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**PREPARATORY EXAMINATION
VOORBEREIDENDE EKSAMEN**

GRADE/GRAAD 12

**PHYSICAL SCIENCES: PHYSICS (P1)
FISIESE WETENSKAPPE: FISIKA (V1)**

SEPTEMBER 2023

MARKS/PUNTE: 150

**MARKING GUIDELINES
NASIENRIGLYNE**

This marking guideline consists of 15 pages.
Hierdie nasienriglyne bestaan uit 15 bladsye.

QUESTION/VRAAG 1

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

QUESTION/VRAAG 2**Marking criteria/Nasienkriteria**

If any of the underlined key words/phrases in the correct context are omitted:

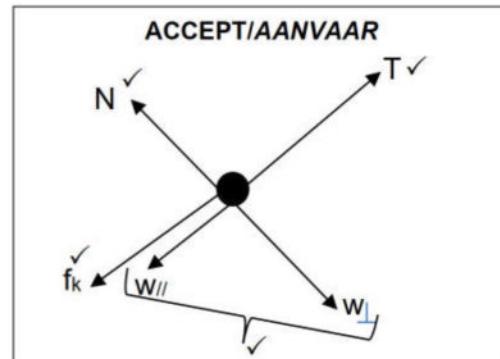
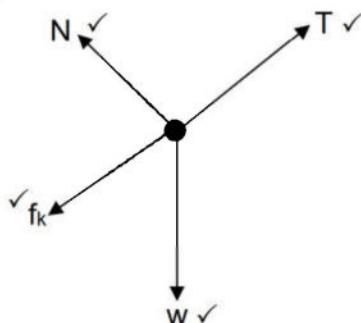
- 1 mark per word/phrase. Net/Resultant force mentioned at least once.

Indien enige van die onderstreepte sleutelwoorde/-frases in die korrekte konteks weggelaat word:

- 1 punt per woord/frase. Netto/resultante krag ten minste een keer genoem.

- 2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the net force at an acceleration that is directly proportional to the net/resultant force ✓ and inversely proportional to the mass of the object. ✓
- Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp versnel in die rigting van die netto krag by 'n versnelling wat direk eweredig is aan die netto/resultante krag en omgekeerd eweredig aan die massa van die voorwerp.* (2)

2.2

**Accept the following symbols/Aanvaar die volgende simbole**

T	F_T /Force on the rope/Krag op die tou	✓
w	F_g /weight/gewig	✓
N	F_N /Normal/Normal force/Normaal/Normaalkrag	✓
f_k	f/Friction/frictional force/kinetic frictional force f /Wrywing/Wywingskrag/Kinetiese wrywingskrag	✓

(4)

NB: Allocate ONE mark for each correct arrow and label in first option.
For the second option, give one mark for both components of weight,
correctly drawn with arrows and labels.
Deduct one mark for any additional forces.

NB: Ken EEN punt toe vir elke korrekte pyltjie en etiket in eerste opsie.
Vir die tweede opsie, gee een punt vir beide komponente van gewig,
korrek geteken met pyle en byskrifte.
Trek een punt af vir enige bykomende kragte.

2.3

OPTION/OPSIE 1

**Take the direction of motion of each block as positive
Neem die bewegingsrigting van elke blok as positief**

For/Vir m_2

$$F_{\text{net}} = ma \checkmark$$

$$w_2 + (-T) = ma$$

$$(8)(9,8) - T \checkmark = 8a \leftarrow \dots \dots (1)$$

For m_1 **Any/Enige** \checkmark

$$F_{\text{net}} = ma$$

$$T + (-w_{\parallel}) + (-f_k) = 8a$$

$$T - (8 \times 9,8) \sin 30^\circ \checkmark - 0,2(8)(9,8) \cos 30^\circ \checkmark = 8a \dots \dots (2)$$

1 + 2:

$$(8)(9,8) - (8 \times 9,8) \sin 30^\circ - 0,2(8)(9,8) \cos 30^\circ = 16a$$

$$a = 1,6 \text{ m} \cdot \text{s}^{-2} \checkmark$$

OPTION/OPSIE 2

**Take the direction of motion of each block as negative
Neem die bewegingsrigting van elke blok as negatief**

For/Vir m_2

$$F_{\text{net}} = ma \checkmark$$

$$-w_2 + T = -ma$$

$$-(8)(9,8) + T \checkmark = -8a \leftarrow \dots \dots (1)$$

For m_1 **Any/Enige** \checkmark

$$F_{\text{net}} = ma$$

$$T + (-w_{\parallel}) + (-f_k) = 8a$$

$$-T + (8 \times 9,8) \sin 30^\circ \checkmark + 0,2(8)(9,8) \cos 30^\circ \checkmark = -8a \dots \dots (2)$$

1 + 2:

$$-(8)(9,8) + (8 \times 9,8) \sin 30^\circ + 0,2(8)(9,8) \cos 30^\circ = -16a$$

$$a = 1,6 \text{ m} \cdot \text{s}^{-2} \checkmark$$

(6)

2.4 The force that block(m_2) exerts on the earth. $\checkmark \checkmark$ *Die krag wat blok (m_2) op die aarde uitoefen.*

(2)

2.5 Down (the incline)/Af (die helling) \checkmark

(1)

[15]

QUESTION/VRAAG 3

- 3.1 Motion of an object under the influence of the gravitational force only.✓✓
Beweging van 'n voorwerp slegs onder die invloed van gravitasiekrag. (2)

- 3.2 0,7 s ✓ (1)

3.3

OPTION/OPSIE 1 UPWARDS POSITIVE OPWAARTS POSITIEF $v_f = v_i + g\Delta t$ ✓ $0 = v_i + (-9,8)(0,7)$ ✓ $v_i = 6,86 \text{ m}\cdot\text{s}^{-1}$ ✓	OPTION/OPSIE 2 DOWNWARDS POSITIVE AFWAARTS POSITIEF $v_f = v_i + g\Delta t$ ✓ $0 = v_i + (9,8)(0,7)$ ✓ $v_i = -6,86$ $v_i = 6,86 \text{ m}\cdot\text{s}^{-1}$ ✓
OPTION/OPSIE 3 UPWARDS POSITIVE OPWAARTS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ ✓ $2,4 = v_i + (-9,8)(0,7)^2$ ✓ $v_i = 6,86 \text{ m}\cdot\text{s}^{-1}$ ✓	OPTION/OPSIE 4 DOWNWARDS POSITIVE AFWAARTS POSITIEF $\Delta y = v_i\Delta t + \frac{1}{2}g\Delta t^2$ ✓ $-2,4 = v_i + (9,8)(0,7)^2$ ✓ $v_i = -6,86$ $v_i = 6,86 \text{ m}\cdot\text{s}^{-1}$ ✓
OPTION/OPSIE 5 UPWARDS POSITIVE OPWAARTS POSITIEF $v_f^2 = v_i^2 + 2g\Delta y$ ✓ $0 = v_i^2 + 2(-9,8)(2,4)$ ✓ $v_i = 6,86 \text{ m}\cdot\text{s}^{-1}$ ✓	OPTION/OPSIE 6 UPWARDS POSITIVE OPWAARTS POSITIEF $v_f^2 = v_i^2 + 2g\Delta y$ ✓ $0 = v_i^2 + 2(9,8)(-2,4)$ ✓ $v_i = -6,86$ $v_i = 6,86 \text{ m}\cdot\text{s}^{-1}$ ✓
OPTION/OPSIE 7 UPWARDS POSITIVE OPWAARTS POSITIEF $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $2,4 = \left(\frac{v_i + 0}{2}\right)0,7$ ✓ $v_i = 6,86 \text{ m}\cdot\text{s}^{-1}$ down/af✓	OPTION/OPSIE 8 UPWARDS POSITIVE OPWAARTS POSITIEF $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $-2,4 = \left(\frac{v_i + 0}{2}\right)0,7$ ✓ $v_i = -6,86$ $v_i = 6,86 \text{ m}\cdot\text{s}^{-1}$ down/af✓
OPTION/OPSIE 9 $(mgh + \frac{1}{2}mv^2)_i = (mgh + \frac{1}{2}mv^2)_f$ ✓ $(gh + \frac{1}{2}v^2)_i = (gh + \frac{1}{2}v^2)_f$ $9,8(2,4) + \frac{1}{2}(0) = 9,8(0) + \frac{1}{2}v_f^2$ ✓ $v_f = 6,86 \text{ m}\cdot\text{s}^{-1}$ ✓	OPTION/OPSIE 10 $W_{net} = \Delta K$ ✓ $mg\Delta x \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ $9,8(2,4)(1) = \frac{1}{2}(v_f^2 - 0)$ ✓ $v_f = 6,86 \text{ m}\cdot\text{s}^{-1}$ ✓

(3)

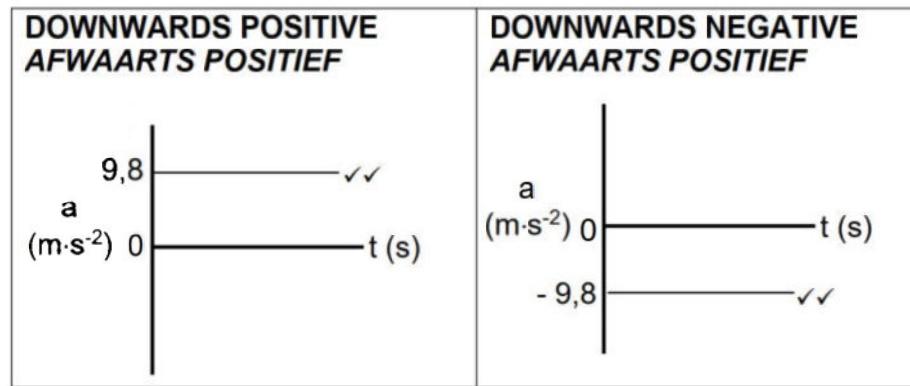
3.4 POSITIVE MARKING FROM/POSITIEWE NASIEN VANAF 3.3

OPTION/OPSIE 1 UPWARDS POSITIVE OPWAARTS POSITIEF <p>Whole motion/Hele beweging</p> $\begin{aligned} v_f &= v_i + g\Delta t \\ &= 6,86 + (-9,8)(1,7) \checkmark \\ &= -9,8 \text{ m}\cdot\text{s}^{-1} \\ \Delta y &= v_i\Delta t + \frac{1}{2}g\Delta t^2 \checkmark \\ &= (-9,8)(1) + \frac{1}{2}(-9,8)(1)^2 \checkmark \\ &= -14,7 \text{ m} \\ \text{Distance/Afstand} &= 14,7 \text{ m} \checkmark \end{aligned}$	OPTION/OPSIE 2 DOWNWARDS POSITIVE AFWAARTS POSITIEF <p>Whole motion/Hele beweging</p> $\begin{aligned} v_f &= v_i + g\Delta t \\ &= -6,86 + (9,8)(1,7) \checkmark \\ &= 9,8 \text{ m}\cdot\text{s}^{-1} \\ \Delta y &= v_i\Delta t + \frac{1}{2}g\Delta t^2 \checkmark \\ &= (9,8)(1) + \frac{1}{2}(9,8)(1)^2 \checkmark \\ &= +14,7 \text{ m} \\ \text{Distance/Afstand} &= 14,7 \text{ m} \checkmark \end{aligned}$
UPWARDS POSITIVE OPWAARTS POSITIEF $\begin{aligned} v_f &= v_i + g\Delta t \\ &= 6,86 + (-9,8)(1,7) \checkmark \\ &= -9,8 \text{ m}\cdot\text{s}^{-1} \end{aligned}$ <p>Velocity striking the ground./ Snelheid as dit grond tref.</p> <p>(Whole motion/Hele beweging)</p> $\begin{aligned} v_f &= v_i + g\Delta t \\ &= 6,86 + (-9,8)(2,7) \checkmark \\ &= -19,6 \text{ m}\cdot\text{s}^{-1} \end{aligned}$ <p>OR/OF</p> <p>(Maximum height/Maksimum hoogte)</p> $\begin{aligned} v_f &= v_i + g\Delta t \\ &= 0 + (-9,8)(2) \\ &= -19,6 \text{ m}\cdot\text{s}^{-1} \end{aligned}$ <p>OR/OF</p> <p>(Point of launch/Punt waar vrygelaat)</p> $\begin{aligned} v_f &= v_i + g\Delta t \\ &= -6,86 + (-9,8)(1,3) \\ &= -19,6 \text{ m}\cdot\text{s}^{-1} \end{aligned}$ <p>OR/OF</p> <p>(Last one second/Duur een sekonde)</p> $\begin{aligned} v_f &= v_i + g\Delta t \\ &= -9,8 + (-9,8)(1) \\ &= -19,6 \text{ m}\cdot\text{s}^{-1} \end{aligned}$	OPTION/OPSIE 3 UPWARDS POSITIVE OPWAARTS POSITIEF $\begin{aligned} v_f^2 &= v_i^2 + 2g\Delta y \checkmark \\ (-19,6)^2 &= (-9,8)^2 \\ &\quad + 2(-9,8)(\Delta y) \checkmark \end{aligned}$ $\Delta y = -14,7 \text{ m}$ <p>OPTION/OPSIE 4 DOWNWARDS POSITIVE AFWAARTS POSITIEF $\begin{aligned} v_f^2 &= v_i^2 + 2g\Delta y \checkmark \\ (19,6)^2 &= (9,8)^2 + 2(9,8)(\Delta y) \checkmark \end{aligned}$ $\Delta y = +14,7 \text{ m}$ <p>OPTION/OPSIE 5 UPWARDS POSITIVE OPWAARTS POSITIEF $\begin{aligned} \Delta y &= \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark \\ &= \left(\frac{-9,8 + (-19,6)}{2}\right)1 \checkmark \\ \Delta y &= -14,7 \text{ m} \\ \text{Distance/Afstand} &= 14,7 \text{ m} \checkmark \end{aligned}$ </p></p>
	OPTION/OPSIE 6 DOWNWARDS POSITIVE AFWAARTS POSITIEF $\begin{aligned} \Delta y &= \left(\frac{v_i + v_f}{2}\right)\Delta t \checkmark \\ &= \left(\frac{9,8 + 19,6}{2}\right)1 \checkmark \\ \Delta y &= 14,7 \text{ m} \\ \text{Distance/Afstand} &= 14,7 \text{ m} \checkmark \end{aligned}$

(5)



3.5



(2)

[13]

QUESTION/VRAAG 4

- 4.1.1 The product of the resultant/net force acting on an object and the time the resultant/net force acts on the object. ✓✓ (2/0)

Die produk van die resulterende/netto krag wat op 'n voorwerp inwerk en die tyd wat die resulterende/netto krag op die voorwerp inwerk. (2)

Accept/Aanvaar:

Impulse is the change in momentum of an object. (2/0)

Impuls is die verandering in momentum van 'n voorwerp.

4.1.2

OPTION/OPSIE 1 EAST AS POSITIVE OOS AS POSITIEF <p>$F_{net} \Delta t = \Delta p$ ✓ $F_{net} \Delta t = m(v_f - v_i)$ $(400)(0,1) \checkmark = 0,4v_f - (0,4)(-40) \checkmark$ $v_f = 60 \text{ m}\cdot\text{s}^{-1}$, east/oos ✓</p>	OPTION/OPSIE 2 EAST AS NEGATIVE OOS AS NEGATIEF <p>$F_{net} \Delta t = \Delta p$ ✓ $F_{net} \Delta t = m(v_f - v_i)$ $(-400)(0,1) \checkmark = 0,4v_f - (0,4)(40) \checkmark$ $v_f = -60 \text{ m}\cdot\text{s}^{-1}$ $\therefore v_f = 60 \text{ m}\cdot\text{s}^{-1}$, east/oos ✓</p>
OPTION/OPSIE 3 EAST AS POSITIVE OOS AS POSITIEF <p>$F_{net} = ma$ $400 = 0,4a \checkmark$ $a = 1000 \text{ m}\cdot\text{s}^{-2}$</p> <p>$v_f = v_i + a\Delta t \checkmark$ $= -40 + (1000)(0,1) \checkmark$ $= 60 \text{ m}\cdot\text{s}^{-1}$, east/oos ✓</p>	OPTION/OPSIE 4 EAST AS NEGATIVE OOS AS NEGATIEF <p>$F_{net} = ma$ $-400 = 0,4a \checkmark$ $a = -1000 \text{ m}\cdot\text{s}^{-2}$</p> <p>$v_f = v_i + a\Delta t \checkmark$ $= 40 + (-1000)(0,1) \checkmark$ $= -60 \text{ m}$ $= 60 \text{ m}\cdot\text{s}^{-1}$, east/oos ✓</p>

(4)



4.2.1

**OPTION/OPSIE 1
RIGHT AS POSITIVE/REGS AS POSITIEF**

$$\Sigma p(\text{before/voor}) = \Sigma p(\text{after/na}) \checkmark$$

$$m_{A\text{Ai}} + m_{B\text{Bi}} = m_{A\text{Af}} + m_{B\text{Bf}}$$

$$(1750)(1,5) + (1450)(-1,1) \checkmark = (1750)(0,25) + (1450)v_{Bf} \checkmark$$

$$v_{Bf} = 0,41 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ to the right/na regs } \checkmark$$

**OPTION/OPSIE 2
LEFT AS POSITIVE/LINKS AS POSITIEF**

$$\Sigma p(\text{before/voor}) = \Sigma p(\text{after/na}) \checkmark$$

$$m_{A\text{Ai}} + m_{B\text{Bi}} = m_{A\text{Af}} + m_{B\text{Bf}}$$

$$(1750)(-1,5) + (1450)(1,1) \checkmark = (1750)(-0,25) + (1450)v_{Bf} \checkmark$$

$$v_{Bf} = -0,41 \text{ m}\cdot\text{s}^{-1}$$

$$v_{Bf} = 0,41 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ to the right/na regs } \checkmark$$

**OPTION/OPSIE 3
RIGHT AS POSITIVE/REGS AS POSITIEF**

$$\Delta p_A = -\Delta p_B \checkmark$$

$$m(v_{Af} - v_{Ai}) = -m(v_{Bf} - v_{Bi})$$

$$1750(0,25 - 1,5) \checkmark = -1450(v_{Bf} - (-1,1)) \checkmark$$

$$v_{Bf} = 0,41 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ to the right/na regs } \checkmark$$

**OPTION/OPSIE 4
LEFT AS POSITIVE/LINKS AS POSITIEF**

$$\Delta p_A = -\Delta p_B \checkmark$$

$$m(v_{Af} - v_{Ai}) = -m(v_{Bf} - v_{Bi})$$

$$1750(0,25 - 1,5) \checkmark = -1450(v_{Bf} - 1,1) \checkmark$$

$$= -0,41 \text{ m}\cdot\text{s}^{-1}$$

$$v_{Bf} = 0,41 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ to the right/na regs } \checkmark$$

(5)

4.2.2 Flexible bumpers reduce the net force✓ by increasing the time✓ required to bring about the same change in momentum. ✓

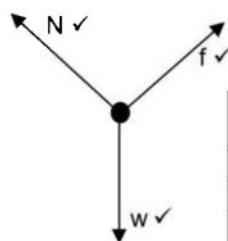
Buigsame buffers vermindert die netto krag deur die tyd wat benodig word om dieselfde verandering in momentum te weeg te bring, te verhoog. (3)
[14]

QUESTION/VRAAG 5

- 5.1 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)

5.2



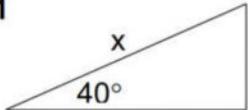
Accept the following symbols/Aanvaar die volgende simbole

w	F_g /weight/gewig	✓
N	F_N /Normal/Normal force/Normaal/normaalkrag	✓
f	f_k /Friction/frictional force/kinetic frictional force Wrywing/wrywingskrag/kinetiese wrywingskrag	✓

(3)

- 5.3 Frictional force/Wrywingskrag ✓ (1)

5.4

OPTION/OPSIE 1

$$X = \frac{2,8}{\sin 40^\circ} = 4,356$$

$$W_{net} = \Delta K$$

$$W_{Fg/\parallel} + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$Fg/\Delta x \cos \theta + f \Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$\frac{70(9,8) \sin 40^\circ \left(\frac{2,8}{\sin 40^\circ}\right) \cos 0^\circ + 0,112(70 \times 9,8) \cos 40^\circ \left(\frac{2,8}{\sin 40^\circ}\right) \cos 180^\circ}{v_f = 6,905 \text{ m} \cdot \text{s}^{-1}} = \frac{1}{2}(70)[v_f^2 - 0,35^2]$$

OPTION/OPSIE 2

$$W_{net} = \Delta K$$

$$mg \Delta x \cos \theta + f \Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$\frac{70(9,8) \cos 50^\circ \left(\frac{2,8}{\sin 40^\circ}\right) \cos 0^\circ + 0,112(70 \times 9,8) \cos 40^\circ \left(\frac{2,8}{\sin 40^\circ}\right) \cos 180^\circ}{v_f = 6,905 \text{ m} \cdot \text{s}^{-1}}$$

OPTION/OPSIE 3

$$W_{nc} = \Delta K + \Delta U$$

$$f \Delta x \cos \theta = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$$

$$\frac{0,112(70 \times 9,8) \cos 40^\circ \left(\frac{2,8}{\sin 40^\circ}\right) \cos 180^\circ}{v_f = 6,905 \text{ m} \cdot \text{s}^{-1}}$$

(6)

5.5 Decreases ✓

The normal force decreases ✓ (because $\cos\theta$ decreases with increase of the size of the angle to the horizontal). Friction is directly proportional to the normal / $f = \mu N$ / ($f \propto N$). ✓

Verlaag

Die normaalkrag neem af (omdat $\cos\theta$ afneem met toename van die grootte van die hoek met die horisontaal). Wrywing is direk eweredig aan die normaal / $f = \mu N$ / ($f \propto N$). (3)

[15]

QUESTION/VRAAG 6

6.1 It is the (apparent) 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. ✓

Dit is die (skynbare) verandering in frekwensie (of toonhoogte) van die klank (bespeur deur 'n luisteraar) omdat die klankbron en die luisteraar verskillende snelhede het relatief tot die medium van klankvoortplanting.

OR/OF

An (apparent) change in (observed/detected) frequency (pitch), (wavelength) ✓ because of the relative motion between a source and an observer (listener). ✓

'n (Skynbare) verandering in (waargenome) frekwensie (toonhoogte), (golflengte) as gevolg van die relatiewe beweging tussen 'n bron en 'n waarnemer (luisteraar). (2)

6.2 Towards/Na ✓

$$\frac{f_L}{f_s} > 1 \checkmark$$

OPTION/OPSIE 2

$\frac{f_L}{f_s}$ increases as v_L increases ✓

$\frac{f_L}{f_s}$ Neem toe soos wat v_L toeneem

(2)

6.3 $\frac{1}{v}$ ✓

(1)

- 6.4 Use any set of values from the graph.
Gebruik enige stel waardes uit die grafiek.

OPTION/OPSIE 1	OPTION/OPSIE 2
$\frac{f_L}{f_s} = \frac{v_L}{v} + 1 \checkmark$ $1,06 \checkmark = \frac{20}{v} + 1$ $v = 333,33 \text{ m} \cdot \text{s}^{-1} \checkmark$	$\text{gradient} = \frac{1,06\checkmark - 1}{20 - 0} \checkmark$ $= 0,003$ $\frac{1}{v} = 0,003$ $v = 333,33 \text{ m} \cdot \text{s}^{-1} \checkmark$
OPTION/OPSIE 3	
$\frac{f_L}{f_s} = \frac{v + v_L}{v} \checkmark$ $1,06 \checkmark = \frac{v + 20}{v} \checkmark$ $v(1,06 = v + 20$ $v = 333,33 \text{ m} \cdot \text{s}^{-1} \checkmark$	(4)

- 6.5 The spectral lines of the star are shifted towards the lower frequency end \checkmark which is the red end of the spectrum. \checkmark

Die spektraallyne van die ster word na die laer frekwensie-end verskuif wat die rooi-end van die spektrum is.

(2)
[11]

QUESTION/VRAAG 7

- 7.1.1 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 elektrostatisiese krag wat deur een puntlading op 'n ander puntlading uitgeoefen word, is direk eweredig aan die produk van die grootte van die ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.

(2)

7.1.2 $F_{Ae} = \frac{k Q_1 Q_2}{r^2}$ ✓
 $= \frac{9 \times 10^9 \times (1,2 \times 10^{-9})(1,6 \times 10^{-19})}{(4 \times 10^{-2})^2}$ ✓
 $= 1,08 \times 10^{-15} \text{ N, left/links}$

$$F_{Be} = \frac{kQ_1Q_2}{r^2}$$

$$= \frac{9 \times 10^9 \times (1,5 \times 10^{-9})(1,6 \times 10^{-19})}{(1 \times 10^{-2})^2}$$

$$= 2,16 \times 10^{-14} \text{ N, right/regs}$$

$$F_{net} = F_{Ae} - F_{Be}$$

$$= 1,08 \times 10^{-15} - 2,16 \times 10^{-14}$$

$$= -2,052 \times 10^{-14}$$

$$= 2,052 \times 10^{-14} \text{ N, right/regs}$$
 ✓

(5)

7.2.1 $E = k \frac{Q}{r^2}$ ✓
 $4 \times 10^7 = (9 \times 10^9) \frac{Q}{(0,03)^2}$ ✓
 $Q = 4 \times 10^{-6} \text{ C}$ ✓

(3)

- 7.2.2 Positive/Positief ✓

<p>7.2.3 $Q = nq_e$ $= 938 \times 1,6 \times 10^{-19}$ ✓ $= 1,5 \times 10^{-16}$</p> <p>OPTION/OPSIE 1</p> $E = \frac{F}{Q}$ $4 \times 10^7 = \frac{F}{1,5 \times 10^{-16}}$ $F = 6 \times 10^{-9} \text{ N}$	<p>OPTION/OPSIE 2</p> $E = k \frac{Q}{d^2}$ $4 \times 10^7 = (9 \times 10^9) \frac{Q}{(0,03)^2}$ $Q = 4 \times 10^{-6} \text{ C}$ $F = K \frac{Q_1 Q_2}{d^2}$ $= \frac{9 \times 10^9 (1,5 \times 10^{-16})(4 \times 10^{-6})}{(0,03)^2}$ $F = 6 \times 10^{-9} \text{ N}$
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(4)

[15]

QUESTION/VRAAG 8

8.1 12 J ✓ of energy is transferred per one coulomb of charge. ✓
12 J ✓ energie word per een coulomb lading oorgedra. (2)

8.2.1

OPTION/OPSIE 1	OPTION/OPSIE 2
$V_{30\Omega} = V_{20\Omega}$ $I_{30\Omega}(30) = I_{20\Omega}(20)$ $0,2(30) = I_{20\Omega}(20) \checkmark$ $= 0,3 A$ $I_1 = 0,3 + 0,2 \checkmark$ $= 0,5 A \checkmark$	$V_{30\Omega} = IR$ $= 0,2(25 + 5) \checkmark$ $= 6V$ $V_{30} = V_{20} = V_p$ $6 = I_{20\Omega}R$ $6 = I_{20}(20)$ $I_{20} = 0,3 A$ $I_1 = 0,3 A + 0,2 A \checkmark$ $= 0,5 A \checkmark$
OPTION/OPSIE 3	
$V_p = 0,2(30)$ $= 6V \checkmark$ $\frac{1}{R_p} = \frac{1}{20} + \frac{1}{25 + 5}$ $R_p = 12 \Omega$ $V_p = I_p R_p$ $6 = I_p(12) \checkmark$ $I_p = 0,5 A \checkmark$	

(3)

8.2.2 POSITIVE MARKING FROM/POSITIEWE NASIEN VANAF 8.2.1

$$\begin{aligned}
 R_X &= \frac{V_2}{I} \checkmark \\
 &= \frac{5,5}{0,5} \checkmark \\
 &= 11\Omega \checkmark
 \end{aligned}$$

(3)

8.2.3 POSITIVE MARKING FROM/POSITIEWE NASIEN VANAF 8.2.2

OPTION/OPSIE 1	OPTION/OPSIE 2
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ $= \frac{1}{20} + \frac{1}{30} \checkmark$ $R_p = 12 \Omega$ $R_{ext} = R_p + R_s$ $= 12 + 11 \checkmark$ $= 23 \Omega \checkmark$	$R_p = \frac{\text{product/produk}}{\text{sum/som}}$ $= \frac{20 \times 30}{20 + 30} \checkmark$ $= 12 \Omega$ $R_{ext} = R_{ext} + R_s \checkmark$ $= 12 + 11 \checkmark$ $= 23 \Omega \checkmark$

(3)

8.2.4

OPTION/OPSIE 1	OPTION/OPSIE 2	
$\varepsilon = I(R + r) \checkmark$ $12 = 0,5(23 + r) \checkmark$ $r = 1 \Omega \checkmark$	$V_{lost} = \varepsilon - V_{ext}$ $= 12 - 11,5 \checkmark$ $= 0,5$ $V_{lost} = Ir \checkmark$ $0,5 = 0,5r$ $r = 1 \Omega \checkmark$	(3)

8.3 Decrease/Afneem ✓

Total external resistance decreases/Totale eksterne weerstand neem af
Total current increases/Totale stroom neem toe

V_{lost} increases/neem toe ✓

V_{ext} decreases/neem af ✓ (E_{mf} stays constant/bly konstant)

(4)
[18]**QUESTION/VRAAG 9**

9.1.1 AC/WS ✓ (1)

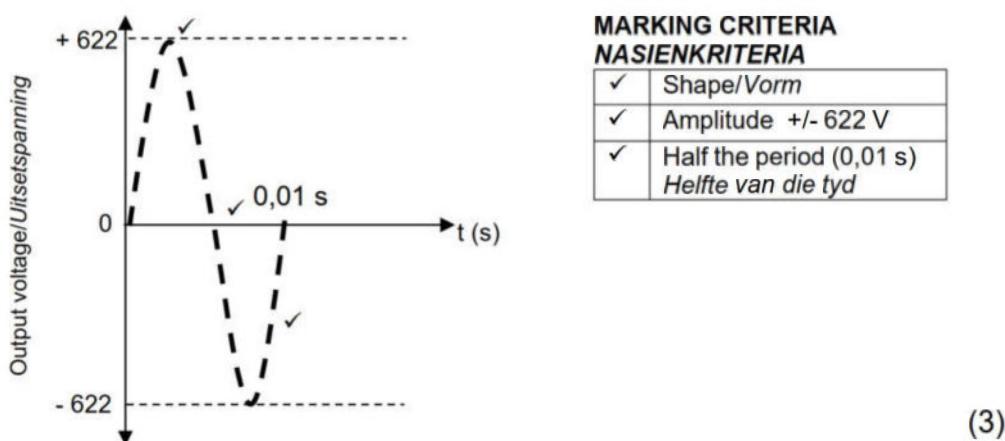
9.1.2 Slip rings/Sleepringe ✓ (1)

9.1.3 To ensure conductivity between the slip rings and the external circuit. ✓
Om geleiding tussen sleepringe en die eksterne stroombaan te verseker. (1)

OR/OF Allow for rotation of the slip rings while maintaining contact with the external circuit.
Laat die sleepringe roteer terwyl kontak met die eksterne stroombaan behou word.

9.1.4 P to/tot Q ✓ (1)

9.2.1



9.2.2 (a)

OPTION/OPSIE 1	OPTION/OPSIE 2
$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ $= \frac{311,12}{\sqrt{2}}$ $= 220 V$	$V_{max} = I_{max}R \checkmark$ $311,12 \checkmark = 8R \checkmark$ $R = 38,87 \Omega \checkmark$
$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ $= \frac{8}{\sqrt{2}}$ $= 5,66 A$	
$V_{rms} = I_{rms}R \checkmark$ $220 \checkmark = 5,66R \checkmark$ $R = 38,87 \Omega \checkmark$	

(4)

9.2.2 (b) POSITIVE MARKING FROM/POSITIEWE NASIEN VANAF 9.2.2(a)

OPTION/OPSIE 1	OPTION/OPSIE 2	OPTION/OPSIE 3
$P_{ave} = V_{rms}I_{rms}$ $= 220(5,66)$ $1 245,2 W$	$P_{ave} = I_{rms}^2R$ $= (5,66)^238,87$ $1 245,22 W$	$P_{ave} = \frac{V_{rms}^2}{R}$ $= \frac{(220)^2}{38,87}$ $1 245,18 W$
$P = \frac{W}{\Delta t} \checkmark$ $1 245,2 = \frac{W}{7200} \checkmark$ $W = 8965440 J \checkmark$	$P = \frac{W}{\Delta t} \checkmark$ $1 245,22 = \frac{W}{7200} \checkmark$ $W = 8965611,16 J \checkmark$	$P = \frac{W}{\Delta t} \checkmark$ $1 245,18 = \frac{W}{7200} \checkmark$ $W = 8965268,85 J \checkmark$
OPTION/OPSIE 4	OPTION/OPSIE 5	OPTION/OPSIE 6
$W = VI\Delta t \checkmark$ $= 220(5,66)(7200) \checkmark$ $= 8965440 J \checkmark$	$W = I^2R\Delta t \checkmark$ $= (5,66)^2(38,87)(7200) \checkmark$ $= 8965611,16 J \checkmark$	$W = \frac{V^2}{R}t \checkmark$ $= \frac{(220)^2}{38,87}(7200) \checkmark$ $= 8965268,85 J \checkmark$

(4)
[15]

QUESTION/VRAAG 10

- 10.1 The work function of a metal is the minimum energy ✓ that an electron (in the metal) needs to be emitted/ejected from the(metal)surface. ✓

Die werkfunksie van 'n metaal is die minimum energie wat 'n elektron (in die metaal) uit die (metaal)oppervlak moet vrygestel. (2)

10.2

$$\left. \begin{aligned} E &= W_0 + K_{\text{max/maks}} \\ h \frac{c}{\lambda} &= W_0 + \frac{1}{2} mv_{\text{max/maks}}^2 \end{aligned} \right\} \text{Any/Enige ✓}$$

$$6,63 \times 10^{-34} \frac{(3 \times 10^8)^{\checkmark}}{\lambda} = 3,36 \times 10^{-19} + \frac{1}{2}(9,11 \times 10^{-31})(7,14 \times 10^5)^2 \checkmark$$

$$\lambda = 3,50 \times 10^{-7} \text{ m} \checkmark$$
(5)

10.3 Positive marking from/Positiewe nasien vanaf 10.2

$$\left. \begin{aligned} E &= W_0 + K_{\text{max/maks}} \\ h \frac{c}{\lambda} &= W_0 + \frac{1}{2} mv_{\text{max/maks}}^2 \end{aligned} \right\} \text{Any/Enige ✓}$$

$$6,63 \times 10^{-34} \frac{(3 \times 10^8)}{3,50 \times 10^{-7}} = 3,65 \times 10^{-19} + \frac{1}{2}(9,11 \times 10^{-31})v_{\text{max/maks}}^2 \checkmark$$

$$v_{\text{max/maks}} = 6,68 \times 10^5 \text{ m} \cdot \text{s}^{-1}$$
(4)

- 10.4 Increase ✓
 More photo electrons strike the surface of the metal per unit time. ✓
 More electrons are ejected per unit time. ✓
 From the formula $I = \frac{Q}{\Delta t}$ ($= \frac{nq}{\Delta t}$; $I \propto n$) ammeter reading increases.

Verhoog

Meer fotoelektrone tref die oppervlak van die metaal per eenheid tyd.

Meer elektrone word per eenheid tyd vrygestel.

Vir die formule $I = \frac{Q}{\Delta t}$ ($= \frac{nq}{\Delta t}$; $I \propto n$) ammeterlesing neem toe. (3)

[14]

TOTAL/TOTAAL: 150