 B ✓✓ 1.5 A ✓✓ 1.6 B ✓✓

1.7 B ✓✓ 1.8 D ✓✓ 1.9 B ✓✓

1.10 C ✓✓ **[20]**

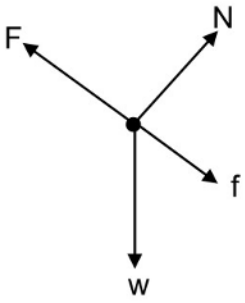
Note about definitions, laws, and principles: Unless otherwise mentioned, one mark is forfeited if any of the underlined key words is omitted.
Aantekening omtrent definisies, wette en beginsels: Tensy anders aangedui, word een punt verbeur indien enige van die onderstreepte sleutelwoorde uitgelaat is.

QUESTION 2 / *VRAAG 2*

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

'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid volhard, tensy 'n nie-nul resulterende/netto krag daarop inwerk. (2)

2.1.2



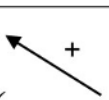
Accepted labels / *Aanvaarbare byskrifte*	
w ✓	F_g/F_w/weight/mg / gravitational force *F_g/$F_{w/gewig}$/mg/gravitasiekrag*
F ✓	F_T/T/tension/$F_{applied}$ / Applied force *F_T/T/spanning/$F_{toegepas}$ / Toegepaste krag*
f ✓	(Kinetic) friction / F_f/12,5 N/f_k *(Kinetiese) wrywing / F_f/12,5 N/f_k*
N ✓	F_{normal}/Normal/F_N *$F_{normaal}$/Normaal/F_N*

Notes/*Aantekeninge*
- Mark is awarded for label and arrow. / *Punt word toegeteken vir byskrif en pyl.*
- Do not penalise for length of arrows since drawing is not to scale.
  Moenie vir die lengte van die pyle penaliseer nie aangesien die tekening nie volgens skaal is nie.
- Any other additional force(s) / *Enige ander addisionele krag(te)* Max/ *Maks* $^3/_4$
- Force(s) do not make contact with body:
  Krag(te) maak nie met die voorwerp kontak nie: Max/*Maks* $^3/_4$

(4)

2.1.3

$F_{net} = ma$ ✓
$F + w_{//} + f = ma$
$F - (4)(9,8)\sin 30°$✓$- 12,5$ ✓$= 0$ ✓
$F = 32,1$ N ✓



(5)

2.1.4 $w_{//}$ ✓ ; f ✓ (Words or correct symbols are fine.)
(Woorde of korrekte simbole is in orde.) (2)

2.1.5

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
$F_{net} = ma$ $w_{//} + f = ma$ $-(4)(9,8)\sin 30° - 12,5$ ✓ $= 4a$ ✓ $a = -8,025\ m{\cdot}s^{-2}$ ✓ ∴Magnitude/*Grootte* $= 8,025\ m{\cdot}s^{-2}$ ✓	$F_{net} = ma$ $w_{//} + f = ma$ $(4)(9,8)\sin 30° + 12,5$ ✓$= 4a$ ✓ $a = +8,025\ m{\cdot}s^{-2}$ ✓ ∴Magnitude/*Grootte* $= 8,025\ m{\cdot}s^{-2}$ ✓
OR: Underlined part = -32,1; positive marking from Q2.1.3. ***OF:*** *Onderstreepte deel = -32,1; positiewe nasien vanaf V2.1.3.*	**OR:** Underlined part = +32,1; positive marking from Q2.1.3. ***OF:*** *Onderstreepte deel = +32,1; positiewe nasien vanaf V2.1.3.*

(4)

2.2.1 Each **body** in the universe attracts every other **body** with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between **their centres**. ✓
OR
Every **particle** in the universe attracts every other **particle** with a force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance **between them**. ✓

*Elke **liggaam** in die heelal trek elke ander **liggaam** aan met 'n krag direk eweredig aan die produk van hul massas en omgekeerd eweredig aan die kwadraat van die afstand tussen **hul middelpunte**.*
OF
*Elke **deeltjie** in die heelal trek elke ander **deeltjie** aan met 'n krag direk eweredig aan die produk van hul massas en omgekeerd eweredig aan die kwadraat van die afstand tussen **hulle**.* (2)

2.2.2

OPTION 1 / *OPSIE 1*

$F = G\frac{m_1 m_2}{r^2}$ ✓

$2,4 \times 10^3$ ✓ $= \frac{(6,67 \times 10^{-11})(250)(5,98 \times 10^{24})}{r^2}$ ✓

$r = 6,4458 \times 10^6\ m$

$r = R_E + h$

$6,4458 \times 10^6 = 6,38 \times 10^6 + h$ ✓

$h = 6,58 \times 10^4$ m ✓

OPTION 2 / *OPSIE 2*
w = mg 2,4 x 10^3 = 250g ✓ g = 9,6 m·s^{-2} $g = \frac{GM}{r^2}$ ✓ $9{,}6 = \frac{(6{,}67 \times 10^{-11})(5{,}98 \times 10^{24})}{r^2}$ ✓ $r = 6{,}4458 \times 10^6\ m$ r = R_E + h 6,4458 x 10^6 = 6,38 x 10^6 + h ✓ h = 6,58 x 10^4 m ✓

(5)
[24]

QUESTION 3 / *VRAAG 3*

3.1.1 Weight/Gravity / Gravitational force. ✓
Gewig/*Gravitasie/Gravitasiekrag/Swaartekrag* (1)

3.1.2 10,944 (m) ✓ (1)

3.1.3

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
Upwards + / *Opwaarts +*	**Downwards + / *Afwaarts +***
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
$0 = v_i + (-9{,}8)(1{,}2)$✓	$0 = v_i + (9{,}8)(1{,}2)$✓
$v_i = 11{,}76$ m·s^{-1}	$v_i = -11{,}76$ m·s^{-1}
∴ speed/*spoed* = 11,76 m·s^{-1} ✓	∴ speed/*spoed* = 11,76 m·s^{-1} ✓

(3)

3.1.4 **POSITIVE MARKING FROM 3.1.3. / *POSITIEWE NASIEN VANAF 3.1.3.***

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
Upwards + / *Opwaarts +*	**Downwards + / *Afwaarts +***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = 11{,}76^2 + 2(-9{,}8)\Delta y$ ✓	$0^2 = (-11{,}76)^2 + 2(9{,}8)\Delta y$ ✓
$\Delta y = 7{,}056\ m$	$\Delta y = -7{,}056\ m$
h = 7,056 + 10,944 ✓ = 18 m ✓	h = 7,056 + 10,944 ✓ = 18 m ✓

OPTION 3 / *OPSIE 3*	**OPTION 4 / *OPSIE 4***
Upwards + / *Opwaarts +*	**Downwards + / *Afwaarts +***
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= (11{,}76)(1{,}2) + \frac{1}{2}(-9{,}8)(1{,}2^2)$ ✓	$= (-11{,}76)(1{,}2) + \frac{1}{2}(9{,}8)(1{,}2^2)$ ✓
$= 7{,}056\ m$	$= -7{,}056\ m$
h = 7,056 + 10,944 ✓ = 18 m ✓	h = 7,056 + 10,944 ✓ = 18 m ✓

(4)

Note about question 3.2: Downward as positive was given.
Aantekening omtrent vraag 3.2: Afwaarts as positief is gegee.

3.2.1 12 m·s^{-1} ✓ (1)

3.2.2 The (gravitational) acceleration ✓ of the object remains constant. ✓ **OR**
The gradient of the graph ✓ represents the (gravitational) acceleration of the object.✓

Die (gravitasie)versnelling van die voorwerp bly konstant. ***OF***
Die gradiënt van die grafiek verteenwoordig die (gravitasie)versnelling van die voorwerp. (2)

3.2.3

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
$v_f^2 = v_i^2 + 2a\Delta y$ ✓ $27^2 = 12^2 + 2(9{,}8)\Delta y$ ✓ $\Delta y = 29{,}85\ m$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $\Delta y = (12)(1{,}53) + \frac{1}{2}(9{,}8)(1{,}53)^2$ ✓ $= 29{,}83\ m$ ✓
OPTION 3 / *OPSIE 3*	**OPTION 4 / *OPSIE 4***
$\Delta y = \left[\frac{v_i + v_f}{2}\right]\Delta t$ ✓ $= \left[\frac{12 + 27}{2}\right](1{,}53)$ ✓ $= 29{,}84\ m$ ✓	Similar correct formulae are acceptable. *Soortgelyke korrekte formules is aanvaarbaar.* $h = \frac{1}{2}(ewewydige\ sye)(\Delta t)$ $h = \frac{1}{2}(parallel\ sides)(\Delta t)$ ✓ $= \frac{1}{2}(12 + 27)(1{,}53)$ ✓ $= 29{,}84\ m$ ✓

(3)

3.2.4
$v_f = v_i + a\Delta t$✓
$0 = -14 + (9{,}8)\Delta t$✓
$\Delta t = 1{,}4286\ s$ (1,43 s)

T = 7,78 -1,4286 ✓ = 6,3514 s ✓ (6,35 s) (4)

3.2.5 2 ✓ (1)

3.2.6 0,02 s ✓ (1)

3.2.7 3,9 s ✓ (1)

3.2.8 Downwards ✓ / *Afwaarts* (1)
[23]

QUESTION 4 / *VRAAG 4*

4.1.1 The total linear momentum of an isolated system remains constant / is conserved. ✓✓ [**Note:** "closed system" is **not** acceptable.]

Die totale lineêre momentum in 'n geïsoleerde sisteem bly konstant /behoue. [**Aantekening:** "geslote sisteem" is **nie** aanvaarbaar **nie**.] (2)

4.1.2

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
East + / *Oos +*	**West + / *Wes +***
$\Sigma p_i = \Sigma p_f$ ✓	$\Sigma p_i = \Sigma p_f$ ✓
$m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_f$	$m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_f$
$(0,02)(251)$ ✓$+ 0$ ✓ $= (0,02 + m)(1)$ ✓	$(-0,02)(251)$ ✓$+ 0$ ✓ $= (0,02 + m)(-1)$ ✓
$m = 5$ kg ✓	$m = 5$ kg ✓

(5)

4.1.3 **POSITIVE MARKING FROM 4.1.2. / *POSITIEWE NASIEN VANAF 4.1.2.***

$\Sigma E_{ki} = \frac{1}{2}m_1v_{i1}^2 + \frac{1}{2}m_2v_{i2}^2$ ✓ $\Sigma E_{kf} = \frac{1}{2}(m_1 + m_2)v_f^2$

$= \frac{1}{2}(5)(0)^2 + \frac{1}{2}(0,02)(251)^2$ ✓ $= \frac{1}{2}(5 + 0,02)(1)^2$ ✓

$= 630,01$ J ✓ $= 2,51$ J

Inelastic / *Onelasties* ✓

Note: If learners **start** with $\Sigma E_{ki} = \Sigma E_{kf}$:
Maximum 2/5 for correct substitutions for "before" and "after.

Aantekening: *Indien leerders **begin** met $\Sigma E_{ki} = \Sigma E_{kf}$:*
***Maksimum 2/5** vir korrekte instellings vir "voor" en "na".*

(5)

4.2.1
- $F_{net} = \frac{\Delta p}{\Delta t}$ ✓
- Δt increases ✓ due to the airbags.
- F_{net} decreases for the same Δp. ✓
  OR F_{net} decreases because $F \propto \frac{1}{\Delta t}$.

The indirect proportionality must be mentioned instead of "same Δp" to earn the third mark.

- $F_{net} = \frac{\Delta p}{\Delta t}$ ✓
- *Δt neem toe* ✓ *a.g.v. die lugsakke.*
- *F_{net} verminder vir dieselfde Δp.* ✓
  ***OF** F_{net} verminder omdat $F \propto \frac{1}{\Delta t}$.*

Die omgekeerde ewere-digheid moet genoem word in plaas van "dieselfde Δp" om die derde punt te verdien.

(3)

4.2.2

OPTION 1 / *OPSIE 1*	**OPTION 2 / *OPSIE 2***
Right + / *Regs +*	**Left + / *Links +***
$F_{net}\,\Delta t = \Delta p$ ✓ $F_{net}(0,3)$ ✓ $= (2\,500)(0 - 20)$ ✓ $F_{net} = -1,667 \times 10^5$ N	$F_{net}\,\Delta t = \Delta p$ ✓ $F_{net}(0,3)$ ✓ $= (2\,500)(0 - (-20))$ ✓ $F_{net} = +1,667 \times 10^5$ N
F_{net} = 1,667 × 10^5 N, left / backwards / away from the wall / opposite to the car's direction of motion ✓ *links / terugwaarts / weg vanaf die muur / teenoorgesteld aan die motor se bewegingsrigting*	

OPTION 3 / *OPSIE 3*	**OPTION 4 / *OPSIE 4***
Right + / *Regs +*	**Left + / *Links +***
$a = \frac{\Delta v}{\Delta t}$ **OR/*OF*** $v_f = v_i + a\Delta t$ $= \frac{0 - 20}{0,3}$ ✓ $= -66,667\ m \cdot s^{-2}$	$a = \frac{\Delta v}{\Delta t}$ **OR/*OF*** $v_f = v_i + a\Delta t$ $= \frac{0 - (-20)}{0,3}$ ✓ $= +66,667\ m \cdot s^{-2}$
$F_{net} = ma$ ✓ $= (2\,500)(-66,667)$ ✓ $= -1,667x10^5\ N$	$F_{net} = ma$ ✓ $= (2\,500)(66,667)$ ✓ $= 1,667x10^5\ N$
F_{net} = 1,667 × 10^5 N, left / backwards / away from the wall / opposite to the car's direction of motion ✓ *links / terugwaarts / weg vanaf die muur / teenoorgesteld aan die motor se bewegingsrigting*	

(4)

4.2.3 **POSITIVE MARKING FROM 4.2.2 FOR MAGNITUDE**
POSITIEWE NASIEN VANAF 4.2.2 VIR GROOTTE
1,667 × 10^5 N ✓
right / forward / towards the wall / same as the car's direction of motion ✓
regs / voorwaarts / na die muur toe / dieselfde as die motor se bewegingsrigting (2)

4.2.4 Newton's third law of motion ✓ / *Newton se derde bewegingswet* (1)
[22]

QUESTION 5 / *VRAAG 5*

5.1 **NEGATIVE MARKING. / *NEGATIEWE NASIEN*.**
Yes ✓ There is no friction on the trolley. / Only weight is doing work on the trolley. ✓
Ja Daar is geen wrywing op die trollie nie. / Slegs gewig verrig arbeid op die trollie. **(**2)

5.2 **Note:** The term "closed" is not acceptable here.
Aantekening: *Die term "geslote" is nie hier aanvaarbaar nie.*

The <u>total mechanical energy</u> (sum of kinetic energy and gravitational potential energy) in an **<u>isolated</u>** <u>system remains constant</u>.✓✓

Die <u>totale meganiese energie</u> (som van gravitasie-potensiële energie en kinetiese energie) in 'n **<u>geïsoleerde</u>** <u>sisteem bly konstant</u>. (2)

5.3

OPTION 1 / *OPSIE 1*

$E_m(X) = E_m(Y)$ ✓
$mgh + \frac{1}{2}mv^2 = mgh + \frac{1}{2}mv^2$
$(2)(9,8)(3) + \frac{1}{2}(2)(0^2)$ ✓ $= (2)(9,8)(0) + \frac{1}{2}(2)v_y^2$ ✓
$v_y = 7,668\ m.s^{-1}$ ✓

OPTION 2 / *OPSIE 2*

$W_{net} = \Delta K$ ✓
$mg\Delta y\cos\Theta = K_f - K_i$
$(2)(9,8)(3)(\cos 0°)$ ✓ $= \frac{1}{2}(2)v_y^2 - 0$ ✓
$v_y = 7,668\ m \cdot s^{-1}$ ✓

OPTION 4 / *OPSIE 4*

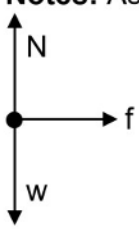
Down + / *Af +*
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= 0^2$ ✓ $+ 2(9,8)(3)$ ✓
$v_y = 7,668\ m \cdot s^{-1}$ ✓

OPTION 3 / *OPSIE 3*

$W_{nc} = \Delta K + \Delta U$ ✓
0 ✓ $= \left[\frac{1}{2}(2)v_y^2 - 0\right] + [0 - (2)(9,8)(3)]$ ✓
$v_y = 7,668\ m \cdot s^{-1}$ ✓

(4)

5.4 **Notes:** As for Q2.1.2. / ***Aantekeninge:*** *Soos vir V2.1.2.*



Accepted labels / *Aanvaarbare byskrifte*	
w ✓	F_g/F_w/weight/mg / gravitational force *$F_g/F_{w/gewig}$/mg/gravitasiekrag*
f ✓	(Kinetic) friction / F_f/f_k *(Kinetiese) wrywing / F_f/f_k*
N ✓	F_{normal}/Normal/F_N *$F_{normaal}$/Normaal/F_N*

(3)

5.5 A force for which the work done in moving an object between two points depends on the path taken.✓✓

'n Krag waarvoor die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die roete wat gevolg word. (2)

5.6 **NOTE:** No mark if the symbol is given.
Aantekening: *Geen punt as die simbool gegee is.*
Gravitational force / Gravity/Weight ✓
Swaartekrag/Gravitasiekrag/Gewig (1)

5.7 **NEGATIVE MARKING. / *NEGATIEWE NASIEN*.**
Z to Y ✓
Speed/velocity of the trolley decreases. ✓
OR The net force on the trolley is from Z to Y.
OR The net force on the trolley has the same direction as the (force of) friction on the trolley.

Z na Y
Spoed/snelheid van die trollie verminder.
OF *Die netto krag op die trollie is van Z na Y.*
Of *Die netto krag op die trollie het dieselfde rigting as die wrywing(skrag) op die trollie.* (2)

5.8 **POSITIVE MARKING FROM 5.3. / *POSITIEWE NASIEN VANAF 5.3.***

OPTION 1 / *OPSIE 1*

$W_{net} = \Delta K$ ✓
$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$f\Delta x\cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$f(5)(\cos180°)$ ✓ $= \frac{1}{2}(2)(0^2)$ ✓ $- \frac{1}{2}(2)(7{,}668^2)$ ✓
f = 11,7596 N ✓

OPTION 2 / *OPSIE 2*

$W_{net} = \Delta K$ ✓
$W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$= \frac{1}{2}(2)(0^2)$ ✓ $- \frac{1}{2}(2)(7{,}668^2)$ ✓
= -58,798 J

$W_f = f\Delta x\cos\theta$
-58,798 = f(5)(cos180°) ✓
f = 11,7596 N ✓

OPTION 3 / *OPSIE 3*

$W_{nc} = \Delta K + \Delta U$ ✓
$W_f = (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2) + 0$
$f(5)(\cos180°)$ ✓ $= \frac{1}{2}(2)(0^2) - \frac{1}{2}(2)(7{,}668^2)$ ✓ + 0 ✓
f = 11,7596 N ✓

OPTION 4 / *OPSIE 4*

$W_f = f\Delta x\cos\theta$ ✓
$\underline{-}$ ✓ $\underline{(2)(9{,}8)(3)}$ ✓ = f(5)(cos180°) ✓
f = 11,76 N ✓

(5)
[21]

QUESTION 6 / *VRAAG 6*

6.1.1 **NEGATIVE MARKING / *NEGATIEWE NASIEN***
Towards ✓
The observed frequency is higher than the actual/source frequency. ✓
OR $f_L > f_S$

Nader aan
Die waargenome frekwensie is hoër as die werklike/bron frekwensie.
OF $f_L > f_S$ (2)

6.1.2
$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$$
$$1{,}3f \checkmark = \left[\frac{343}{343 - v_s}\right] \checkmark \; f \checkmark$$
$$v_s = 79{,}1538\ m \cdot s^{-1} \checkmark$$
(5)

6.1.3 To measure the heartbeat of a foetus. ✓
OR To measure rate of blood flow.
OR Correct alternative.

Om die hartklop van 'n fetus te monitor.
OF Om die tempo van bloedvloei te meet.
OF *Korrekte alternatief.* (1)

6.2 The red shift is the <u>movement of the spectral lines (of light) towards the red end</u> ✓ of the spectrum with <u>longer wavelengths/smaller frequency</u>.✓

Die rooi verskuiwing is die <u>beweging van die spektraallyne (van lig) na die rooi kant</u> van die spektrum met <u>langer golflengtes/kleiner frekwensies</u>. (2)
[10]

QUESTION 7 / *VRAAG 7*

7.1 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) 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 (Q_1) op 'n ander puntlading (Q_2) uitoefen, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand (r) tussen hulle. (2)

7.2

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$
$$= \frac{(9x10^9)(5x10^{-6})(6x10^{-6})}{0{,}02^2} \checkmark \checkmark$$
$$= 675\ N$$
$$F = 675\ N\ towards\ S\ OR\ attractive \checkmark$$
$$na\ S\ toe\ OF\ aantrekkend$$

(4)

7.3

$$Q_S = \frac{5\ \mu C + (-6\ \mu C)}{2}$$
$$= -0{,}5\ \mu C \checkmark$$

OR/*OF*

$$Q_S = \frac{5x10^{-6}\ C + (-6x10^{-6}\ C)}{2}$$
$$= -5x10^{-7}\ C \checkmark$$

(1)

7.4



(2)

7.5

OPTION 1 / *OPSIE 1*

$$F_{RP} = \frac{kQ_RQ_P}{r^2}$$
$$= \frac{(9x10^9)(5x10^{-7})Q_R}{0{,}01^2} \checkmark$$
$$= 4{,}5x10^7 Q_R$$

$$F_{SP} = \frac{kQ_SQ_P}{r^2}$$
$$= \frac{(9x10^9)(5x10^{-7})(5x10^{-7})}{0{,}02^2} \checkmark$$
$$= 5{,}625\ N$$

For the **net force to the left**, with **right positive:**
*Vir die **netto krag na links**, met **regs positief:***

$F_{net} = F_{RP} + F_{SP}$
$-84{,}375 \checkmark = (-4{,}50 \times 10^7)Q_R + 5{,}625 \checkmark$
$Q_R = 2 \times 10^{-6}$ C ✓

OR/*OF*

For the **net force to the left**, with **left positive:**
*Vir die **netto krag na links**, met **links positief:***

$F_{net} = F_{RP} + F_{SP}$
$84{,}375 \checkmark = (4{,}50 \times 10^7)Q_R + (-5{,}625) \checkmark$
$Q_R = 2 \times 10^{-6}$ C ✓

Max 3/5 for option 2. The net force cannot be to the right. Test it by using the value of Q_R to calculate the net force. It differs from the given value in the question paper.

***Maks 3/5 vir opsie 2**. Die netto krag kan nie na regs wees nie. Toets dit deur die waarde van Q_R te gebruik om die netto krag te bereken. Dit verskil van die gegewe waarde in die vraestel.*

OPTION 2 / *OPSIE 2*

$$F_{RP} = \frac{kQ_RQ_P}{r^2} = \frac{(9x10^9)(5x10^{-7})Q_R}{0{,}01^2} \checkmark = 4{,}5x10^7Q_R$$

$$F_{SP} = \frac{kQ_SQ_P}{r^2} = \frac{(9x10^9)(5x10^{-7})(5x10^{-7})}{0{,}02^2} \checkmark = 5{,}625\ N$$

For the **net force to the right**, with **right positive:**
*Vir die **netto krag na regs**, met **regs positief:***

$F_{net} = F_{RP} + F_{SP}$
$84{,}375 = (-4{,}50 \times 10^7)Q_R + 5{,}625$ ✓
$Q_R = -1{,}75 \times 10^{-6}$ C

OR/*OF*

For the **net force to the right**, with **left positive:**
*Vir die **netto krag na links**, met **links positief:***

$F_{net} = F_{RP} + F_{SP}$
$-84{,}375 = (4{,}50 \times 10^7)Q_R + (-5{,}625)$ ✓
$Q_R = -1{,}75 \times 10^{-6}$ C ✓

(5)

7.6 **POSITIVE MARKING FROM 7.3. / *POSITIEWE NASIEN VANAF 7.3.***

$$E_{net} = \frac{F_{net}}{Q_P} \checkmark = \frac{84{,}375}{5x10^{-7}} \checkmark = 1{,}6875x10^8\ N \cdot C^{-1} \checkmark$$

(3)
[17]

QUESTION 8 / *VRAAG 8*

8.1 The potential difference across a conductor is directly proportional to the current in the conductor✓ at constant temperature. ✓

Die potensiaalverskil oor 'n geleier is direk eweredig aan die stroom in die geleier by konstante temperatuur. (2)

8.2 12 J✓ (1)

8.3.1

$$\frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3} \checkmark$$
$$\frac{1}{R_p} = \frac{1}{10} + \frac{1}{30} \checkmark$$
$$R_p = 7{,}5\ \Omega$$

OR/*OF*

$$R_p = \frac{R_2 \times R_3}{R_2 + R_3} \checkmark$$
$$= \frac{10 \times 30}{10 + 30} \checkmark$$
$$= 7{,}5\ \Omega$$

$$R_T = R_P + R_1$$
$$= 7{,}5 + 2{,}5 \checkmark$$
$$= 10\ \Omega \checkmark$$

(4)

8.3.2 **POSITIVE MARKING FROM 8.3.1. / *POSITIEWE NASIEN VANAF 8.3.1.***

$$R = \frac{V}{I} \checkmark$$
$$10 \checkmark = \frac{12}{I_{R1}} \checkmark$$
$$I_{R1} = 1{,}2\ A \checkmark$$

(4)

8.4 **NEGATIVE MARKING. / *NEGATIEWE NASIEN.***
I_T increases ✓ because total resistance decreases ✓.
I_T neem toe (toeneem) omdat totale weerstand afneem. (2)
[13]

GRAND TOTAL / *GROOTTOTAAL*: 150

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Physical Sciences P1 June 22

Addendum

3.1.4

$Area\ of\ A = \frac{1}{2}bh$
$= \frac{1}{2}(11{,}76)(1{,}2)$✓
$\Delta y = 7{,}056\ m$
✓
h = 7,056 + 10,944 = 18 m ✓

$\left(\frac{3}{4}\right)$

$y = \left(\frac{v_i + v_f}{2}\right)\Delta t$✓
$= \left(\frac{11{,}76+0}{2}\right)(1{,}2)$✓
$\Delta y = 7{,}056\ m$
✓
h = 7,056 + 10,944 = 18 m ✓

(4)

3.2.4

$m = \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{12-27}{0-1{,}53}$✓
$= 9.8039$
$9{,}8039 = \frac{0-(-14)}{7{,}78-T}$✓
$T = 6{,}63\ s$✓

$\left(\frac{3}{4}\right)$

3.2.7 Accept both 3,9 s and 2,35 s ✓ (1)

7.2 Accept: F = 675 N left/*links*✓ (1)

7.6 $E_{net} = E_R - E_S$
$= \frac{kQ}{r^2} - \frac{kQ}{r^2}$✓
$= 9 \times 10^9 \left[\frac{2\times10^{-6}}{0{,}01^2} - \frac{5\times10^{-7}}{0{,}02^2}\right]$✓
$= 1{,}6875 \times 10^8\ NC^{-1}$ ✓

(3)