Possible Answers March 2006

NATIONAL DEPARTMENT OF EDUCATION

PHYSICAL SCIENCE (HG) – PAPER 1 / *NATUUR- en SKEIKUNDE (HG) – VRAESTEL 1*

QUESTION 1 / *VRAAG 1*

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

[15 x 4 = 60]

QUESTION 2 / *VRAAG 2*

2.1

If three forces acting at a point are in equilibrium✓, they can be represented in magnitude✓ and direction by the three sides of a triangle✓ taken in order. **OR**

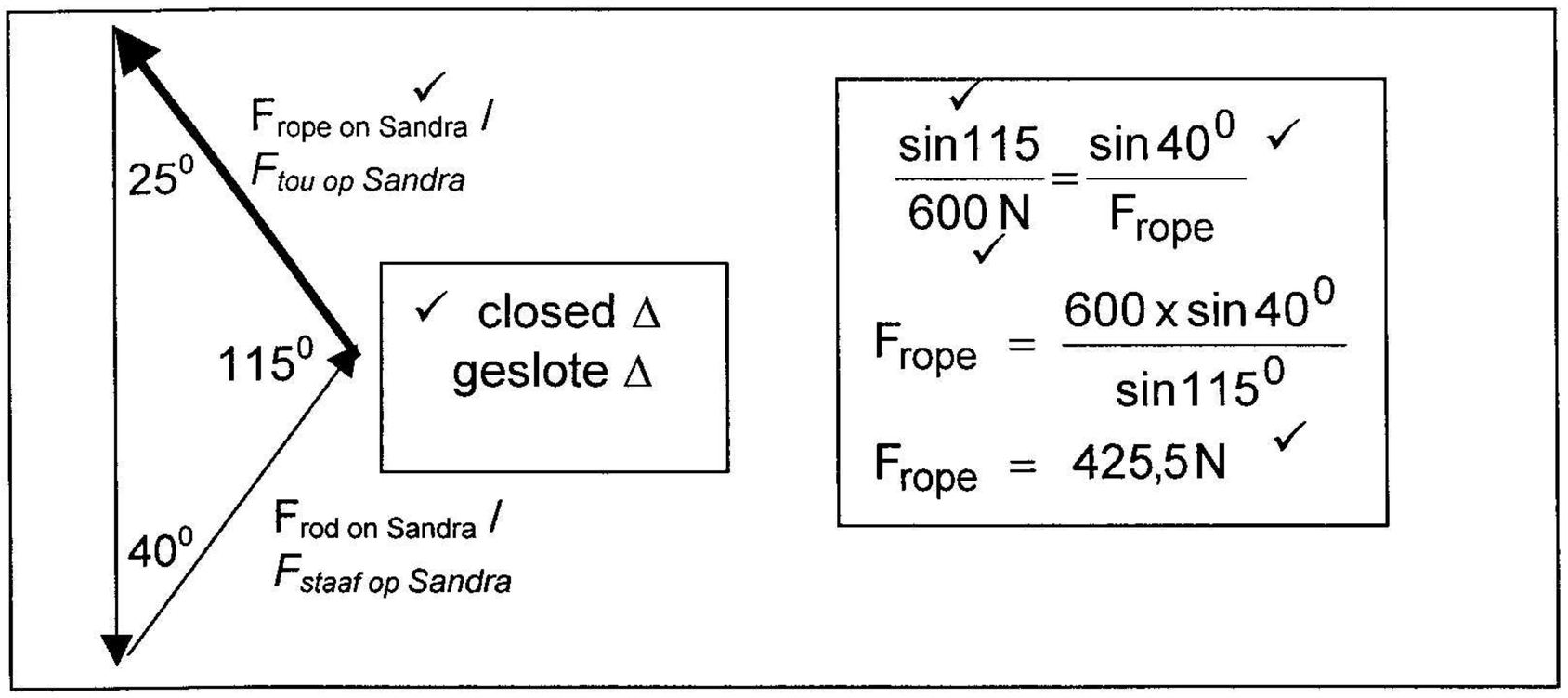
If the three forces acting at✓ a point✓ are placed head-to-tail✓, (one after the other), they will form a closed triangle✓ (triangle where the resultant is zero).

As drie kragte in ewewig is✓ kan hulle voorgestel word in grootte en rigting✓ as die drie sye van 'n geslote driehoek✓, in orde geplaas kop-aan-stert.

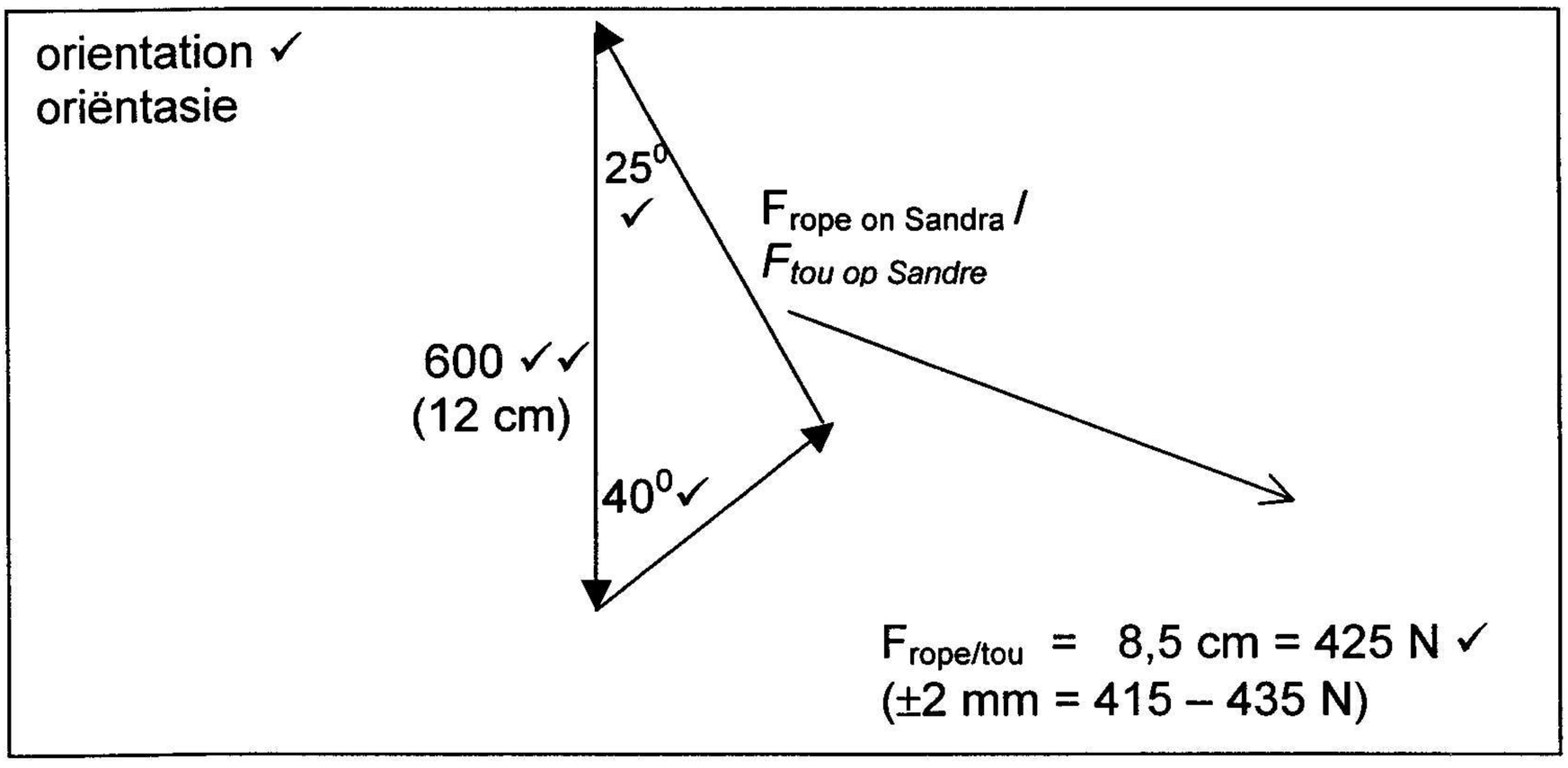
As die drie kragte wat op 'n punt inwerk✓ kop-aan-stert geplaas✓ word, sal hulle 'n geslote driehoek vorm✓.

(3)

2.2



BY CONSTRUCTION / *BY SKAALTEKENING*



(6)

2.3

In Fig. 1 the rod exerts an upward component of force on her -
$\therefore (F_{rod} + F_{rope})_{up} = 600$ N. ✓
In Fig 2 the rod exerts a downward component of force on her –
$\therefore (F_{rod})_{down} + (F_{rope})_{up} = 600$ N ✓
$\Rightarrow$ F_{rope} is more than before. ✓ **OR**
Increase ✓ bigger force opposite to bigger angle ✓ (2 marks) **OR**
Increase ✓ θ is smaller ✓ (2 marks)

In Fig 1 oefen die staaf 'n opwaartse komponent van 'n krag uit op haar - $\therefore (F_{staaf} + F_{tou})_{op} = 600$ N. ✓
In Fig 2 oefen die staaf 'n afwaartse komponent van 'n krag uit op haar
$\therefore (F_{staaf})_{af} + (F_{tou})_{op} = 600$ N ✓
$\Rightarrow$ F_{rope} is meer as voorheen. ✓ ***OF***
Toeneem ✓ groter krag teenoor groter hoek ✓ (2 punte) OF
Toeneem ✓ θ is kleiner ✓ (2 punte)

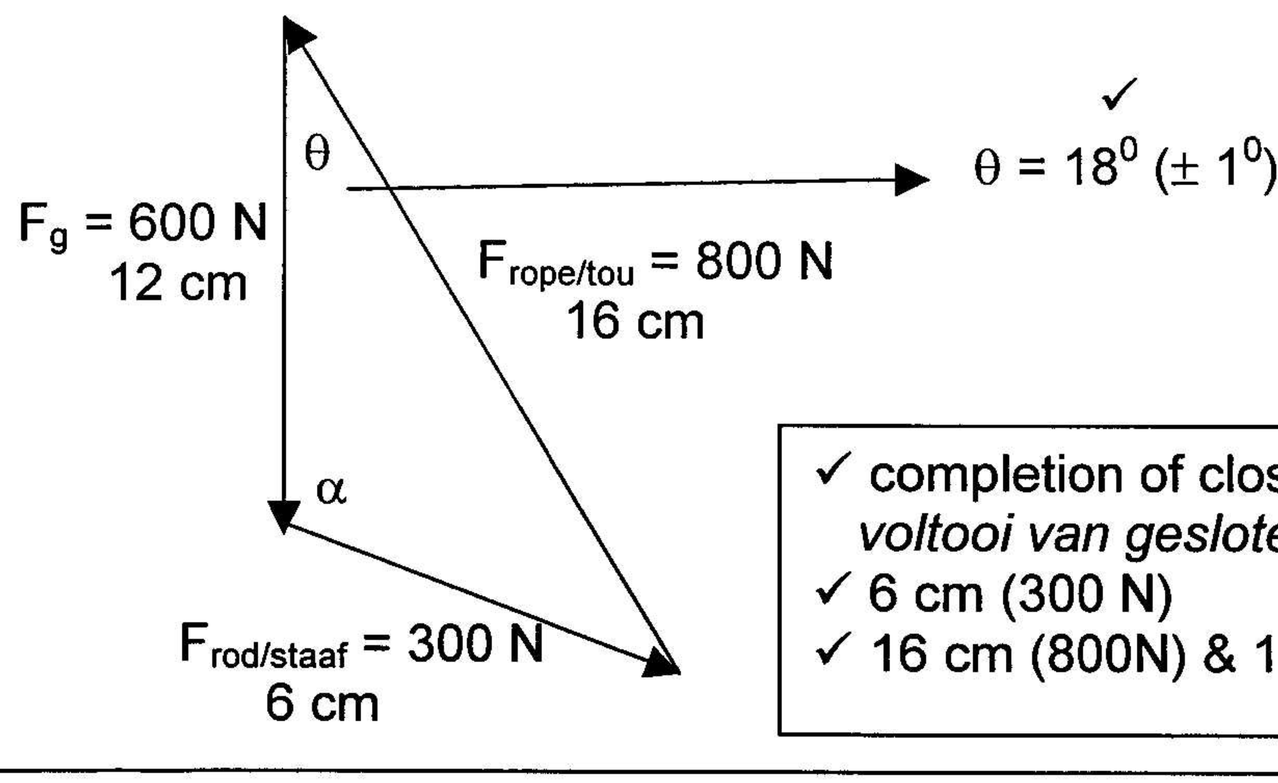
(3)

2.4 **CALCULATION / *BEREKENING***

✓ ✓ ✓
$300^2 = (600^2 + 800^2) - (2 \times 600 \times 800 \times \cos\theta)$

$\cos\theta = 0{,}948$
$\theta = 18{,}56^0$ ✓

BY CONSTRUCTION / *MET SKAALTEKENING*



✓
$\theta = 18^0 (\pm 1^0)$

✓ completion of closed triangle
voltooi van geslote driehoek
✓ 6 cm (300 N)
✓ 16 cm (800N) & 12 cm (600N)

(4)

[16]

QUESTION 3 / *VRAAG 3*

3.1

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

$$16 = 0 + \frac{1}{2}(10)t^2 \quad \checkmark\ \checkmark\ \checkmark$$

$$t^2 = \frac{16 \times 2}{10}$$

$$t = 1{,}79\,s \quad \checkmark$$

(5)

3.2

time for A to reach ground / Tyd vir A om grond te bereik

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

$$57{,}5 = 0 + \frac{1}{2}(10)t^2 \quad \checkmark\ \checkmark$$

$$t = 3{,}39\,s$$

∴ time from Q to ground / Tyd vir Q om grond te bereik

$= 3{,}39 - 1{,}79 = 1{,}6\,s$

∴ initial velocity of B / aanvangsnelheid van B :

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

$$57{,}5 = u(1{,}6) + \frac{1}{2}(10)(1{,}6)^2 \quad \checkmark\ \checkmark\checkmark\ \checkmark$$

$$u = 27{,}94\ m.s^{-1} \quad \checkmark$$

(8)

[13]

QUESTION 4 / *VRAAG 4*

4.1 Acceleration can be defined as the rate of change of velocity **OR** the rate at which velocity is changing. ✓✓

Versnelling kan gedefinieer word as die tempo van verandering in snelheid **OF** *die tempo waarteen die snleheid verander.* ✓✓ (2)

4.2.1 MN ✓ > QR ✓ because it has a bigger gradient. ✓ Both in the same direction. ✓

MN > QR aangesien dit 'n groter gradient het – beide selfde rigting (3)

4.2.2 They are the same (equal) in magnitude ✓ and direction ✓

Hulle is dieselfde (gelyk) in grootte en rigting (2)

4.3 It slows down ✓ to a stop ✓ and then speed up ✓ in the opposite direction ✓

Dit beweeg stadiger en stop, beweeg dan weer vinniger in teenoorgestelde rigting. (4)

4.3 Distance travelled will be equal to sum of all areas underneath v-t graph. ✓
Afstand afgelê is gelyk aan die som van alle oppervlaktes onder v-t grafiek.

s_{total} = s(0 – 10s) + s(10 – 20s) + (20 – 32s)
✓ ✓ ✓

= (5.10 + ½ 10.10) + (15.10) + (½ .12 .15)
= 480 m ✓

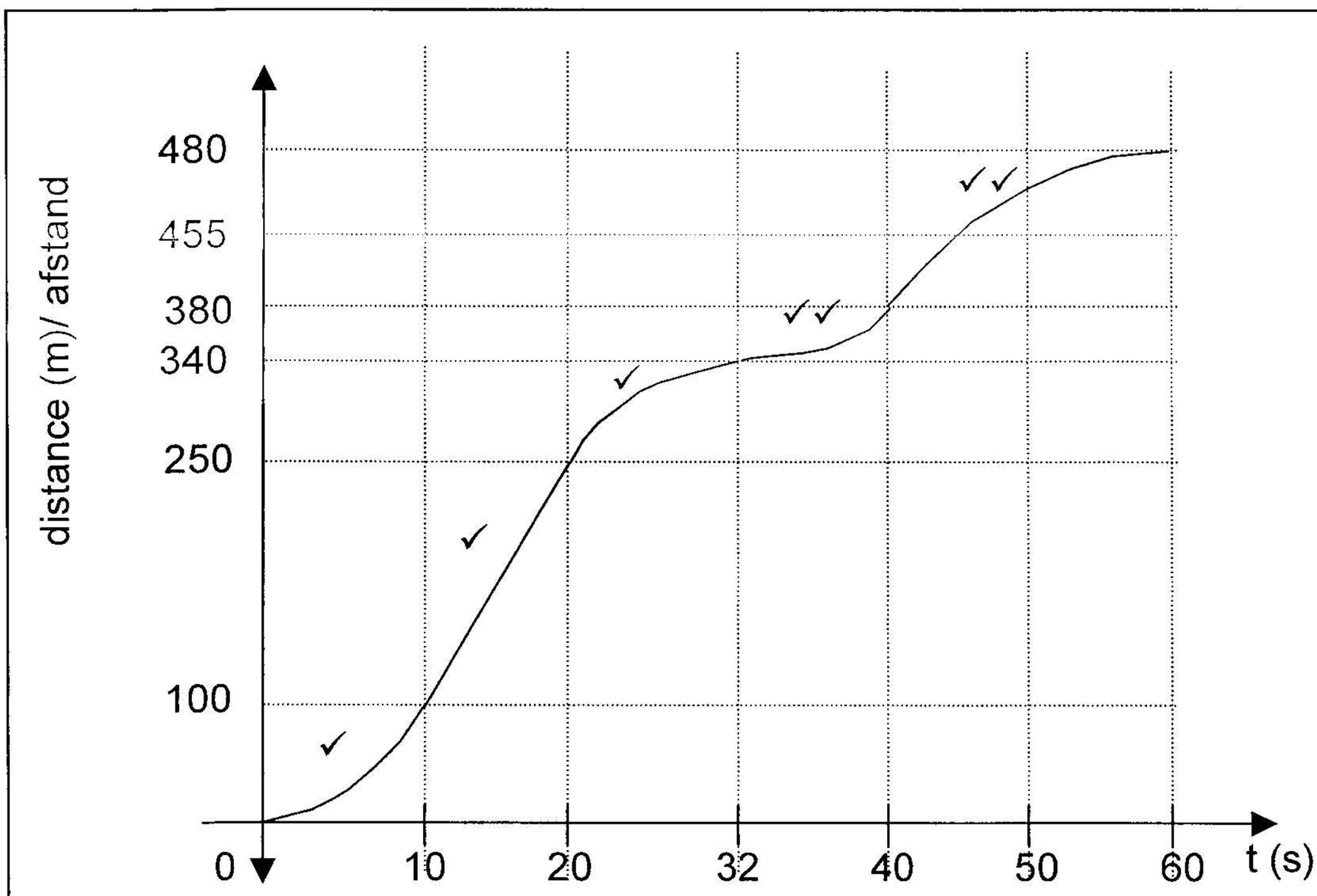
OR / *OF*

s_{total} = s(0 – 10s) ✓ + s(10 – 32s) ✓ + s(32 – 60s) ✓

$= [\frac{1}{2}(15+5)x10] + [\frac{1}{2}(22+10)x15] + [\frac{1}{2}x28x10]$

= 480 m ✓ (5)

4.4



Criteria:
- ✓ shape 0 – 10 s / vorm 0 – 10 s
- ✓ shape / vorm : 10 – 20 s
- ✓ shape / vorm : 20 – 32 s
- ✓✓ shape / vorm : 32 – 40 s
- ✓✓ shape / vorm :40 – 60 s

(7)

[23]

QUESTION 5 / *VRAAG 5*

5.1 ✓

It moves forward at velocity of car/ continues forward.
Dit beweeg vorentoe teen snelheid van motor / vorentoe

(1)

5.2 ✓ ✓

Newton 1 (NOT inertia)
A body will remain at rest or continue at constant velocity (speed in a straight line) unless acted on by an external non-zero resultant force. ✓
Newton 1 ✓ (Nie traagheid)
'n Liggaam sal in sy toestand van rus ✓ bly of teen 'n konstante snelheid in 'n reguit lyn bly beweeg ✓ tensy 'n nie-zero resulterende krag ✓ daarop inwerk.

(4)

5.3 ✓✓

Resultant force is directly proportional to change in momentum. **OR**
$F_{res} \propto \Delta p$ ✓✓
NOT: F_{res} is directly proportional to rate of change in momentum

Resultante krag is direk eweredig aan verandering in momentum
$F_{res} \propto \Delta p$

(2)

5.4

$F_{res}\,\Delta t = mv - mu$ ✓

✓ ✓ ✓

$F_{res}\,(0{,}25) = 60\,(0 - 14)$ ✓

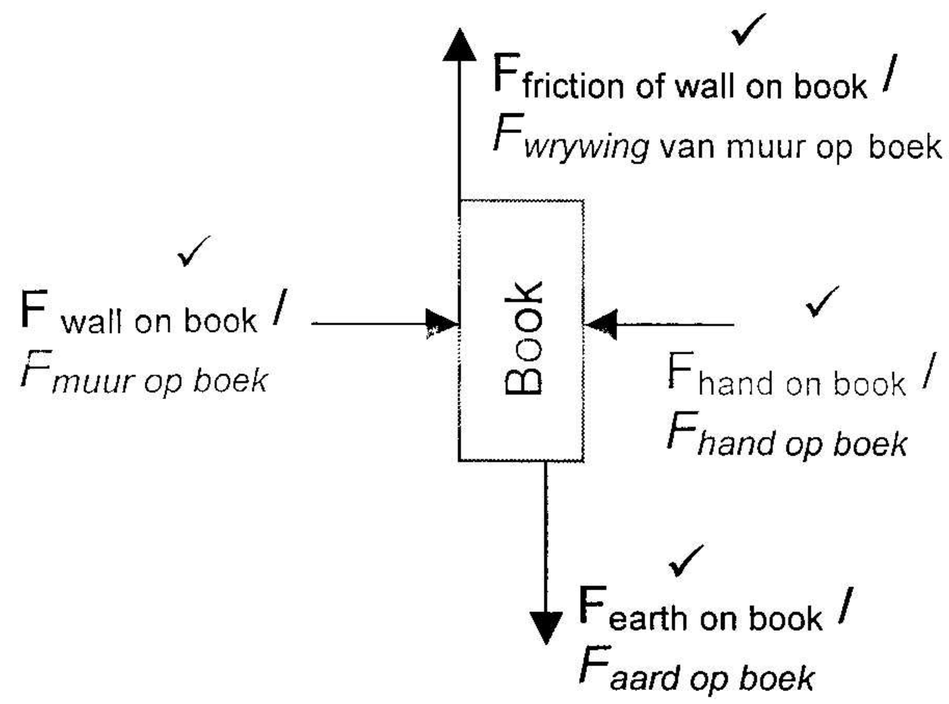
$F_{res} = 3\,360$ N ✓ opposite to direction of motion of car / left
teenorgestelde rigting van motor / links

(6)

[13]

QUESTION 6/ *VRAAG 6*

6.1



arrows missing (-2 max)
pyle ontbreek (-2 max)

(4)

6.2

If body A exerts a force on body B then body B exerts a force of equal magnitude on body A, but in the opposite direction.

As liggaam A 'n krag op liggaam B uitoefen ✓ sal liggaam B 'n krag van dieselfde grootte ✓ maar in die teenoorgestelde rigting ✓ op ligaam A uitoefen.

(3)

6.3

(wall on book) and (book on wall) ✓✓
(hand on book) and (book on hand) ✓✓
[**no** gravitational forces considered here] [0, 2 or 4]

muur oop boek en boek op muur ✓✓
hand op boek en boek op hand ✓✓
(geen gravitasiekragte in ag geneem)

(4)

[11]

QUESTION 7 / VRAAG 7

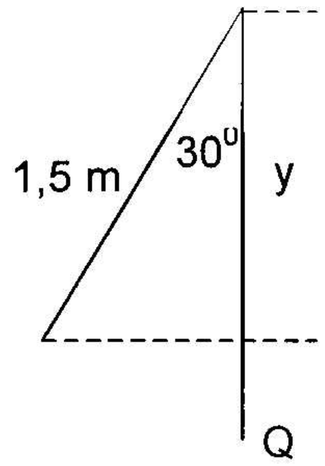
7.1

The sum of the gravitational potential energy (E_P) and the kinetic energy (E_K) of a body in the absence of air friction / moving freely in a vertical plain remains constant.

Die som van die gravitasie-potensiële energie (E_p) en die kinetiese energie (E_k) van 'n liggaam in die afwesigheid van wrywing in die vertikale vlak bly konstant.

(3)

7.2



$y = 1{,}5 \times \cos 30^0$

$= 1{,}3\,m$

$\therefore$ height above reference point, Q

$= 1{,}5 - 1{,}3 = 0{,}2\,m$

$\therefore E_p = mgh = (1)(10)(0{,}2) = 2\,J$

(7)

7.3

$(E_p + E_k)_{top} = (E_p + E_k)_{bottom}$

$2 + 0 = 0 + (\frac{1}{2} \times 1 \times v^2)$

$v = 2\ m.s^{-1}$

zero if equations of motion are used
nul as bewegingsvergelykings gebruik

(5)

7.4

$2\ m.s^{-1}$

(2)

7.5

In an isolated system (no external forces are acting) the total linear momentum remains constant (conserved) in magnitude and direction **OR**

The total momentum before a collision is equal to the total momentum after a collision if there are no external forces acting

Die totale liniêre momentum in 'n geisoleerde sisteem bly behoue in grootte en rigting ***OF***

Die totale momentum voor 'n botsing is gelyk aan die totale momentum na die botsing indien daar geen eksterne kragte daarop inwerk nie.

(3)

[20]

QUESTION 8 / *VRAAG 8*

8.1

One charged particle exerts an electrostatic force ✓ of attraction or repulsion ✓ on another charged particle. The force is directly proportional to the product of their charges and inversely proportional to the square of the distance between their centres. ✓✓

Een gelaaide deeltjie oefen 'n krag ✓ op 'n ander gelaaide deeltjie uit. Die krag is direk eweredig ✓aan die produk van hulle ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle. ✓✓

(4)

8.2

$$\frac{2\times10^{-3}}{1{,}25\times10^{-4}} = 16 \quad \checkmark\checkmark$$

new force is $\frac{1}{16}$ times the old force
nuwe krag is 1/16 keer die ou krag (2)

8.3

$$F_{new} = \frac{1}{16}F_{old} \quad \checkmark$$

$$\frac{kqq}{(x+10)^2} \quad \checkmark = \checkmark \frac{1}{16}\cdot\frac{kqq}{x^2} \quad \checkmark$$

$$16x^2 = x^2 + 20x + 100$$

(4)

8.4

$$F = \frac{kq^2}{r^2} \quad \checkmark$$

$$2\times10^{-3} \checkmark = \frac{(9\times10^9)q^2}{(3{,}3\times10^{-3})^2} \quad \checkmark$$

$$q^2 = 2{,,}42\times10^{-18} \checkmark$$

$$q = 1{,}56\times10^{-9}\ C \quad \checkmark$$

(5)

[15]

QUESTION 9 / *VRAAG 9*

9.1

emf is the rate ✓ of supply of energy ✓ per unit current ✓. **OR**

the rate ✓ of work done ✓ in moving 1 ampere of current ✓ **OR**

the work done / maximum energy ✓ required to move 1 coulomb of charge ✓ through the whole circuit ✓

emk is die tempo van energievoorsiening per eenheidstroom OF

die tempo van arbeid verrig om 1 ampere stroom te beweeg OF

die arbeid verrig / maksimum energie om 1 coulomb lading deur die hele stroombaan te beweeg

(3)

9.2

$P_L = I^2R$ ✓

18 ✓ $= (1,5)^2$ ✓ R_L

$R_L = 8\Omega$ ✓

(4)

9.3

$emf = I(R_{ext} + r_{int})$ ✓

24 ✓ $= 1,5[(8+6) + r]$ ✓✓

$r = 2\Omega$ ✓

$V_L = IR_L = (1,5)(8)\ 12V$

$V_{6\Omega} = (1,5)(6) = 9V$

$\therefore V_{ext\,cir} = 12+9 = 21V$ ✓

$emf = V_{ext} + V_{lost}$ ✓

$24 = 21 + 1,5r$

$r = \frac{3}{1,5} = 2\Omega$ ✓

(6)

9.4

$emf = IR_{ext} + Ir_{int})$

24 ✓ $= V_{ext} + (2)$ ✓ (2) ✓

$V_{ext\,cir} = 20V$ ✓

(4)

9.5

$emf = IR_{ext} + Ir_{int})$

$24 = (2)R_{ext} + (2)(2)$ ✓ ✓

$R_{ext\,cir} = 10\,\Omega$ ✓

$\therefore R_p = 10 - 8 = 2\Omega$ ✓ ✓

$\therefore \frac{1}{R_p} = \frac{1}{X} + \frac{1}{6}$

$\frac{1}{X} = \frac{1}{2} - \frac{1}{6} = \frac{1}{3}$ ✓ ✓

$\therefore X = 3\Omega$ ✓

$V_L = IR_L = (2)(8) = 16\,V$ ✓ ✓

$V_p = 20 - 16 = 4\,V$ ✓

$\therefore R_p = \frac{V_p}{I_{cir}} = \frac{4}{2} = 2\Omega$ ✓ ✓

$\therefore \frac{1}{R_p} = \frac{1}{X} + \frac{1}{6}$

$\frac{1}{X} = \frac{1}{2} - \frac{1}{6} = \frac{1}{3}$ ✓ ✓

$\therefore X = 3\Omega$ ✓

$V_L = IR_L = (2)(8) = 16\,V$ ✓ ✓

$\therefore V_p = 20 - 16 = 4\,V$ ✓

$V_{6\Omega} = I_{6\Omega} R_{6\Omega}$

$4 = I_{6\Omega}(6)$

$I_{6\Omega} = \frac{4}{6} = 0{,}67\,A$ ✓

$\therefore I_X = 2 - 0{,}67 = 1{,}33\,A$ ✓

$\therefore V_p = I_X R_X$ ✓ ✓

$4 = (1{,}33)R_X$

$R_X = 3\Omega$ ✓

(8)

9.6

$W = I^2Rt$ ✓

$= (2)^2(8)(120)$ ✓ ✓

$= 3840\,J$ ✓

$W = \frac{V^2t}{R}$ ✓

$= \frac{(16)^2(120)}{8}$ ✓ ✓

$= 3840\,J$ ✓

$W = VIt$ ✓

$= (16)(2)(120)$ ✓ ✓

$= 3840\,J$ ✓

(4)

[29]

Question 1 = 60
Question 2 – 9 = 140
Grand Total = 200