



basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE
NASIONALE
SENIOR SERTIFIKAAT**

GRADE/GRAAD 12

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

NOVEMBER 2019

MARKING GUIDELINES/NASIENRIGLYNE

MARKS/PUNTE: 150

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG 9000, PRETORIA 0001
2019-11-10
APPROVED MARKING GUIDELINE PUBLIC EXAMINATION

*Approved
Muzina
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Moderators
2019-11-12*

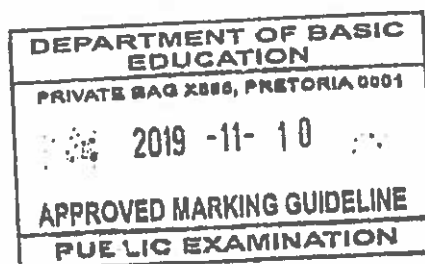
**These marking guidelines consist of 23 pages. /
Hierdie nasienriglyne bestaan uit 23 bladsye.**

*Approved
DBE CE
2019/11/12*

*Approved
DBE Int. Mod.
2019/11/12*

QUESTION 1/VRAAG 1

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



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P.N

QUESTION 2/VRAAG 2

2.1

Marking criteria/Nasienriglyne

- 1 mark for each key word/phrase omitted in the correct context.
- 1 punt vir elke sleutel woord/frase in die korrekte konteks weggelaat.

(2)

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

Wanneer 'n resultante/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel teen 'n versnelling wat direk eweredig is aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

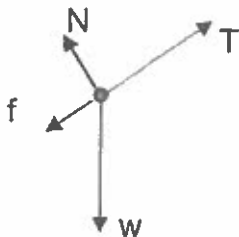
OR/OF

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 resultant/net force!) ✓✓

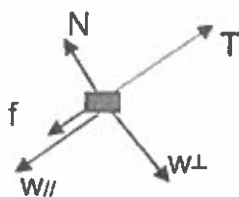
Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering van momentum van die voorwerp (in die rigting van die resulterende/netto krag.)

(2)

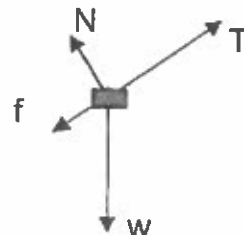
2.2



ACCEPT/AANVAAR



OR/OF



Accept the following symbols/Aanvaar die volgende simbole.

N ✓	F_N / Normal / <i>Normaal</i> / Normal force / <i>Normaalkrag</i> / 16,97 N
f ✓	F_f / f_k / f_r / frictional force / <i>wrywingskrag</i> / kinetic frictional force / <i>kinetiese wrywingskrag</i>
W ✓	F_g / mg / weight / $F_{\text{Earth on block}}$ / 19,6 N / gravitational force / <i>gewig</i> / $F_{\text{aarde op blok}}$ / <i>gravitasiekrag</i>
T ✓	Tension / <i>Spanning</i> / F_T / F_A / F / F_s

Notes/Aantekeninge

- Mark is awarded for label and arrow. /Punt word toegeken vir byskrif en pyltjie
- Do not penalise for length of arrows. /Moenie vir die lengte van die pyltjies penaliseer nie.
- Deduct 1 mark for any additional force. /Trek 1 punt af vir enige addisionele krag.
- If force(s) do not make contact with body/dot /Indien krag(te) nie met die voorwerp / kolletjie kontak maak nie: Max./Maks: $\frac{3}{4}$
- If arrows missing/Indien pyltjies uitgelaat is: Max./Maks: $\frac{3}{4}$ (penalise 1st vector only) (penalise 1^{ste} vektor slegs)

(4)

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 2019 -11- 10
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miss
 have not
 here if
 not included!
 in px ample

rate of change of momentum
 rate of change of energy

A J M A S
 AN

2.3

<p>For the 2 kg (P) block/Vir die 2 kg (P) blok:</p> $F_{net} = ma$ $T + (-w_{II}) + (-f_k) = ma$ $T - (w_{II} + f_k) = ma$ $T - (2)(9,8)\sin 30^\circ - 2,5 = 2a$ $T - 9,8 - 2,5 = 2a$ $T - 12,3 = 2a \dots\dots\dots(1)$ <p>For the 3 kg (Q) block/Vir die 3 kg (Q) blok:</p> $F_x + (-T) + (-w_{II}) = ma$ $F_x - (T + w_{II}) = ma$ $[40 \cos 25^\circ - T - (3)(9,8)\sin 30^\circ] = 3a$ $36,25 - T - 14,7 = 3a$ $21,55 - T = 3a \dots\dots\dots(2)$ $9,25 = 5a$ $a = 1,85 \text{ m}\cdot\text{s}^{-2}$	<p>Marking criteria/Nasienriglyne</p> <ul style="list-style-type: none"> • Formula/Formule ✓ • Substitution of /vervanging van w_{II} for/vir 2 kg: $(2)(9,8)\sin 30^\circ$ ✓ • Substitution of $-2,5 \text{ N}$ /Vervanging van $-2,5 \text{ N}$ ✓ <i>dep. on sign</i> • 2a OR/OF 3a ✓ • Calculate/Bereken F_x: $40 \cos 25^\circ$ ✓ ($40 \sin 65^\circ$) • Substitution of /vervanging van w_{II} for/vir for 3 kg: $(3)(9,8)\sin 30^\circ$ ✓ <i>subs. is ind. of sign</i> • Left hand side substitution for 3 kg/Linkerkant vervanging vir 3 kg ✓ <i>correct subs of signs are for LHS</i> • Final answer/Finale antwoord: $1,85 \text{ m}\cdot\text{s}^{-2}$ ✓
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19,6

ALWAYS

separate bodies (2b) 1 system max 5/8

2.4 Greater than/groter as ✓
 F_{net} increases. / F_{net} neem toe. ✓

ACCEPT/AANVAAR
 There is no friction. /Daar is geen wrywing nie.
OR/OF
 The surface is smooth. /Die oppervlak is glad.
 frictionless

(2)
 [16]

QUESTION 3/VRAAG 3

3.1 (Motion during which) the only force acting is the force of gravity. ✓ ✓
 (Beweging waartydens) die enigste krag wat inwerk gravitasiekrag is.
 (2 or/of 0) (2)

3.2

<p>Marking criteria/Nasienriglyne:</p> <ul style="list-style-type: none"> • Any appropriate formula for Δy /Enige toepaslike formule vir Δy ✓ <i>can use Δx</i> • Whole substitution to calculate 5,1 m /Hele vervanging om 5,1 m te bereken ✓ • <u>40</u> + answer from calculation/antwoord van berekening ✓ • Final answer/Finale antwoord: 45,10 m ✓ (Accept/aanvaar 45,1 m) <p>OPTION 1/OPSIE 1 UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = (10)^2 + (2)(-9,8)\Delta y$ ✓ $\Delta y = 5,10 \text{ m} (5,102 \text{ m})$</p> <p>Height = $\frac{40}{2} + 5,10$ ✓ <i>saving addition</i> $= 45,10 \text{ m}$ ✓ 45,1 m</p> <p>DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF: $v_f^2 = v_i^2 + 2a\Delta y$ ✓ $0 = (-10)^2 + (2)(9,8)\Delta y$ ✓ $\Delta y = -5,10 \text{ m} (5,102 \text{ m})$</p> <p>Height = $\frac{40}{2} + 5,10$ ✓ $= 45,10 \text{ m}$ ✓ 45,1 m</p>	
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* Signs.

P.N.

OPTION 2/OPSIE 2

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:

$$v_f = v_i + a\Delta t$$

$$0 = (10) + (-9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

Accept swopping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

$$\begin{aligned} \Delta y &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \checkmark \\ &= (10)(1,02) + \frac{1}{2} (-9,8)(1,02)^2 \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

OR/OF

$$\begin{aligned} \Delta y &= \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \\ &= \left(\frac{10 + 0}{2} \right) (1,02) \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

Height = $40 + 5,10 \checkmark$ adding
 $= 45,10 \text{ m} \checkmark$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$v_f = v_i + a\Delta t$$

$$0 = (-10) + (9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

Accept swopping of v_i and v_f
Aanvaar die omruiling van v_i en

$$\begin{aligned} \Delta y &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \checkmark \\ &= (-10)(1,02) + \frac{1}{2} (9,8)(1,02)^2 \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

Height = $40 + 5,10 \checkmark$
 $= 45,10 \text{ m} \checkmark$

OPTION 3/OPSIE 3

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:

$$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$$

$$0 = (10) \Delta t + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 2,04 \text{ s}$$

$$\begin{aligned} \Delta y &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \checkmark \\ &= (10)(1,02) + \frac{1}{2} (-9,8)(1,02)^2 \checkmark \\ &= 5,10 \text{ m} \end{aligned}$$

Height = $40 + 5,10 \checkmark$ adding
 $= 45,10 \text{ m} \checkmark$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$$

$$0 = (-10) \Delta t + \frac{1}{2}(9,8)\Delta t^2$$

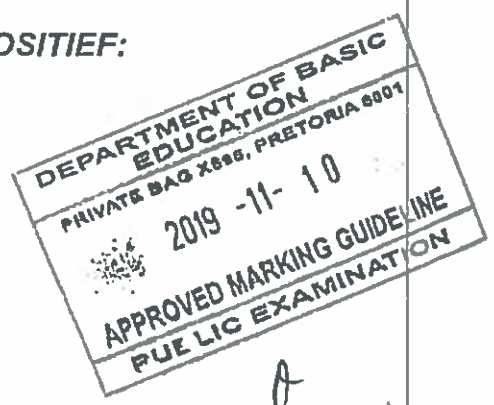
$$\Delta t = 2,04 \text{ s}$$

$$\begin{aligned} \Delta y &= v_i\Delta t + \frac{1}{2} a\Delta t^2 \checkmark \\ &= (-10)(1,02) + \frac{1}{2} (9,8)(1,02)^2 \checkmark \\ &= -5,10 \text{ m} \end{aligned}$$

Height = $40 + 5,10 \checkmark$
 $= 45,10 \text{ m} \checkmark$

IF Δt answer is wrong) substit can still get sub but not mark

no mark awarded for calc Δt , only for sub



P.N.

OPTION 4/OPSIE 4

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$0 = (10) \Delta t + \frac{1}{2} (-9,8) \Delta t^2$$

$$\Delta t = 2,04 \text{ s}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \quad \frac{1}{2} \Delta t$$

$$= \left(\frac{10 + 0}{2} \right) (1,02) \checkmark \quad \text{Subs}$$

$$= 5,10 \text{ m}$$

$$\text{Height} = 40 + 5,10 \checkmark \text{ adding}$$

$$= 45,10 \text{ m} \checkmark$$

Accept swapping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

$$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$0 = (-10) \Delta t + \frac{1}{2} (9,8) \Delta t^2$$

$$\Delta t = 2,04 \text{ s}$$

$$\Delta y = \left(\frac{v_i + v_f}{2} \right) \Delta t \checkmark \quad \frac{1}{2} \Delta t$$

$$= \left(\frac{-10 + 0}{2} \right) (1,02) \checkmark$$

$$= -5,10 \text{ m}$$

$$\text{Height} = 40 + 5,10 \checkmark \quad 40 + (-5,10) \checkmark \text{ subs.} \quad 40 - 5,10 \times$$

$$= 45,10 \text{ m} \checkmark$$

Accept swapping of v_i and v_f
Aanvaar die omruiling van v_i en v_f

OPTION 5/OPSIE 5

$$E_{(\text{mech/meg})\text{roof/dak}} = E_{(\text{mech/meg})\text{top/bo}}$$

$$(E_p + E_k)_{\text{roof/dak}} = (E_p + E_k)_{\text{top/bo}}$$

$$(mgh + \frac{1}{2} mv^2)_{\text{roof/dak}} = (mgh + \frac{1}{2} mv^2)_{\text{top/bo}}$$

$$m(9,8)(0) + \frac{1}{2} m(10)^2 = m(9,8)(h) + 0 \checkmark$$

$$h = 5,10 \text{ m}$$

$$\text{Height} = 40 + 5,10 \checkmark \text{ adding}$$

$$= 45,10 \text{ m} \checkmark$$

Any one/Enige een

if just giving '0' or omitted - don't penalize

h_f: roof

OPTION 6/OPSIE 6

$$W_{\text{net}} = \Delta E_k \checkmark$$

$$w \Delta x \cos \theta = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2 \quad \text{must show}$$

$$(m)(9,8) \Delta x \cos 180^\circ = 0 - \frac{1}{2} m(10)^2 \checkmark \quad \text{may omit}$$

$$\Delta x = 5,10 \text{ m}$$

$$\text{Height} = 40 + 5,10 \checkmark \text{ adding}$$

$$= 45,10 \text{ m} \checkmark$$

OPTION 7/OPSIE 7

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

$$0 = m(9,8)(h_f - 0) + \frac{1}{2} m(0 - 10^2) \checkmark$$

$$h_f = 5,10 \text{ m}$$

$$\text{Height} = 40 + 5,10 \checkmark \text{ adding}$$

$$= 45,10 \text{ m} \checkmark$$

OPTION 8/OPSIE 8

Marking criteria/Nasienriglyne:

- Appropriate formula/Toegepaste formule ✓
- Substitution left/Vervanging links ✓
- Substitution right/Vervanging regs ✓
- Final answer/Finale antwoord: 45,10 m ✓

$$E_{(\text{mech/meg})\text{roof/dak}} = E_{(\text{mech/meg})\text{top/bo}}$$

$$(E_p + E_k)_{\text{roof/dak}} = (E_p + E_k)_{\text{top/bo}}$$

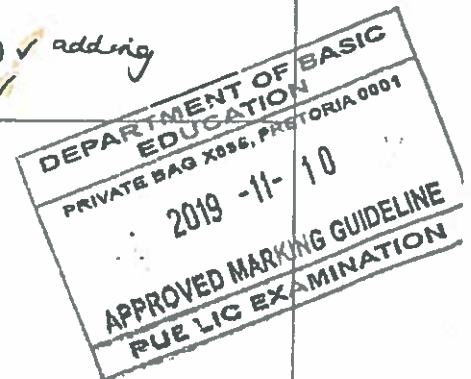
$$(mgh + \frac{1}{2} mv^2)_{\text{roof/dak}} = (mgh + \frac{1}{2} mv^2)_{\text{top/bo}}$$

$$m(9,8)(40) + \frac{1}{2} m(10)^2 \checkmark = m(9,8)(h) + 0 \checkmark$$

$$h = 45,10 \text{ m} \checkmark$$

Any one/Enige een

h_f: grond



P.N.D. (4)

3.3 9,8 m·s⁻² ✓ downwards/afwaarts ✓

(2)

3.4 **Marking criteria/Nasienglyne**

- Calculation/use of 10,26 m./Berekening/gebruik van 10,26 m ✓
- Appropriate formula to calculate Δt./Toepaslike formule om Δt te bereken. ✓
- Substitution for stone A./Vervanging vir klip A. ✓
- Substitution for stone B./Vervanging vir klip B. ✓
- Calculating time difference between two stones./Berekening van tydverskil tussen klippe. ✓ *Subtraction*
- Final answer/Finale antwoord: 1,34 (s) ✓

OPTION 1/OPSIE 1

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = -40 + 29,74 = - 10,26 m

Stone/Klip A

$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

-10,26 ✓ = $10 \Delta t + \frac{1}{2} (-9,8) \Delta t^2$ ✓ *Subst A*

$\Delta t = 2,79$ s

Stone/Klip B

$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$

-10,26 = $0 + \frac{1}{2} (-9,8) \Delta t^2$ ✓ *Subst B*

$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓ = 1,34 (s) ✓

t_A - t_B subtraction mark

OR/OF

$[-10,26 = 0(2,79 - x) + \frac{1}{2} (-9,8)(2,79 - x)^2]$ ✓

$x = 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$

= $0^2 + 2(-9,8)(-10,26)$

$v_f = -14,18$ m·s⁻¹

$v_f = v_i + a\Delta t$

-14,18 = $0 + (-9,8)\Delta t$ ✓

$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓

= 1,34 (s) ✓

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = 40 - 29,74 = 10,26 m

Stone/Klip A

$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

10,26 ✓ = $-10 \Delta t + \frac{1}{2} (9,8) \Delta t^2$ ✓

$\Delta t = 2,79$ s

Stone/Klip B

$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$

10,26 = $0 + \frac{1}{2} (9,8) \Delta t^2$ ✓

$\Delta t = 1,45$ s (1,447 s)

$x = 2,79 - 1,45$ ✓ = 1,34 (s) ✓

OR/OF

$[-10,26 = 0(2,79 - x) + \frac{1}{2} (-9,8)(2,79 - x)^2]$ ✓

$x = 1,34$ (s) ✓

$v_f^2 = v_i^2 + 2a\Delta y$

= $0^2 + 2(9,8)(10,26)$

$v_f = 14,18$ m·s⁻¹

$v_f = v_i + a\Delta t$

14,18 = $0 + (9,8)\Delta t$ ✓

$\Delta t = 1,45$ s

$x = 2,79 - 1,45$ ✓

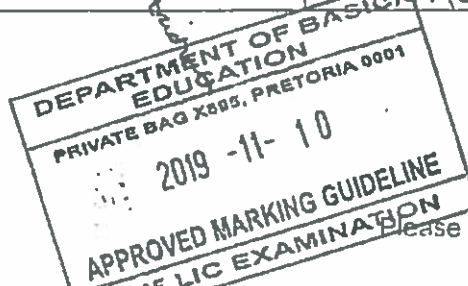
= 1,34 (s) ✓

Mark allowed where substituted (+, or -)

Give mark for 10,26 whenever value used dir.

x = A or B same as in mark's calculation

*OR FOR A:
10,26 = (1,45 + x)
↳ to get 2,79*



OPTION 2/OPSIE 2**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement from roof to meeting point/Verplasing vanaf dak tot ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Displacement of stone A from max height to meeting point/Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt = $-15,36$ m

Stone/Klip A

$$v_f = v_i + a\Delta t$$

$$0 = 10 + (-9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$-15,36 = 0 + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 1,77 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,77 + 1,02$$

$$= 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 = 1,34 \text{ (s)}$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-14,18 = 0 + (-9,8)\Delta t$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45$$

$$= 1,34 \text{ (s)}$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point /Verplasing vanaf dak tot ontmoetingspunt = $40 - 29,74 = 10,26$ m ✓

Displacement of ball A from max height to meeting point/ Verplasing van bal A vanaf maksimum hoogte tot ontmoetingspunt = $15,36$ m

Stone/Klip A

$$v_f = v_i + a\Delta t$$

$$0 = -10 + (9,8)\Delta t$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$15,36 = 0 + \frac{1}{2}(9,8)\Delta t^2$$

$$\Delta t = 1,77 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,77 + 1,02$$

$$= 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 = 1,34 \text{ (s)}$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

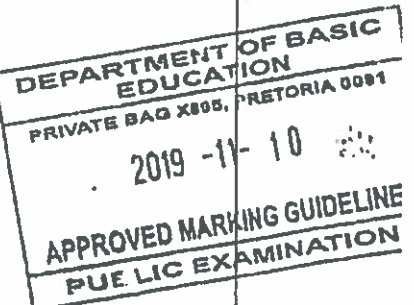
$$v_f = v_i + a\Delta t$$

$$14,18 = 0 + (9,8)\Delta t$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45$$

$$= 1,34 \text{ (s)}$$



OPTION 3/OPSIE 3

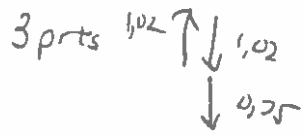
$v_i = 10$

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:

Displacement of stones A and B from roof to meeting point/Verplasing van klippe A en B vanaf dak tot by ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Stone/Klip A

$v_f = v_i + a\Delta t$
 $0 = 10 + (-9,8)\Delta t$
 $\Delta t = 1,02$ s



$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$
 $-10,26 = 10\Delta t + \frac{1}{2}(-9,8)\Delta t^2$
 $\Delta t = 0,75$ s
 $\Delta t_{tot} = 1,02 + 0,75 = 1,77$ s

Stone/Klip B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
 $-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2$
 $\Delta t = 1,45$ s (1,447 s)

$v_f^2 = v_i^2 + 2a\Delta y$
 $= 0^2 + 2(-9,8)(-10,26)$
 $v_f = -14,18$ m·s⁻¹

$x = 2,79 - 1,45 = 1,34$ (s) ✓

$v_f = v_i + a\Delta t$
 $-14,18 = 0 + (-9,8)\Delta t$
 $\Delta t = 1,45$ s

$x = 2,79 - 1,45 = 1,34$ (s) ✓

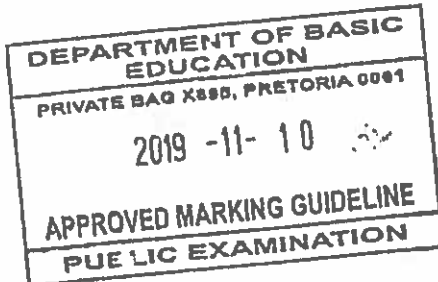
DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement of stones A and B from roof to meeting point/Verplasing van klippe A en B vanaf dak tot by ontmoetingspunt = $40 - 29,74 = 10,26$ m

Stone/Klip A

$v_f = v_i + a\Delta t$
 $0 = -10 + (9,8)\Delta t$
 $\Delta t = 1,02$ s

$\Delta y_A = v_i\Delta t + \frac{1}{2}a\Delta t^2$
 $10,26 = -10\Delta t + \frac{1}{2}(9,8)\Delta t^2$
 $\Delta t = 0,75$ s
 $\Delta t_{tot} = 1,02 + 0,75 = 1,77$ s



Stone/Klip B

$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$
 $10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2$
 $\Delta t = 1,45$ s (1,447 s)

$v_f^2 = v_i^2 + 2a\Delta y$
 $= 0^2 + 2(9,8)(10,26)$
 $v_f = 14,18$ m·s⁻¹

$x = 2,79 - 1,45 = 1,34$ (s) ✓

$v_f = v_i + a\Delta t$
 $14,18 = 0 + (9,8)\Delta t$
 $\Delta t = 1,45$ s

$x = 2,79 - 1,45 = 1,34$ (s) ✓

Handwritten initials and signatures, including 'P.N.' and a large signature.

OPTION 4/OPSIE 4**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement from roof to meeting point / Verplasing vanaf dak tot ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Stone/Klip A

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-5,10 = 0 + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$-10,26 \checkmark = -10,26 + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 0,75 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,02 + 0,75$$

$$= 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-14,18 = 0 + (-9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point / Verplasing vanaf dak tot by ontmoetingspunt = $40 - 29,74 = 10,26$ m

Stone/Klip A

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$5,10 = 0 + \frac{1}{2}(9,8)\Delta t^2$$

$$\Delta t = 1,02 \text{ s}$$

$$\Delta y_A = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$$

$$10,26 \checkmark = 10,26 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 0,75 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,02 + 0,75$$

$$= 2,79 \text{ s}$$

Stone/Klip B

$$\Delta y_B = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2 \checkmark$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 \checkmark = 1,34 \text{ (s)} \checkmark$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$14,18 = 0 + (9,8)\Delta t \checkmark$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45 \checkmark$$

$$= 1,34 \text{ (s)} \checkmark$$

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OPTION 5/OPSIE 5**UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:**

Displacement from roof to meeting point/Verplasing vanaf dak tot ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Displacement of stone A from max height to meeting point/Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt = $-15,36$ m

Stone/Klip A

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (0)^2 + (2)(-9,8)(-15,36)$$

$$v_f = -17,35 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-17,35 = 0 + (-9,8)\Delta t$$

$$\Delta t = 1,77 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,77$$

$$= 2,79 \text{ (s)}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 = 1,34 \text{ (s)}$$

By from max height

Any one/Enige een

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-14,18 = 0 + (-9,8)\Delta t$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45$$

$$= 1,34 \text{ (s)}$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point/Verplasing vanaf dak tot ontmoetingspunt = $40 - 29,74 = 10,26$ m

Displacement of stone A from max height to meeting point/Verplasing van klip A vanaf maksimum hoogte tot ontmoetingspunt = $15,36$ m

Stone/Klip A

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (0)^2 + (2)(9,8)(15,36)$$

$$v_f = +17,35 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$17,35 = 0 + (9,8)\Delta t$$

$$\Delta t = 1,77 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,77$$

$$= 2,79 \text{ (s)}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 = 1,34 \text{ (s)}$$

Any one/Enige een

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

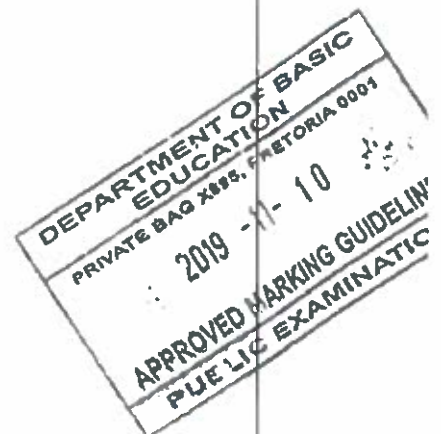
$$v_f = v_i + a\Delta t$$

$$14,18 = 0 + (9,8)\Delta t$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45$$

$$= 1,34 \text{ (s)}$$



OPTION 6/OPSIE 6

UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF:

Displacement from roof to meeting point/Verplasing vanaf dak tot by ontmoetingspunt = $-40 + 29,74 = -10,26$ m

Stone/Klip A

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = (-10)^2 + (2)(-9,8)(-10,26)$$

$$v_f = -17,35 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-17,35 = -10 + (-9,8)\Delta t$$

$$\Delta t = 0,75 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,02 + 0,75$$

$$= 2,79 \text{ (s)}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$-10,26 = 0 + \frac{1}{2}(-9,8)\Delta t^2$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 = 1,34 \text{ (s)}$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(-9,8)(-10,26)$$

$$v_f = -14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$-14,18 = 0 + (-9,8)\Delta t$$

$$\Delta t = 1,45 \text{ s}$$

$$x = 2,79 - 1,45$$

$$= 1,34 \text{ (s)}$$

DOWNWARDS AS POSITIVE/AFWAARTS AS POSITIEF:

Displacement from roof to meeting point/Verplasing vanaf dak tot by ontmoetingspunt = $40 - 29,74 = 10,26$ m

Stone/Klip A

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$v_f^2 = [(10)^2 + (2)(9,8)(10,26)]$$

$$v_f = 17,35 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$17,35 = 10 + (9,8)\Delta t$$

$$\Delta t = 0,75 \text{ s}$$

$$\Delta t_{\text{tot}} = 1,02 + 1,02 + 0,75$$

$$= 2,79 \text{ (s)}$$

Stone/Klip B

$$\Delta y_B = v_i\Delta t + \frac{1}{2}a\Delta t^2$$

$$10,26 = 0 + \frac{1}{2}(9,8)\Delta t^2$$

$$\Delta t = 1,45 \text{ s (1,447 s)}$$

$$x = 2,79 - 1,45 = 1,34 \text{ (s)}$$

$$v_f^2 = v_i^2 + 2a\Delta y$$

$$= 0^2 + 2(9,8)(10,26)$$

$$v_f = 14,18 \text{ m}\cdot\text{s}^{-1}$$

$$v_f = v_i + a\Delta t$$

$$14,18 = 0 + (9,8)\Delta t$$

$$\Delta t = 1,45 \text{ s}$$

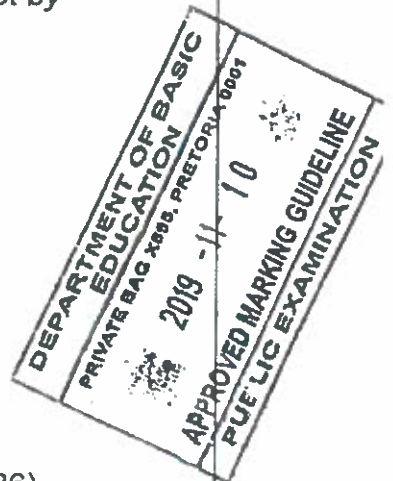
$$x = 2,79 - 1,45$$

$$= 1,34 \text{ (s)}$$

Handwritten note: "Marking from 3-2 op + 2)Δt"

✓ Any one/Enige een

✓ Any one/Enige een



Handwritten notes: "Subs of 10,26"

3.5.1 d ✓ Accept / Aanvaar (0 – e; 0 – d; d – e)

3.5.2 a ✓

3.5.3 f ✓

3.5.4 c ✓

(6)

(1)

(1)

(1)

(1)

[18]

Handwritten signatures and initials: "F", "RN."

QUESTION 4/VRAAG 4

4.1

Marking criteria/Nasienriglyne

- 1 mark for each key word/phrase omitted in the correct context.
- 1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.

Isolated system is a system on which the resultant/net external force is zero. ✓✓

Geïsoleerde sisteem is 'n sisteem waarop die resultante/netto eksterne krag nul is.

OR/OF

Isolated system is one that has no net/external force acting on it.

'n Geïsoleerde stelsel is een waarop geen netto/eksterne krag inwerk nie.

(2)

zero awaiting clarity (/ omit)

4.2.1

$$p = mv \checkmark$$

$$24 = m (480) \checkmark$$

$$m = 0,05 \text{ kg} \checkmark$$

Note: p and v must have the same sign
Let wel: p en v moet dieselfde tekens hê

(3)

4.2.2

Marking criteria/Nasienriglyne

- Appropriate formula including F_{net} or W_{net} . / Toepaslike formule wat F_{net} of W_{net} insluit. ✓
- Substitutions/Vervangings ✓✓
- Final answer/Finale antwoord: 2 000 N ✓
- Correct direction/Korrekte rigting: west or left/Wes of links ✓ / opp die

POSITIVE MARKING FROM QUESTION 4.2.1.

POSITIEWE NASIEN VANAF VRAAG 4.2.1.

OPTION 1/OPSIE 1

$$F_{net}\Delta t = \Delta p$$

$$F_{net}\Delta t = (p_{bullet})_f - (p_{bullet})_i$$

$$F_{net}\Delta t = (mv_{bullet})_f - (mv_{bullet})_i$$

✓ Any one/Enige een

$$F_{net}(0,01) \checkmark = (0,05)(80) - 24 \checkmark \text{ or/of } (0,05)(80) - (0,05)(480)$$

$$F_{net} = -2\,000 \text{ N}$$

$$F_{net} = 2\,000 \text{ N} \checkmark \text{ west/wes} \checkmark \text{ or left / opp die to motion}$$

OPTION 2/OPSIE 2

$$v_f = v_i + a\Delta t$$

$$80 = 480 + a(0,01) \checkmark$$

$$a = -40\,000 \text{ m}\cdot\text{s}^{-2}$$

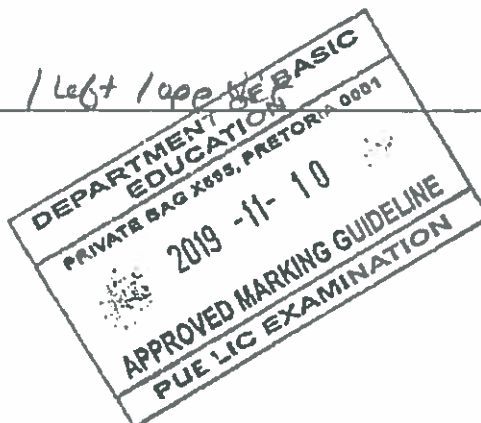
$$F_{net} = ma \checkmark$$

$$= (0,05)(-40\,000) \checkmark \text{ Subs}$$

$$= -2\,000 \text{ N}$$

$$F_{net} = 2\,000 \text{ N} \checkmark \text{ west/wes} \checkmark \text{ / left / opp die}$$

miss newton



Handwritten signatures and initials

OPTION 3/OPSIE 3

$$\Delta x = \left(\frac{v_i + v_f}{2} \right) \Delta t$$

$$= \frac{480 + 80}{2} (0,01)$$

$$= 2,80 \text{ m}$$

$$v_f^2 = v_i^2 + 2a\Delta x$$

$$(80)^2 = (480)^2 + 2a(2,80)$$

$$a = -40\,000 \text{ m}\cdot\text{s}^{-2}$$

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

$$= (0,05)(-40\,000)$$

$$= -2\,000 \text{ N}$$

$$F_{\text{net}} = 2\,000 \text{ N west/wes}$$

can give mark if no a pre calculated

Subs into Δx

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

$$F_{\text{net}}\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$F_{\text{net}}(2,80)\cos 0^\circ = \frac{1}{2}(0,05)(80^2 - 480^2)$$

$$F_{\text{net}} = -2\,000 \text{ N}$$

$$F_{\text{net}} = 2\,000 \text{ N west/wes}$$

OR/OF

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

$$F_{\text{net}}\Delta x \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$F_{\text{net}}(2,80)\cos 180^\circ = \frac{1}{2}(0,05)(80^2 - 480^2)$$

$$F_{\text{net}} = 2\,000 \text{ N west/wes}$$

✓ Any one/ Enige een

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(5)
[10]

QUESTION 5

5.1

Marking criteria/Nasienriglyne

- 1 mark for each key word/phrase omitted in the correct context.
- 1 punt vir elke sleutelwoord/frase weggelaat in die korrekte konteks.
- IF: The word "work" is omitted - 0 marks.
- INDIEN: Die woord "arbeid" uitgelaat is - 0 punte.

A conservative force is a force for which the work done (in moving an object between two points) is independent of the path taken. ✓✓

'n Konserwatiewe krag is 'n krag waarvoor die arbeid wat verrig is (om 'n voorwerp tussen twee punte te beweeg) onafhanklik is van die pad wat gevolg word.

OR/OF

A conservative force is a force for which the work done in moving an object in a closed path is zero. ✓✓

'n Konserwatiewe krag is 'n krag waarvoor die arbeid verrig om 'n voorwerp in 'n geslote pad te beweeg, nul is.

(2)

5.2

Gravitational (force)/Gravitasie(krag) ✓

ACCEPT/AANVAAR: Gravitation /Gravity /Gravitasie /Weight /Gewig

(1)

5.3

No/Nee ✓

There is friction/non-conservative force (doing work)/It is not an isolated system. ✓

Daar is wrywing/nie konserwatiewe krag (wat arbeid verrig)./Dit is nie 'n geïsoleerde sisteem nie.

OR/OF

The net work done by the non-conservative forces is not zero/Die netto arbeid deur die nie-konserwatiewe kragte is nie nul nie. ✓

(2)

5.4

<p>OPTION 1/OPSIE 1 $E_p = mgh \checkmark$ $= (1,8)(9,8)(1,5) \checkmark$ $= 26,46 \text{ J} \checkmark$</p>	<p>OPTION 2/OPSIE 2 $W_w = -\Delta E_p \checkmark$ $(1,8)(9,8)(h - 0)\cos 180^\circ = -(E_{pA} - E_{p(\text{ground/grond})})$ $(1,8)(9,8)(1,5)(-1) = -E_{pA} \checkmark$ $E_p = 26,46 \text{ J} \checkmark$</p> <p>OR/OF $W = F\Delta x \cos \theta$ $= mg\Delta h \cos \theta \checkmark$ } Any one/Enige een $= (1,8)(9,8)(1,5)\cos 0^\circ \checkmark$ $= 26,46 \text{ J} \checkmark$</p>
---	--

(3)

5.5

**POSITIVE MARKING FROM QUESTION 5.4.
 POSITIEWE NASIEN VANAF VRAAG 5.4.**

<p>OPTION 1/OPSIE 1 $W_{nc} = \Delta K + \Delta U$ $W_f = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i) \checkmark$ } Any one/Enige een $= \frac{1}{2}(1,8)(4^2 - 0,95^2) \checkmark + (0 - 26,46) \checkmark$ $= -12,87 \text{ J} \checkmark$</p> <p style="text-align: center;"><i>Do NOT accept + - answers</i></p>	
<p>OPTION 2/OPSIE 2 $W_{net} = \Delta K$ $W_f + W_g = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ } Any one/Enige een $W_f + mgh = \frac{1}{2}m(v_f^2 - v_i^2)$ $W_f + mgh = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $W_f + 26,46 \checkmark = \frac{1}{2}(1,8)[(4)^2 - (0,95)^2] \checkmark$ $W_f = -12,87 \text{ J} (-12,872 \text{ J}) \checkmark$</p>	
<p>OPTION 3/OPSIE 3 $E_{(\text{mech/meg})A} = E_{(\text{mech})B} - W_f$ } Any one/Enige een $(E_p + E_k)_A = (E_p + E_k)_B - W_f$ $(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B - W_f$ $26,46 + \frac{1}{2}(1,8)(0,95^2) \checkmark = 0 + \frac{1}{2}(1,8)(4^2) - W_f \checkmark$ $W_f = -12,87 \text{ J} \checkmark$</p> <p style="text-align: right;"><i>12,87 = -10,4 W_f = -12,87 J</i></p>	

(4)

5.6

$W_{net} = 0 \text{ (J) / zero} \checkmark$

(1)

[13]

QUESTION 6/VRAAG 6

6.1 Doppler effect/Doppler-effek \checkmark

(1)

6.2 (Q): (records sounds with) longer period/ longer time per wave / lower frequency.

(Q): (teken klank aan met) langer periode / langer tyd per golf / laer frekwensie.

not req. explaining ito Q.

OR/OF

P: (records sounds with) shorter period/ shorter time per wave / higher frequency. \checkmark

P: (teken klank aan met) korter periode/ korter tyd per golf / hoër frekwensie.

ACCEPT/AANVAAR

(Q): longer wavelength. /P: shorter wavelength.

(Q): langer golflengte./P: korter golflengte het.

h *[Signature]* *[Signature]* (1)

6.3

<p>OPTION 1/OPSIE 1</p> $f = \frac{1}{T} \checkmark = \frac{1}{17 \times 10^{-4}} \checkmark = 5,88 \times 10^2 = 588,24 \text{ Hz} \checkmark$	
<p>OPTION 2/OPSIE 2</p> <p>speed = $\frac{\text{distance}}{\text{time}}$</p> $340 = \frac{\text{distance}}{25,5 \times 10^{-4}}$ <p>Distance = 0,867 m Distance = $1 \frac{1}{2} \lambda$</p> $\therefore \lambda = 0,578 \text{ m}$ <p>$v = f\lambda \checkmark$ <i>subs</i></p> $340 = f(0,578) \checkmark$ $f = 588,24 \text{ Hz} \checkmark$	<p>OPTION 3/OPSIE 3</p> $v = \frac{\lambda}{T}$ $340 = \frac{\lambda}{17 \times 10^{-4}}$ $\therefore \lambda = 0,578 \text{ m}$ <p>$v = f\lambda \checkmark$</p> $340 = f(0,578) \checkmark$ $f = 588,24 \text{ Hz} \checkmark$

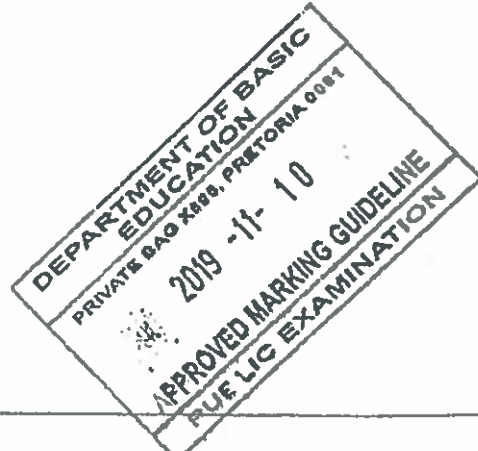
f = 1/T
but corr. with super marking

(3)

6.4

POSITIVE MARKING FROM QUESTIONS 6.2 AND 6.3.
POSITIEWE NASIEN VANAF VRAE 6.2 EN 6.3.
 Do not penalise if 10^{-4} is again omitted.
Moenie penaliseer indien 10^{-4} weer uitgelaat is nie.

<p>OPTION 1/OPSIE 1</p> $f = \frac{1}{18 \times 10^{-4}} \checkmark = 5,56 \times 10^2 = 555,56 \text{ Hz}$ $f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$ <p>OR/OR $f_L = \frac{v}{v + v_s} f_s$</p> $555,56 \checkmark \left(\frac{340}{340 + v} \right) 588,24 \checkmark \left(\oplus \right)$ <p>$v_s = 20 \text{ m} \cdot \text{s}^{-1} \checkmark$</p> <p>Range/Gebied: 19,57 – 20,09 m·s⁻¹</p>
<p>OPTION 2/OPSIE 2</p> $f_L = \frac{1}{18 \times 10^{-4}} \checkmark$ $f_L = \frac{v \pm v_L}{v \pm v_s} f_s \checkmark$ <p>OR/OR $f_L = \frac{v}{v + v_s} f_s$</p> $\frac{1}{18 \times 10^{-4}} \checkmark = \left(\frac{340}{340 + v} \right) \frac{1}{17 \times 10^{-4}} \checkmark$ <p>$v = 20 \text{ m} \cdot \text{s}^{-1} \checkmark$</p> <p>Range/Gebied: 19,57 – 20,09 m·s⁻¹</p>



(6)
[11]

award 2 mks if substituted

P.N.

QUESTION 7/VRAAG 7

7.1.1 Positive/Positief ✓ (1)

7.1.2

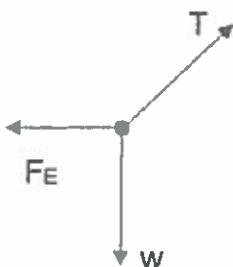
Marking criteria/Nasienriglyne:

- Appropriate formula / Toepaslike formule ✓
- Whole substitution Hele vervanging ✓
- Final answer/finale antwoord: $2,26 \times 10^{-6} \text{ C}$ ✓ (do NOT accept 226µC)

OPTION 1/OPSIE 1	OPTION 2/OPSIE 2
$F = \frac{kQ_1Q_2}{r^2} \checkmark$ $3,05 = \frac{(9 \times 10^9)(6 \times 10^{-6})Q}{0,2^2} \checkmark$ $Q = 2,26 \times 10^{-6} \text{ C} \checkmark$ $(2,259 \times 10^{-6} \text{ C})$	$E = \frac{kQ}{r^2}$ $= \frac{(9 \times 10^9)(6 \times 10^{-6})}{0,2^2}$ $= 1,35 \times 10^6 \text{ N} \cdot \text{C}^{-1}$ $F = Eq \checkmark \text{ subs (even if incorrect)}$ $3,05 = (1,35 \times 10^6)q \checkmark$ $q = 2,26 \times 10^{-6} \text{ C} \checkmark$

(3)

7.1.3



Accepted labels/Aanvaarde benoemings	
W ✓	F_g / F_w / weight / mg / gravitational force F_g / F_w / gewig / mg / gravitasiekrag
T ✓	F_T / tension / spanning
F_E / F ✓	Electrostatic force / Coulomb force / $F_{E \text{ Field}} / F_{x \text{ on } y}$ / 3,05 N Elektrostatiese krag / Coulombkrag

Notes/Aantekeninge

- Mark is awarded for label and arrow. /Punt word toegeken vir byskrif en pyltjie.
 - Do not penalise for length of arrows.
Moenie vir die lengte van die pyltjies penaliseer nie. ✓ x
 - Deduct 1 mark for any additional force /Trek 1 punt af vir enige addisionele krag
 - If force(s) do not make contact with dot /Indien krag(te) nie met die kolletjie kontak maak nie: Max/Maks $\frac{2}{3}$
 - If arrows missing /Indien pyltjies uitgelaat word: Max/Maks $\frac{2}{3}$
- (3)

7.1.4

$F_{\text{net}} = 0$

$F_E = T \sin 10^\circ$

$F_E = T \cos 80^\circ$

$[3,05 = T \sin 10^\circ] \checkmark \checkmark \rightarrow \text{equating}$

$T = 17,56 \text{ N} \checkmark (17,564 \text{ N})$

calc of the component

For equating - show bracket in marking
 $[IF/INDIEN T \cos 10^\circ = 3,05 (\frac{1}{3})]$

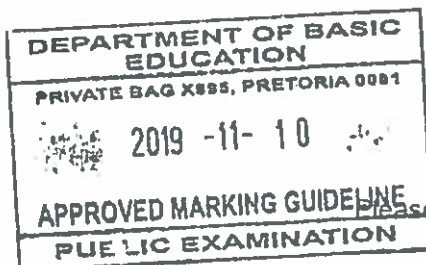
OR/OF

$[3,05 = T \cos 80^\circ] \checkmark$

$T = 17,56 \text{ N} \checkmark (17,564 \text{ N})$

$[IF/INDIEN T \sin 80^\circ = 3,05 (\frac{1}{3})]$

(3)



P.N. [Signature]

7.2.1

Marking criteria/Nasienriglyne

-1 mark for each of the 5 key words omitted in the correct context.
 -1 punt vir elk van die 5 sleutelwoorde weggelaat in die korrekte konteks.

The electric field at a point is the (electrostatic) force experienced per unit positive charge placed at that point. ✓✓

Die elektriese veld by 'n punt is die (elektrostatiese) krag wat per positiewe eenheids-lading wat by die punt geplaas is, ondervind word.

(2)

7.2.2

OPTION 1/OPSIE 1

Electric field at M due to A (+2 x 10⁻⁵ C):

$$E_A = \frac{kQ}{r^2} \checkmark$$

$$= 9 \times 10^9 \frac{(2 \times 10^{-5})}{(0,2)^2} \checkmark$$

$$= 4,5 \times 10^6 \text{ N}\cdot\text{C}^{-1}$$

Electric field at M due to B (-4 x 10⁻⁵ C):

$$E_B = \frac{kQ}{r^2} \quad \text{OR/OF} \quad q_B = 2q_A$$

$$= 9 \times 10^9 \frac{(4 \times 10^{-5})}{(0,2)^2} \checkmark \quad E_B = 2E_A \checkmark$$

$$= 9 \times 10^6 \text{ N}\cdot\text{C}^{-1} \quad = 9 \times 10^6 \text{ N}\cdot\text{C}^{-1}$$

all subs & adding both same sign

$$E_{\text{net at M}} = E_A + E_B$$

$$= (4,5 \times 10^6 + 9 \times 10^6) \checkmark$$

$$= 1,35 \times 10^7 \text{ N}\cdot\text{C}^{-1} \checkmark \text{ to the right/na regs/towards B/na B}$$

away from A / weg vanaf A/east/oos ✓

marks for addition if both same sign

OPTION 2/OPSIE 2

Net electrostatic force at M / Netto elektrostatiese krag by M

$$F_{\text{net}} = \frac{kQ_1Q_2}{r^2} + \frac{kQ_1Q_2}{r^2}$$

$$= \frac{(9 \times 10^9)(2 \times 10^{-5})q}{(0,2)^2} + \frac{(9 \times 10^9)(4 \times 10^{-5})q}{(0,2)^2} \checkmark \text{ (any one/ enige een)}$$

$$= 4,5 \times 10^6 q + 9 \times 10^6 q$$

$$= 1,35 \times 10^7 q \text{ N}$$

If/Indien $F = \frac{kQ}{r^2}$ Max/Maks $\frac{2}{6}$

F_{net} = E_{net}q
+ dir

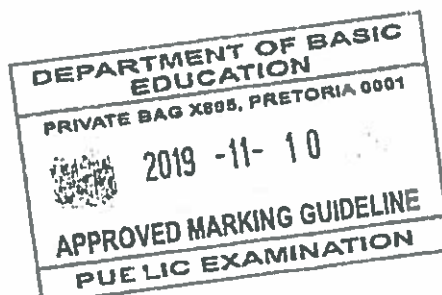
Subs

$$F_{\text{net}} = E_{\text{net}}q \checkmark$$

$$1,35 \times 10^7 q \checkmark = E_{\text{net}}q$$

$$E_{\text{net}} = 1,35 \times 10^7 \text{ N}\cdot\text{C}^{-1} \checkmark \text{ to the right/na regs/towards B / na B / east/oos}$$

(6)
[18]



Handwritten signatures and initials.

QUESTION 8/VRAAG 8

8.1 (Maximum) energy provided / work done ✓ by a battery per coulomb / unit charge passing through it. ✓
 (Maksimum) energie verskaf / arbeid verrig deur 'n battery per coulomb/eenheidlading wat daardeur beweeg.

part marking (opt 1)

ACCEPT/AANVAAR:

Note: From 2020 the following answer will not be accepted.

Let Wel: Vanaf 2020 sal die volgende antwoord nie meer aanvaar word nie.

no part marking

The reading on a voltmeter connected across a battery in an open circuit / when there is no current. ✓✓ (2 or 0)

Lesing op 'n voltmeter wat oor 'n battery geskakel is in 'n oop stroombaan / wanneer daar geen stroom vloei nie. (2 of 0)

(2)

8.2 13 V ✓

(1)

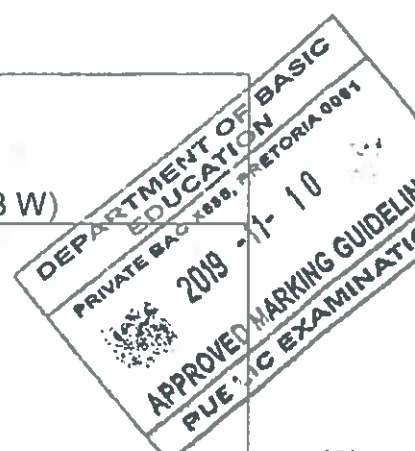
8.3.1

$R = \frac{V}{I} \checkmark$ $5,6 = \frac{10,5}{I} \checkmark$ $I = 1,88 \text{ A} \checkmark (1,875 \text{ A})$	<p>Marking criteria/Nasienriglyne:</p> <ul style="list-style-type: none"> • Appropriate formula/Toepaslike formule ✓ • Whole substitution/Hele vervanging ✓ • Final answer/Finale antwoord: 1,88 A ✓
--	--

(3)

8.3.2 **POSITIVE MARKING FROM QUESTION 8.3.1.**
POSITIEWE NASIEN VANAF VRAAG 8.3.1.

<p>OPTION 1/OPSIE 1</p> $P = VI \checkmark$ $= (10,5)(1,88) \checkmark \text{ whole subs}$ $= 19,74 \text{ W} \checkmark (19,688 \text{ W})$	<p>OPTION 2/OPSIE 2</p> $P = I^2 R \checkmark$ $= (1,88)^2 (5,6) \checkmark$ $= 19,79 \text{ W} \checkmark (19,688 \text{ W})$
<p>OPTION 3/OPSIE 3 (no ⊕ marking for OPT 3)</p> $P = \frac{V^2}{R} \checkmark$ $= \frac{10,5^2}{5,6} \checkmark$ $= 19,69 \text{ W} \checkmark (19,688 \text{ W})$	



(3)

8.3.3 **POSITIVE MARKING FROM QUESTIONS 8.2 AND 8.3.1.**
POSITIEWE NASIEN VANAF VRAE 8.2 EN 8.3.1.

<p>OPTION 1/OPSIE 1</p> $\mathcal{E} = I(R + r) \checkmark$ $13 = 1,88 (5,6 + r) \checkmark$ $r = 1,31 \Omega \checkmark$ $(1,31 - 1,33 \Omega)$	<p>OPTION 2/OPSIE 2</p> $r = \frac{V_{\text{internal}}}{I} \checkmark \frac{V_{\text{lost}}}{I}$ $= \frac{2,5}{1,88} \checkmark$ $= 1,33 \Omega \checkmark$ $(1,31 - 1,33 \Omega)$	<p>OPTION 3/OPSIE 3</p> $\mathcal{E} = V_{\text{ext}} + V_{\text{int}} \checkmark$ $13 = 10,5 + V_{\text{int}} \checkmark \text{ no marks}$ $V_{\text{int}} = 2,5 \text{ V} \checkmark$ $V_{\text{int}} = Ir \checkmark$ $2,5 = (1,88)r \checkmark$ $r = 1,31 \Omega \checkmark$ $(1,31 - 1,33 \Omega)$
---	---	--

(3)

** Do not penalise if differs by 1*

2 Dec
P.N.

8.4.1 Decreases/Neem af ✓

- 
 $V_{\text{internal resistance}}$ /Internal volts increase ✓
 $V_{\text{interne weerstand}}$ /Interne volts neem toe

(2)

8.4.2

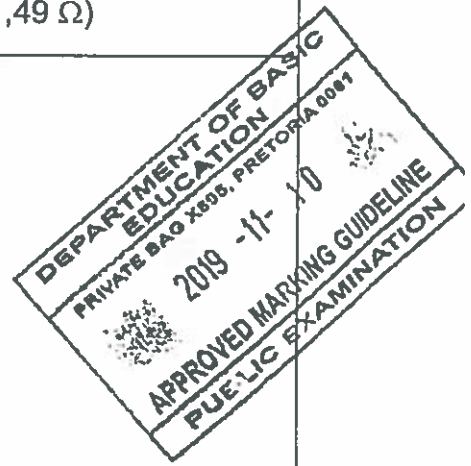
Marking criteria/Nasienriglyne

- Formula/Formule $\mathcal{E} = I(R + r)$ ✓
- Correct substitution into/ Korrekte vervanging in $\mathcal{E} = I(R + r)$ ✓
- Substitution of values into R_p formula/Vervanging van waarde van R_p in formule ✓
- Halving value of R_{2x} /Halvering van waarde van R_{2x} ✓
- Final answer/Finale antwoord: $1,49 \Omega$ ✓ Range/Gebied: $1,46 \Omega - 1,49 \Omega$

POSITIVE MARKING FROM QUESTIONS 8.2 AND 8.3.3.

POSITIEWE NASIEN VANAF VRAE 8.2 EN 8.3.3.

<p>OPTION 1/OPSIE 1</p> <p>$\mathcal{E} = I(R + r)$ ✓</p> <p>$13 = 4(R_{\text{ext}} + 1,31)$ ✓</p> <p>$R_{\text{ext}} = 1,94 \Omega$ (1,92 Ω)</p> <p>$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓</p> <p>$\frac{1}{1,94} = \frac{1}{5,6} + \frac{1}{R_2}$ ✓</p> <p>$R_2 = 2,97 \Omega$ (2,92 Ω)</p> <p>$X = \frac{1}{2}(2,97)$ ✓</p> <p>$= 1,49 \Omega$ ✓ (1,46 – 1,49 Ω)</p>	<p>OPTION 2/OPSIE 2</p> <p>$\mathcal{E} = I(R + r)$ ✓</p> <p>$13 = 4(R_{\text{ext}} + 1,31)$ ✓</p> <p>$R_{\text{ext}} = 1,94 \Omega$ (1,92 Ω)</p> <p>$R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓</p> <p>$1,94 = \frac{5,6 R_2}{5,6 + R_2}$ ✓</p> <p>$R_2 = 2,97 \Omega$ (2,92 Ω)</p> <p>$X = \frac{1}{2}(2,97)$ ✓</p> <p>$= 1,49 \Omega$ ✓ (1,46 – 1,49 Ω)</p>
<p>OPTION 3/OPSIE 3</p> <p>$\mathcal{E} = I(R + r)$ ✓</p> <p>$13 = 4(R_{\text{ext}} + 1,31)$ ✓</p> <p>$R_{\text{ext}} = 1,94 \Omega$ (1,92 Ω)</p> <p>$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓</p> <p>$\left[\frac{1}{1,94} = \frac{1}{5,6} + \frac{1}{2X} \right]$ ✓</p> <p>$X = 1,49 \Omega$ ✓ (1,46 – 1,49 Ω)</p>	<p>OPTION 4/OPSIE 4</p> <p>$\mathcal{E} = I(R + r)$ ✓</p> <p>$13 = 4(R_{\text{ext}} + 1,31)$ ✓</p> <p>$R_{\text{ext}} = 1,94 \Omega$ (1,92 Ω)</p> <p>$R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓</p> <p>$\left[1,94 = \frac{(5,6)(2X)}{5,6 + 2X} \right]$ ✓</p> <p>$X = 1,49 \Omega$ ✓</p>
<p>OPTION 5/OPSIE 5</p> <p>$\mathcal{E} = I(R + r)$ ✓</p> <p>$V_{\text{ext}} = 13 - (4)(1,31)$ ✓</p> <p>$= 7,76 \text{ V}$</p> <p>$V_p = IR_{5,6}$</p> <p>$7,76 = I(5,6)$</p> <p>$I_{5,6\Omega} = 1,37 \text{ A}$</p> <p>$I_T = I_{2x} + I_{5,6}$</p> <p>$4 = I_{2x} + 1,37$</p> <p>$I_{2x} = 2,63 \text{ A}$</p> <p>$V = IR_{2x}$</p> <p>$[7,76 = (2,63)2X]$ ✓</p> <p>$X = 1,46 \Omega$ ✓</p>	<p>OPTION 6/OPSIE 6</p> <p>$\mathcal{E} = I(R + r)$ ✓</p> <p>$V_{\text{ext}} = 13 - (4)(1,31)$ ✓</p> <p>$V_{\text{ext}} = 7,76 \text{ V}$</p> <p>$I_{5,6\Omega} = \frac{7,76}{5,6} = 1,39 \text{ A}$</p> <p>$I_{2x} = 4 - 1,39 = 2,61 \text{ A}$</p> <p>$V_{2x} = I_{2x}R_{2x}$</p> <p>$[7,76 = (2,61)2X]$ ✓</p> <p>$2X = 2,97 \Omega$</p> <p>$X = 1,49 \Omega$ ✓</p> <p>$V_x = I_x R_x$</p> <p>$3,88 = (2,61)R_x$ ✓</p> <p>$R_x = 1,49 \Omega$ ✓</p>



Handwritten notes and signatures at the bottom right corner, including a date '7.7.20' and initials 'P.N.'.

OPTION 7/OPSIE 7

$\mathcal{E} = I(R + r)$ ✓

$V_{ext} = 13 - (4)(1,31)$ ✓
 $= 7,76 \text{ V}$

$V_{ext} = IR_{ext}$

$7,76 = (4) \left(\frac{1}{2X} + \frac{1}{5,6} \right)^{-1}$ ✓

$X = 1,48 \Omega$ ✓

9.1.1) DC ✓
 9.1.3)

9.1.1 DC ✓
 9.1.3

9.1.1 AC X
 9.1.3

(5)
 [19]

QUESTION 9/VRAAG 9

9.1

9.1.1 DC/GS ✓

9.1.2

Marking criteria/Nasienriglyne

-1 mark for each key word/phrase omitted in correct context.
 -1 punt vir elke sleutel woord/frase weggelaat in die korrekte konteks.

Emf is induced as a result of change of magnetic flux (linked) with the coil. ✓✓

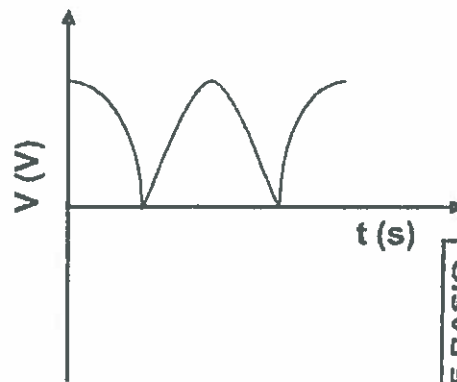
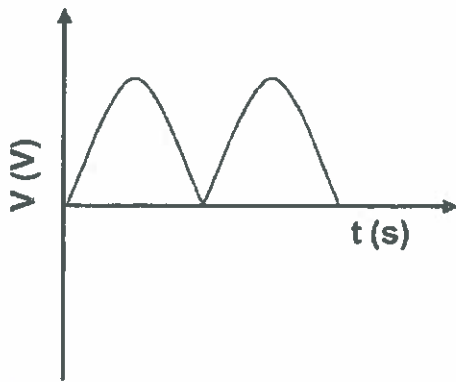
Emk word geïnduseer as gevolg van verandering van die magnetiese vloedkoppeling.

9.1.3

POSITIVE MARKING FROM QUESTION 9.1.1.
POSITIEWE NASIEN VANAF VRAAG 9.1.1.

? if not flux (magnetic field lines)
 flux
 if omitted, then no context ∴ 0/2

(1)

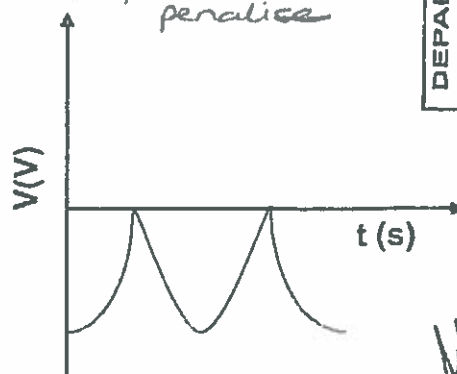
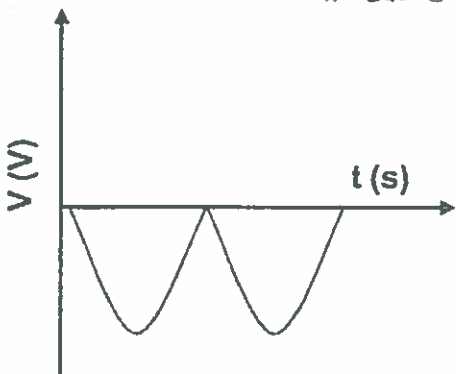


OR/OF

Marking criteria for graph:

Correct shape / Korrekte vorm	✓
One complete cycle / Een volledige siklus	✓

if axes labels omitted, do NOT penalise



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⊕ marking

(2)

9.2.1 The AC potential difference/voltage which dissipates the same amount of energy ✓ as DC (potential difference) ✓

Die WS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as GS potensiaalverskil/spanning

OR/OF

(The rms value of AC is) the DC potential difference/voltage which dissipates the same amount of energy ✓ as AC (potential difference/voltage) ✓

Dit is die GS potensiaalverskil/spanning wat dieselfde hoeveelheid energie verbruik as WS potensiaalverskil/spanning.

(2)

9.2.2

<p>OPTION 1/ OPSIE 1</p> $W = \frac{V^2}{R} \Delta t \checkmark$ $500 = \frac{V^2}{200} (10) \checkmark$ $V = V_{rms} = 100 \text{ V}$ <p><i>Subs</i></p> $V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{max}}{\sqrt{2}} \checkmark$ $V_{max} = 141,42 \text{ V} \checkmark$	<p>OPTION 2/ OPSIE 2</p> $W = I^2 R \Delta t$ $500 = I^2 (200) (10) \checkmark$ $I = I_{rms} = 0,5 \text{ A}$ $P_{ave} = V_{rms} I_{rms} \checkmark$ $\frac{500}{10} = V_{rms} (0,5) \checkmark$ $V_{rms} = 100 \text{ V}$ <p><i>Subs</i></p> $V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{max}}{\sqrt{2}} \checkmark$ $V_{max} = 141,42 \text{ V} \checkmark$	<p>OPTION 3/ OPSIE 3</p> $P_{ave} = I_{rms}^2 R$ $\frac{500}{10} = I_{rms}^2 (200) \checkmark$ $I_{rms} = 0,5 \text{ A}$ $P_{ave} = V_{rms} I_{rms} \checkmark$ $\frac{500}{10} = V_{rms} (0,5) \checkmark$ $V_{rms} = 100 \text{ V}$ <p><i>Subs</i></p> $V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{max}}{\sqrt{2}} \checkmark$ $V_{max} = 141,42 \text{ V} \checkmark$	<p>OPTION 4/ OPSIE 4</p> $R = \frac{V_{rms}}{I_{rms}} \checkmark$ $200 = \frac{V_{rms}}{0,5} \checkmark$ $V_{rms} = 100 \text{ V}$ <p><i>magnete rms</i></p> $V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{max}}{\sqrt{2}} \checkmark$ $V_{max} = 141,42 \text{ V} \checkmark$
<p>OPTION 5/ OPSIE 5</p> $P_{ave} = \frac{V_{rms}^2}{R} \checkmark$ $\frac{500}{10} = \frac{V_{rms}^2}{200} \checkmark$ $V_{rms} = 100 \text{ V}$ <p><i>Subs</i></p> $V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{max}}{\sqrt{2}} \checkmark$ $V_{max} = 141,42 \text{ V} \checkmark$	<p>OPTION 6/ OPSIE 6</p> $P_{ave} = \frac{P_{max}}{2} \checkmark$ $\frac{500}{10} = \frac{P_{max}}{2} \checkmark$ $P_{max} = 100 \text{ W}$ $P_{max} = \frac{V_{max}^2}{R} \checkmark$ $100 = \frac{V_{max}^2}{200} \checkmark$ $V_{max} = 141,42 \text{ V} \checkmark$	<p>OPTION 7/ OPSIE 7</p> $P = \frac{W}{\Delta t} = \frac{500}{10} = 50 \text{ W}$ $P_{ave} = \frac{V_{rms}^2}{R} \checkmark$ $50 = \frac{V_{rms}^2}{200} \checkmark$ $V_{rms} = 100 \text{ V}$ <p><i>Subs</i></p> $V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$ $100 = \frac{V_{max}}{\sqrt{2}} \checkmark$ $V_{max} = 141,42 \text{ V} \checkmark$	<p>OPTION 8/ OPSIE 8</p> $P_{ave} = I_{rms}^2 R \checkmark$ $\frac{500}{10} = I_{rms}^2 (200) \checkmark$ $I_{rms} = 0,5 \text{ A}$ $I_{rms} = \frac{I_{max}}{\sqrt{2}} \checkmark$ $0,5 = \frac{I_{max}}{\sqrt{2}} \checkmark$ $I_{max} = 0,71 \text{ A}$ $V_{max} = I_{max} R \checkmark$ $= (0,71)(200) \checkmark$ $= 142 \text{ V} \checkmark$ <p><i>if using V_{max} = I_{max} then be awarded 2 mks (5)</i></p>

2019 -11- 10
APPROVED MARKING GUIDELINE
PUBLIC EXAMINATION

if using V_{max} = I_{max} then be awarded 2 mks (5)
Opt 2 & 8 wrong
P.N.

QUESTION 10/VRAAG 10

10.1

Marking criteria/Nasienriglyne

- 1 mark for each key word/phrase omitted in correct context.
- 1 punt vir elke sleutel woord/frase weggelaat in die korrekte konteks.

Do NOT accept definition of W_0

The process whereby electrons are ejected from a metal/surface when light (of suitable frequency) is incident on that surface. ✓✓

Die proses waarby elektrone vanaf 'n (metaal)oppervlak vrygestel word wanneer lig (van geskikte frekwensie) daarop skyn/inval. (2)

10.2

$7,48 \times 10^{-19}$ (J) ✓

if 10^{-19} omitted then X, but consider reason

$E = W_0 + E_{k(max)} (= W_0 + \frac{1}{2}mv_{max}^2)$ ✓

When/Wanneer $E_{k(max)} = 0$ / $v = 0$ / $v^2 = 0$ / $E = W_0$ / W_0 is the y-intercept / W_0 is die y-afsnit ✓ (3)

10.3

Mass (of photo-electron)/Massa (van foto-elektron)/m ✓

ACCEPT/AANVAAR:

$\frac{1}{2}m$

if Planck's const

10.4

OPTION 1/OPSIE 1

Gradient = $\frac{1}{2}m$

$\frac{11,98 \times 10^{-19} - 7,48 \times 10^{-19}}{X - 0} = \frac{1}{2}(9,11 \times 10^{-31})$ ✓

$X = 0,9879$ ✓ (0,99 or 0,988)

don't penalise for omitting 10^{-19} (gradient method)

Subs
 $\frac{11,98 \cdot 10^{-19} - 7,48 \cdot 10^{-19}}{x - 0} = 6,63 \cdot 10^{-31}$
 gradient method

ACCEPT/AANVAAR

$X = 0,9879 \times 10^{12} \text{ (m}^2 \cdot \text{s}^{-2})$ $9,879 \times 10^{11}$

POSITIVE MARKING FROM Q10.2./POSITIEWE NASIEN VANAF V10.2.

OPTION 2/OPSIE 2

$E = W_0 + E_{k(max)}$ } ✓ Any one / Enige een

$E = W_0 + \frac{1}{2}mv_{max}^2$

$11,98 \times 10^{-19} \checkmark = 7,48 \times 10^{-19} \checkmark + \frac{1}{2}(9,11 \times 10^{-31}) v^2 \checkmark$ [or/of $\frac{1}{2}(9,11 \times 10^{-31})X$]

$4,5 \times 10^{-19} = 4,56 \times 10^{-31}v^2$

$v^2 = 0,9868 \times 10^{12}$

$X/v^2 = 0,9868$ ✓ (0,99)

Rang/gebied (0,9868 – 0,9879 / $9,87 \times 10^{11} - 9,88 \times 10^{11}$)

ACCEPT/AANVAAR:

$X = 0,9868 \times 10^{12} \text{ (m}^2 \cdot \text{s}^{-2})$ / $9,868 \times 10^{11} \text{ (m}^2 \cdot \text{s}^{-2})$ (5)

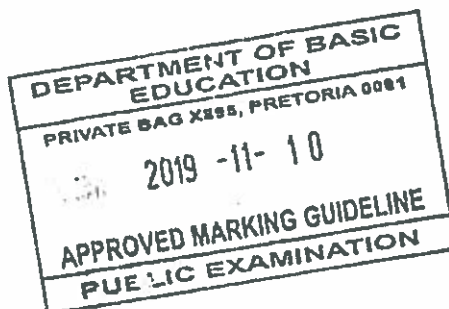
if penal. for subs. in 10.2, don't penalise in 10.4

10.5.1

Remains the same / Bly dieselfde ✓ (1)

10.5.2

Increases / Neem toe ✓ (1)



TOTAL/TOTAAL: 150

PN. [Signatures]

