POSSIBLE ANSWERS FOR / MOONTLIKE ANTWOORDE VIR :

PHYSICAL SCIENCE FINAL HG P1 NOV 2003

NATIONAL DEPARTMENT OF EDUCATION
NASIONALE ONDERWYSDEPARTEMENT

PHYSICAL SCIENCE (HG) **PAPER 1**
NATUUR- EN SKEIKUNDE (HG) **VRAESTEL 1**

NOVEMBER 2003

QUESTION 1/ VRAAG 1

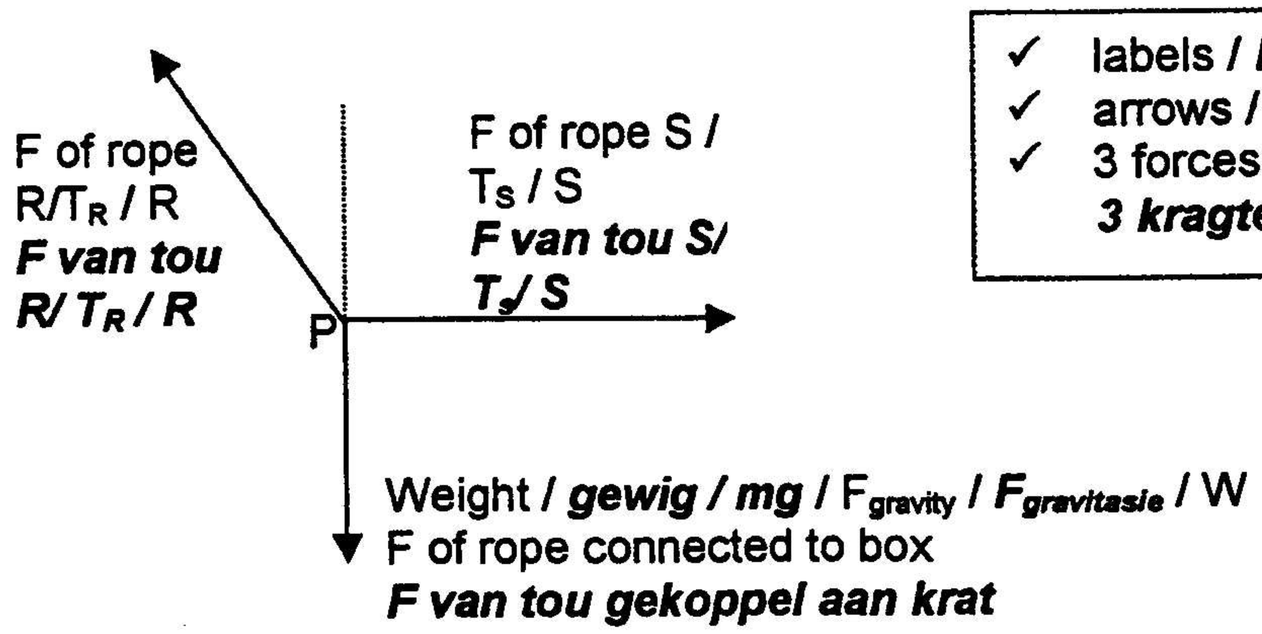
1.1	A	1.2	B	1.3	D	1.4	B	1.5	B	1.6	B	1.7	C
1.8	D	1.9	A	1.10	C or B	1.11	B	1.12	A	1.13	C	1.14	A
1.15	D												

[15 X 4 = 60]

→ 1.10 Although there is only one correct answer for this question, B will also be accepted because of an uncertainty which could have occurred due to the 1 km given.
→ 1.10 Alhoewel daar slegs een regte antwoord vir die vraag is, sal B ook as reg aanvaar word as gevolg van 'n onsekerheid wat kon ontstaan as gevolg van die gegewe 1 km.

QUESTION 2 / VRAAG 2

2.1

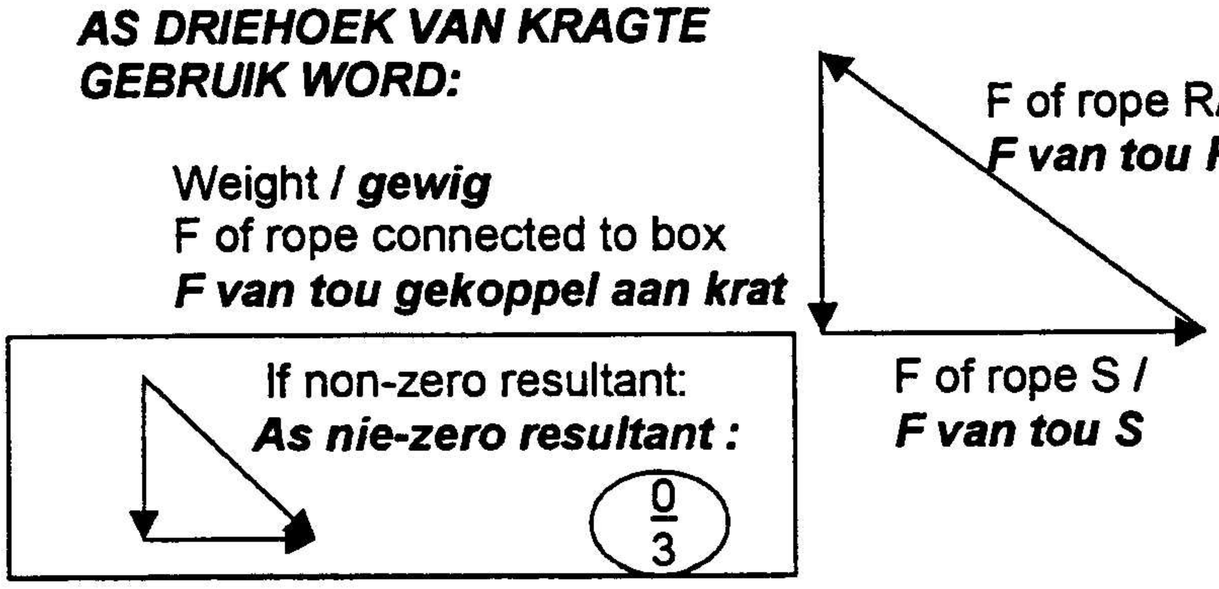


- ✓ labels / *byskrifte*
- ✓ arrows / *pylpunte*
- ✓ 3 forces + orientation
  3 kragte + oriëntasie

(3)

→ Components will be acceptable if labelled adequately
Komponente sal aanvaar word indien korrek benoem
→ If any extra forces are indicated, for example strut then – 0/3
Indien enige ekstra kragte aangedui word soos bv. stut - 0/3

IF TRIANGLE OF FORCES IS USED:
AS DRIEHOEK VAN KRAGTE GEBRUIK WORD:



2.2

2.2.1

$F_S = F_R . \sin 70^0$ ✓ ✓ ✓

$= 5\,850 \times \sin 70^0$

$= 5\,497{,}2$ N ✓

(5500 N)

Mark allocated for link with horizontal component / Punt toegeken vir verband met horisontale komponent

If triangle was done in 2.1 and sine rule or any other trigonometry is used then:
As driehoek in 2.1 gedoen is en die sinus reël of enige ander trigonometrie word gebruik : $\frac{1}{4}$

Incorrect angle - positive marking

OR use

$F_S = F_R . \cos 20^0$ ✓ ✓ ✓

$= 5\,850 \times \cos 20^0$

$= 5\,497{,}2$ N ✓

(4)

→ If resolving into components is done by means of construction and link between the components and force of rope S is indicated then $\frac{4}{4}$
As ontbinding in komponente met behulp van 'n konstruksie gedoen is en die verband met die krag van tou S aangetoon word dan

→ Only construction – no components : 1/4
Net konstruksie – geen komponente : 1/4

2.2.2

$F_{gravitational} = F_R . \cos 70^0$ ✓ ✓ ✓
$F_{gravitasie}$

$= 5\,850 \times \cos 70^0$

$= 2\,000{,}8$ N ✓

$m = \frac{2\,000{,}8}{10} = 200{,}08$ kg ✓ (200,1 kg / 200 kg)

Mark allocated for link with vertical component / Punt toegeken vir verband met vertikale komponent

$F_{gravitational} = F_R . \sin 20^0$ ✓ ✓ ✓
$F_{gravitasie}$

$= 5\,850 \times \sin 20^0$

$= 2\,000{,}8$ N ✓

$m = \frac{2\,000{,}8}{10} = 200{,}08$ kg ✓ (200,1 kg / 200 kg)

(4)

2.3

Tension in rope R increases ✓ | ***krag in tou R neem toe***
because the horizontal component ✓ | ***omdat die horisontale***
increases ***komponent toeneem***
(70° angle increases → sin 70° increases ✓ | (70° hoek neem toe → sin 70° neem toe
20° angle decreases → cos 20° increases) | 20° hoek neem af → cos 20° neem toe

OR / OF

while the vertical component (weight) | ***terwyl die vertikale***
remains constant ✓ ***komponent (gewig) konstant bly***

(3)

[14]

PHYSICAL SCIENCE FINAL HG NOV 2003 3

QUESTION 3 / VRAAG 3

3.1

$$\bar{v}_{car} = \frac{\Delta s}{\Delta t} = \frac{300 - 0}{10 - 0} = 30 \text{ m.s}^{-1}$$

$$\bar{v}_{car} = \frac{\Delta s}{\Delta t} = \frac{300}{10} = 30 \text{ m.s}^{-1}$$

$\bar{v}_{car}$ = gradient of graph / ***gradiënt van grafiek*** $= \frac{\Delta y}{\Delta x} = \frac{300}{10} = 30 \text{ m.s}^{-1}$

$$\bar{v}_{car} = \frac{s}{t} = \frac{300}{10} = 30 \text{ m.s}^{-1}$$

(4)

3.2

$$s = ut + \frac{1}{2}at^2$$

$$375 = 0 + \frac{1}{2}a(10)^2$$

$$a = 7{,}5 \text{ m.s}^{-2}$$

Average velocity over 10s $= \frac{\Delta s}{\Delta t} = \frac{375}{10} = 37{,}5 \text{ m.s}^{-1}$

$$a = \frac{\Delta v}{\Delta t} = \frac{37{,}5 - 0}{5 - 0} = 7{,}5 \text{ m.s}^{-2}$$

(4)

3.3

$s_{MC} = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2}(7{,}5 \times t^2)$

$= 3{,}75t^2$

$s_{car} = ut + \frac{1}{2}at^2$

$= 30t + 0$

After time X: $s_{MC} = s_{car}$

$\frac{1}{2}(7{,}5)t^2 = 30t$

$3{,}75t^2 - 30t = 0$

$t(t - 8) = 0$

$t = 0$ OR $t = 8$ s

Putting the displacements equal to each other
Stel verplasings gelyk

(5)

3.4

CAR / motor : $s = ut + \frac{1}{2}at^2 = (30 \times 15) + 0$ ✓

$= 450$ m

MOTORCYCLE / MOTORFIETS :

s at 10 s = 375 m (read off)

after 10 seconds / na 10 sekondes $v = u + at$

$= 0 + (7{,}5 \times 10)$

$= 75\ m.s^{-1}$ ✓

from 10 s to 15 s / van 10 s tot 15 s

$s = ut + \frac{1}{2}at^2 = (75 \times 5) + 0 = 375$ m ✓✓

∴ total distance travelled / totale afstand afgelê $= 375 + 375$ ✓

$= 750$ m ✓

∴ car is $(750 - 450) = 300$ m behind ✓

motor is $(750 - 450) = 300$ m agter

(7)

Displacement motorcycle / Verplasing motorfiets

$s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}(7{,}5)(15^2) = 843{,}75$

Displacement car / Verplasing motor : $s = vt = 30 \times 15 = 450$

Car is $(843{,}75 - 450)$m $= 393{,}75$ m behind

Motor is $(843{,}75 - 450)$m $= 393{,}75$ m agter

$\frac{2}{7}$

[20]

QUESTION 4 / VRAAG 4

4.1

$F_{cable} = mg = 1\,200 \times 10 = 12\,000$ N ✓✓ (no unit : -1)
(geen eenheid : -1)

Explanation : zero resultant force ✓ ***zero resulterende krag***

or /of $F_{cable} = F_{gravity}$ ***$F_{kabel} = F_{gravitasie}$***

or/of Equilibrium system ***Ewewig stelsel***

or/of N II and acceleration = 0 $m.s^{-2}$ ***N II en versnelling = 0 $m.s^{-2}$***

→ Just a = 0 is not acceptable / ***Net a = 0 is nie aanvaarbaar nie***

(3)

PHYSICAL SCIENCE FINAL HG NOV 2003 5

4.2

$v^2 = u^2 + 2as$ ✓

$0 = (9)^2 + 2.a.18$ ✓ ✓ } this only 4/4

$a = -2{,}25\,m.s^{-2}$ ✓

$a = 2{,}25\ m.s^{-2}$ (magnitude / ***grootte***)

→ if v and u swapped around: 2/4
As v en u omgeruil word:

$v^2 = u^2 + 2as$ (up + / op +) ✓

$0^2 = (-9)^2 + 2(a)(-18)$ ✓ ✓

$a = -2{,}25\ m.s^{-2}$ ✓

$F_{res} \times s = \Delta E_k$

$ma \times s = \frac{1}{2}m(v^2 - u^2)$ ✓

$1200(a) \times 18 = \frac{1}{2}(1200)(0^2 - 9^2)$ ✓ ✓

$a = \frac{-48600}{21600} = -2{,}25\,m.s^{-2}$ ✓

(4)

4.3

Down positive / ***AF POSITIEF***

$F_R = F_{cable/KABEL} + mg$

$F_{cable/KABEL} = ma - mg$ } ✓

✓ ✓	✓ ✓
$F_{cable} = (1\,200)(-2.25) - 12\,000$	$F_{cabel} = (1\,200)(-2.25) - (1\,200 \times 10)$
$= -14\,700$ N ✓	$= -14\,700$ N ✓

OR / ***OF***

Up positive / ***OP POSITIEF***

$F_R = F_{cable/KABEL} + mg$

$F_{cable/KABEL} = ma - mg$ } ✓

✓ ✓	✓ ✓
$F_{cable} = (1\,200)(2.25) + 12\,000$	$F_{cable} = (1\,200)(2.25) - (1\,200 \times -10)$
$= 14\,700$ N ✓	$= 14\,700$ N ✓

(4)

$F_{res} = ma = 1200 \times 2{,}25 = 2700$ N (1/4)

[11]

QUESTION 5 / VRAAG 5

5.1 To the back of the truck / to the right at 10 km.h^{-1} / opposite to direction of motion of truck / (2,8 m.s^{-1})east

Na die agterkant van die trok / na regs teen 10 km.h^{-1} / in teenoorgestelde rigting van die beweging van die trok / (2,8 m.s^{-1})oos (2)

5.2 To the front of the truck / towards the left/ west / same direction as motion of truck ✓✓

Na die voorkant van die trok / na links / wes / selfde rigting as beweging van trok ✓ ✓ (2)

5.3 Newton's First Law, (N I , Newton I)✓

An object continues in its state of rest or of uniform velocity (uniform speed in a straight line) unless a non zero resultant force acts on it.

Newton se Eerste wet. (N I , Newton I)✓

'n Voorwerp sal in sy toestand van rus bly of teen eenvormige snelheid (spoed in 'n reguit lyn) volhard tensy 'n nie-zero resulterende krag daarop inwerk. (4)

[8]

QUESTION 6 / VRAAG 6

6.1

$(E_K)_{initial} = \frac{1}{2} mu^2 = \frac{1}{2}(3)(4)^2 = 24$ J ✓ ✓

$(E_K)_{final} = \frac{1}{2} m v^2 = \frac{1}{2}(3)(6)^2 = 54$ J ✓ ✓

$\Delta E_K = 30$ J ✓

$\Delta E_K = (E_K)_{final} - (E_K)_{initial}$
$= \frac{1}{2} mv^2 - \frac{1}{2} m u^2$ ✓ ✓ ✓
$= \frac{1}{2}(3)(6)^2 - \frac{1}{2}(3)(4)^2$
$= 30$ J ✓

If v and u swapped around:
As v en u omgeruil word :

3/5

$\Delta E_K = (E_K)_{initial} - (E_K)_{final}$
$= \frac{1}{2} mu^2 - \frac{1}{2} m v^2$ ✓ ✓ ✓
$= \frac{1}{2}(3)(4)^2 - \frac{1}{2}(3)(6)^2$
$= -30$ J ✓

If positive 30 J is the answer:
As positief 30 J die antwoord:

3/5

(5)

6.2 increases / ***toeneem*** ✓✓ (no positive marking from 6.1 / ***geen positiewe nasien vanaf 6.1***) (2)

6.3 Work done by the compressed spring on the trolley. ✓✓
OR due to the transfer of the potential energy of the spring (into E_k trolley)
OR force exerted by the spring

Arbeid verrig op die trollie deur die saamgedrukte veer ✓✓
OF oordrag van die potensiële energie van die veer (na E_k trollie)
OF die krag uitgeoefen deur die veer (2)

(1 mark for spring and one mark for work done/ transfer of energy/ force exerted by spring)
(***1 punt vir veer en een punt vir arbeid verrig/ oordrag van energie/ krag uitgeoefen deur veer***)

elastic E_p transferred to E_k → 2/2
elastiese E_p *oordrag* na E_k → 2/2

E_p transferred to E_k→0/2
E_p *oordrag* na E_k → 0/2

no spring / elastic → 0/2
geen veer / of* elastiese → *0/2

6.4

$v^2 = u^2 + 2as$ ✓

✓ ✓

$0^2 = 6^2 + 2a \times 10$ ✓

$a = \frac{0^2 - 6^2}{2 \times 10} = -1{,}8\ m.s^{-2}$

$a = 1{,}8\ m.s^{-2}$

(u and v substituted incorrectly → 2/4)

$\Delta E_k = W = F \times s$ ✓

$-54\ J = F \times 10$

$F = -5{,}4\ N$ ✓

$F = ma$

$-5{,}4 = 3 \times a$ ✓

$a = -1{,}8\ m.s^{-2}$ ✓

$a = 1{,}8\ m.s^{-2}$

(4)

6.5

$v = u + at$ ✓

✓ ✓

$0 = 6 + (-1{,}8)\ t$

$t = 3{,}33\ s$ ✓

s and u - same sign but opposite to a

s en u - selfde teken maar teenoorgesteld van a

$s = \left(\frac{u + v}{2}\right)t$ ✓

✓ ✓

$10 = \left(\frac{6+0}{2}\right)t$

$t = 3{,}33\ s$ ✓

$s = ut + \frac{1}{2}at^2$ ✓

✓ ✓

$10 = 6t + \frac{1}{2}(-1{,}8)t^2$

$0{,}9t^2 - 6t + 10 = 0$

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$t = 3{,}33\ s$ ✓

(4)

6.6

$F_{friction} = F_{res} = ma$ ✓

✓

$= 3 \times (-1{,}8)$

$= -5{,}4\ N$ ✓

✓

$= 5{,}4$ N opposite to direction of motion / to right

teenoorgestelde rigting van beweging / na regs

Mark direction independent of calculation – one mark obtained if only direction given / ***sien rigting onafhanklik van berekening na – een punt toegeken as slegs rigting gegee word .***

(4)

✓

$W = \Delta E_k = \frac{1}{2}(3)(0^2 - 6^2) = F \times s$

$= F_{friction\ /\ wrywing} \times 10$

$F_{friction/\ wrywing} = \frac{-54}{10} = -5{,}4\ N$

✓ ✓ ✓

$= 5{,}4$ N opposite to direction of motion / to right

teenoorgestelde rigting van beweging / na regs

[21]

QUESTION 7 / VRAAG 7

7.1 Sum of kinetic and (gravitational) potential energy in an isolated system (no forces other than gravitational force) remains constant (during free fall).

In an isolated system as the E_k increases the E_p decreases (vice versa) proportionally / at the same rate.

Die som van die kinetiese en die gravitasie-potensiële energie in 'n geisoleerde sisteem (geen ander kragte as gravitasiekrag nie) bly konstant (gedurende vryval)

In 'n geisoleerde sisteem sal die toename in E_k en die afname in E_p (vice versa) eweredig wees / teen dieselfde tempo. (3)

7.2

$E_p = mgh$
$= 5,4 \times 10 \times 0,45$
$= 24,3$ J

E_k (lost/***verloor***) = E_p (gained/***bykry***)

$\frac{1}{2}mv^2 = 24,3$

$\frac{1}{2}(5,4)v^2 = 24,3$

$v^2 = \frac{24,3}{2,7}$

$v = 3\ m.s^{-1}$

$(E_p + E_k)_X = (E_p + E_k)_Y$

$0 + \frac{1}{2}mv^2 = mgh + 0$

$v^2 = 2gh$

$= (2.10)(0,45)$

$v = 3\ m.s^{-1}$

(3)

NOT / NIE : $v = \sqrt{2gs}$
$v^2 = u^2 + 2as$ 0/3

7.3

$p_{before/voor} = p_{after/na}$
$m_1u_1 + m_2u_2 = (m_1 + m_2)v$
$0 + 0,4u_2 = 5,4 \times 3$
$u_2 = 40,5\ m.s^{-1}$

If 0 not given move mark to $0,4u_2$ (for 2 marks) → $0,4u_2$

$p_{before} = p_{after}$
$m_1u_1 + m_2u_2 = (m_1 + m_2)v$
$0 + 0,4u_2 = (5 \times 3) + (0,4 \times 3)$
$u_2 = 40,5\ m.s^{-1}$

$p_{before/voor} = p_{after/na}$
$0,4u_2 = 5,4 \times 3$
$u_2 = 40,5\ m.s^{-1}$ 5/6

$m_1v_1 = m_2v_2$
$0 + 0,4u_2 = 5,4 \times 3$
$u_2 = 40,5\ m.s^{-1}$ 4/6

(6)

[12]

QUESTION 8 / VRAAG 8

8.1

Accept arrows more or less the same length

Aanvaar pyle min of meer ewe lank

electrostatic force / Eq / $F_{electric\ field}$ ✓
elektrostatiese krag / Eq / $F_{elektriese\ veld}$

✓ ARROWS

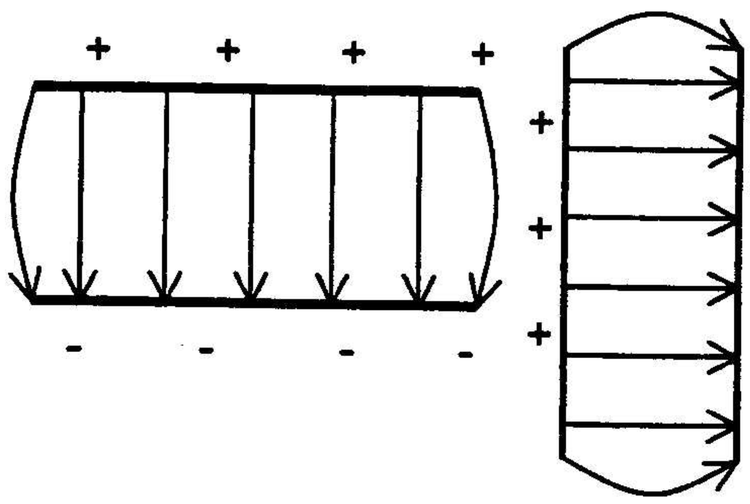
$F_{gravity}$ / weight / mg /gravitational force ✓
$F_{gravitasiekrag}$ / gewig /mg / gravitasie krag

→ E and W as labels will not be accepted
E en W sal nie as byskrifte aanvaar word nie

(3)

8.2 Plate P is positive / ***Plaat P is positief*** ✓✓ OR(+) ✓✓ (2)

8.3



- ✓ parallel lines / ***lyne parallel***
- ✓ end effects / ***rand effekte***
- ✓ equally spaced / ***eweredig gespasieer***
- ✓ direction / ***rigting***

(polarity of plates must be shown !!)

(4)

8.4

$V = E.d$ ✓

$= \frac{F.d}{Q}$ ✓

$= \frac{mgd}{Q} = \frac{(4x10^{-15})(10)(0,03)}{8x10^{-19}}$ ✓ ✓ ✓

$= 1\,500\ V$ ✓

If d is incorrectly substituted, then continue to mark → 6/7
As d verkeerd ingestel, merk verder vir → 6/7

$F_g = mg = (4 \times 10^{-15})(10)$ ✓ ✓ ✓
$= 4 \times 10^{-14}\ N$

$E = \frac{F}{Q} = \frac{4x10^{-14}}{8x10^{-19}} = 5x10^4\ N.C^{-1}$ ✓

$V = Ed = (5x10^4)(0,03) = 1500\ V$ ✓ ✓ ✓

(7)

8.5

8.5.1 charge / ***lading*** = $(-8 + 3,2) \times 10^{-19}\ C = -4,8 \times 10^{-19}\ C$ ✓ ✓
if only answer / ***as slegs antwoord gegee*** → ✓✓

(2)

8.5.2 no. of excess electrons = $\frac{-4,8x10^{-19}}{-1,6x10^{-19}}$ ✓ = 3 electrons / elektrone ✓

aantal oormaat elektrone : (if $+1,6x10^{-19}$ is used no mark)

(2)

if + 1,6 x 10^{-19} used the 0/2

[20]

QUESTION 9 / VRAAG 9

9.1

∴ pd across L_2 = pd across $L_3 + L_4$ ✓
PV oor L_2 = PV oor $L_3 + L_4$
(V is the same / ***V is dieselfde***)

Resistance ($L_3 + L_4$) = 2 x resistance of L_2 ✓
Weerstand ($L_3 + L_4$) = 2 x weerstand van L_2

Reading on A_2 = total current = 1,5 ✓+ 3 = 4,5 A
Lesing op A_2 = totale stroom = 1,5 + 3 = 4,5 A

Ratio method and V is the same → 3/3; ratio method without V is the same → 2/3

Verhoudingsmetode met V is dieselfde → 3/3; verhoudingsmetode sonder V selfde → 2/3

(3)

9.2

$R_{L_3} = \frac{V✓}{I} = \frac{3✓}{1,5✓} = 2\,\Omega$ ✓

R_{L3} = 2 Ω ✓✓ only /slegs → 2/4

(4)

9.3

✓ ✓ ✓ ✓ ✓
emf = IR + Ir = (6+9) + (4,5x1) = 19,5 V

$V(L_3 + L_4)$ = 6 V ✓

✓ ✓ ✓
$V_{L_1} = IR_{L_1}$ = 4,5x2 = 9 V

✓ ✓
V_{lost} = Ir = 4,5x1 = 4,5 V

✓ ✓ ✓ ✓
∴ emf = (6+9) + 4,5 = 19,5 V

$\frac{1✓}{R_P} = \frac{1✓}{2} + \frac{1✓}{4}$ ✓
R_P = 1,33 Ω

R_{ext} = 2 + 1,33 = 3,33 Ω ✓

✓ ✓ ✓ ✓
emf = I(R+r) = 4,5(3,33+1) = 19,5 V

$R_p = \frac{\text{productR}}{\text{sumR}} = \frac{2 \times 4}{2+4} = 1,33\,\Omega$ ✓ ✓ ✓ ✓

✓ ✓
R_{tot} = (1,33+2)+1 = 4,33 Ω

✓ ✓ ✓
emf = IR_{tot} = 4,5x4,33 = 19,5 V

(9)

9.4

9.4.1 resistance increases noticeably ✓✓ / ***merkbaar toeneem*** positive marking (2)

9.4.2 reading on A_2 decreases noticeably ✓✓/ ***merkbaar afneem*** (2)

9.4.3 reading on V becomes zero ✓✓ / ***lesing op V word 0*** (2)

[22]

QUESTION 10 / VRAAG 10

10.1

Direct current - flow of charge in one direction only (flows from + to - terminal of a battery through an external circuit (resistance). ✓✓

Gelykstroom – beweging van lading in een rigitng (van + na – terminaal)

✓

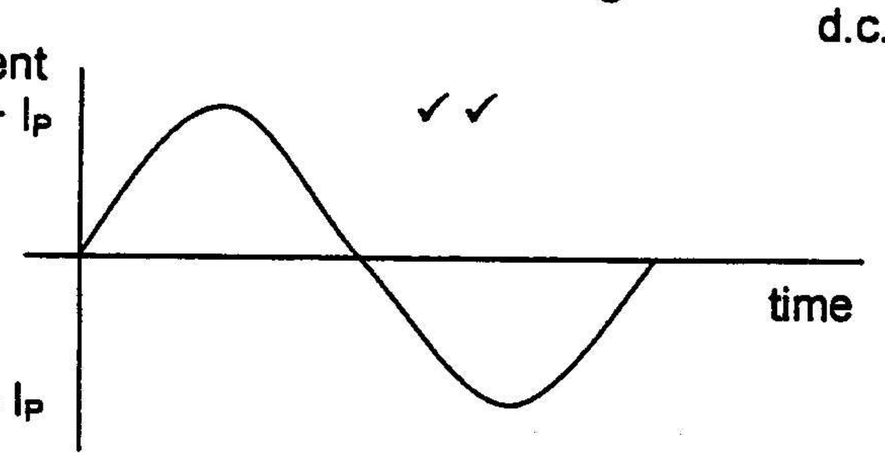
Alternating current – the flow of charge changes direction continually between two opposite directions or the potential difference alternates between a + maximum and a - maximum. ✓

Wisselstroom – die beweging van lading verander gedurig van rigting tussen twee teenoorgestelde rigitngs of die potensiaalverskil wissel tussen 'n + maksimum en 'n - maksimum

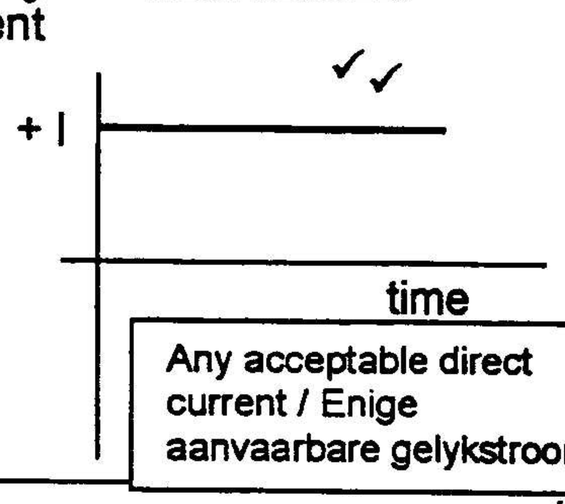
or a graph of ac showing the variation of I or V with time is acceptable

OF 'n grafiek van ac se verandering van I teen V teen tyd is aanvaarbaar

a.c. current



d.c. current



Any acceptable direct current / Enige aanvaarbare gelykstroom

(4)

10.2

10.2.1

$P = VI$

$1\,500 = (240)\,I$ ✓

$I = 6{,}25\ A$

$R = \frac{V}{I} = \frac{240}{6{,}25} = 38{,}4\ \Omega$ ✓✓✓

$R = \frac{P}{I^2} = \frac{1500}{(6{,}25)^2} = 38{,}4\ \Omega$ ✓✓✓

$R = \frac{V^2}{P} = \frac{240^2}{1500} = 38{,}4\ \Omega$ ✓✓✓✓

(4)

10.2.2

$W = Pt$ ✓✓✓

$= (1500)(180)$

$= 2{,}7 \times 10^5\ J$ ✓

$W = VIt$ ✓✓✓✓

$= (240)(6{,}25)(180)$

$= 2{,}7 \times 10^5\ J$ ✓

$W = \frac{V^2t}{R}$ ✓

$= \frac{(240)^2}{38{,}4}(180)$ ✓

$= 2{,}7 \times 10^5\ J$ ✓

$W = I^2Rt$ ✓✓✓

$= (6{,}25)^2(38{,}4)(180)$

$= 2{,}7 \times 10^5\ J$ ✓

If 3 min substituted / As 3 min ingestel → $\frac{3}{4}$

(4)

[12]

GRAND TOTAL : 200