

Newton Memo
November 2018/1

- 1.1 A ✓✓ (2)
- 1.2 C ✓✓ (2)
- 1.3 C ✓✓ (2)
- 1.4 D ✓✓ (2)

QUESTION 2/VRAAG 2

2.1 Resultant (net) vector/Resultante (netto) vektor ✓ (1)

2.2.1 $F_y = F \sin \theta$
 $= 50 \sin 30^\circ$ ✓ **OR/OF** $50 \cos 60^\circ$
 $= 25 \text{ N}$ ✓ (2)

2.2.2 **POSITIVE MARKING FROM QUESTION 2.2.1**
POSITIEWE NASIEN VANAF VRAAG 2.2.1

$$F_x = 50 \cos 30^\circ$$

$$= 43,3 \text{ N}$$

$$R_x = 80 - 43,3$$

$$= 36,7 \text{ N}$$

$$F_{\text{net}}^2 = R_x^2 + F_y^2$$

$$= 36,7^2 + 25^2$$

$$= 44,41 \text{ N}$$

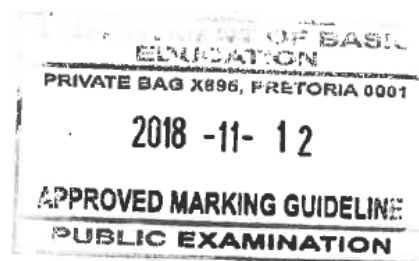
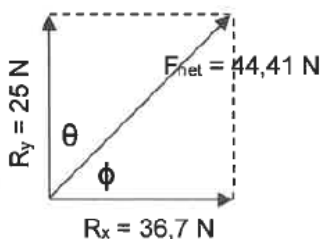
Substitution marks awarded within the question even if calculations for F_x and R_x are wrong
Substitusiepunte toegeken in die vraag selfs indien berekening vir F_x en R_x verkeerd bereken word.

(5)

2.2.3 **POSITIVE MARKING FROM QUESTION 2.2.1 AND 2.2.2**
POSITIEWE NASIEN VANAF VRAAG 2.2.1 EN 2.2.2
OPTION 1/OPSIE 1

$$\tan \theta = \frac{36,7}{25}$$

$$\theta = 55,74^\circ$$



OPTION 2/OPSIE 2

$$\cos \theta = \frac{25}{44,41}$$

$$\theta = 55,74^\circ$$

OPTION 3/OPSIE 3

$$\sin \theta = \frac{36,7}{44,41}$$

$$\theta = 55,74^\circ$$

OPTION 4/OPSIE 4

$$\cos \theta = \frac{25}{44,41}$$

$$\theta = 55,74^\circ$$

Accept direction as /Aanvaar rigting as
 $\phi = 90^\circ - \theta$
 $= 34,26^\circ$ ✓✓

(2)
[10]

QUESTION 3/VRAAG 3

3.1 The force that opposes the motion of a moving object relative to a surface. ✓✓
Die krag wat die beweging van 'n bewegende voorwerp relatief tot 'n oppervlak teenwerk.
[2 or/of 0] (2)

3.2 A body will remain in its state of rest or motion at constant velocity ✓ unless a non-zero resultant/net force acts on it. ✓
'n Liggaam sal in sy toestand van rus of beweging teen konstante snelheid bly/volhard tensy 'n nie-nul resulterende/netto krag daarop inwerk.
[Penalise -1 if key words/phrase is omitted/
Penaliseer -1 indien sleutelwoorde/frase is uitgelaat] (2)

3.3 $F_x = 90\cos 50^\circ \checkmark$ **OR/OF** $90\sin 40^\circ$
 $= 57,85 \text{ N} \checkmark$ (2)

3.4 $N = F_g - F_y \checkmark$
 $N = 45(9,8) \checkmark - 90\sin 50^\circ \checkmark$
 $N = 372,06 \text{ N} \checkmark$ (4)

NOTE/NOTA:
Weight and the vertical component can be calculated separately, award one mark each even if the formula for N is incorrect
Gewig en vertikale komponent kan apart bereken word, een punt elk selfs indien die formule vir N verkeerd is.

3.5 **POSITIVE MARKING FROM QUESTION 3.3 and 3.4**
POSITIEWE NASIEN VANAF VRAAG 3.3 en 3.4

$f_k = \mu_k N \checkmark$
 $57,85 \checkmark = \mu_k(372,06) \checkmark$
 $\mu_k = 0,16 \checkmark$ (4)

3.6 No ✓ The coefficient is dependent on the (nature of) the surfaces / type of material in contact. ✓
Nee. Die koëffisiënt is afhanklik van die (tipe) oppervlakke / soort materiaal in kontak. (2)

QUESTION 4/VRAAG 4

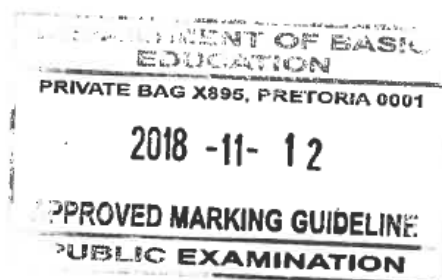
- 4.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force. The acceleration is directly proportional to the net force and inversely proportional to the mass of the object. ✓
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Die versnelling is direk eweredig aan die netto krag en omgekeerd eweredig aan die massa van die voorwerp.
[Penalise -1 if key words/phrase is omitted/
Penaliseer -1 indien sleutelwoorde/frase is uitgelaat] (2)

- 4.2 Accept any set of coordinates from the graph, e.g.:
Aanvaar enige kombinasie van koördinate vanaf die grafiek, bv.:

$$\text{Gradient/Helling} = \frac{2,5 - 0}{1,25 - 0} \checkmark = 2 \checkmark$$

OR/OF

$$\text{Gradient/Helling} = \frac{2,1 - 1,7}{1,05 - 0,85} \checkmark = 2 \checkmark$$



- 4.3 **OPTION 1/OPSIE 1**

$$\text{Gradient/Helling} = \frac{1}{ma} = \frac{1}{F_{\text{net}}} = 2 \checkmark$$

$$F_{\text{net}} = \frac{1}{2} = 0,5 \text{ N} \checkmark \quad \text{Accept/Aanvaar } F_{\text{net}} = 0,5 \text{ N} \checkmark \checkmark$$

OPTION 2/OPSIE 2

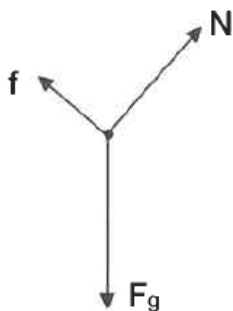
$$\begin{aligned} F_{\text{net}} &= ma \\ &= (1)(1/2) \checkmark \\ &= 0,5 \text{ N} \checkmark \end{aligned}$$

Accept any coordinates from graph
Aanvaar enige koördinate vanaf grafiek

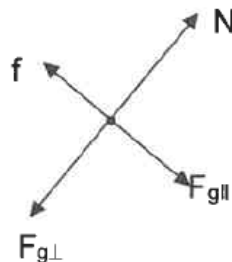
- 4.4 Acceleration is inversely proportional to the mass of an object (if the net force is kept constant) ✓✓
Accept: The inverse of acceleration is directly proportional to the mass of the object (if the net force is kept constant)
OR $\frac{1}{a} \propto m$
Versnelling is omgekeerd eweredig aan die massa van die voorwerp (indien die netto krag konstant bly)
Aanvaar: Die omgekeerde van die versnelling is direk eweredig aan die massa van die voorwerp (indien die netto krag konstant bly)
OF $\frac{1}{a} \propto m$ (2)

QUESTION 5/VRAAG 5

5.1



OR/OF



(3)

Accepted Labels/Aanvaarbare Byskrifte		Mark/Punt
w	weight/ F_G/F_g OR Both components for one mark <i>gewig/gravitasiekragswaartekrag</i> OF <i>Beide komponente vir een punt</i>	✓
N	Normal force/ F_N <i>Normaalkrag/F_N</i>	✓
f	Friction/ F_f <i>Wrywingskrags/F_f</i>	✓
	Any additional force: deduct 1 mark (maximum $\frac{2}{3}$) <i>Enige addisionele krag: trek 1 punt af (maksimum $\frac{2}{3}$)</i>	
	Omission of arrow heads: deduct 1 mark (maximum $\frac{2}{3}$) <i>Pylpunte uitgelaat: trek 1 punt af (maksimum $\frac{2}{3}$)</i>	
	Lines must touch object otherwise (maximum $\frac{2}{3}$) <i>Lyne moet voorwerp raak anders (maksimum $\frac{2}{3}$)</i>	
	Do not penalise if vectors are not to scale <i>Moenie penaliseer indien vektore nie op skaal is nie</i>	

5.2 $F_{net} = ma$
 $mg \sin \theta = ma$ } ✓ Any one/Enige een
 $25(9,8) \sin 15^\circ \checkmark = 25a \checkmark$
 $a = 2,54 \text{ m} \cdot \text{s}^{-2} \checkmark$
OR/OF
 $25(9,8) \cos 75^\circ \checkmark = 25a \checkmark$
 $a = 2,54 \text{ m} \cdot \text{s}^{-2} \checkmark$

NOTE/NOTA:
Award one mark for the parallel component if calculated separately
Ken een punt toe indien die parallel komponent apart bereken is

(4)

5.3 Up the slope/Teen die helling op ✓

(1)

5.4 $F_{net} = ma$
 $F_{gH} + (-f) = ma$ } ✓ Any one/Enige een
 $25(9,8) \sin 15^\circ - f \checkmark = 25(-1,2) \checkmark$
 $f = 93,41 \text{ N} \checkmark$
OR/OF
 $25(9,8) \cos 75^\circ - f \checkmark = 25(-1,2) \checkmark$
 $f = 93,41 \text{ N} \checkmark$

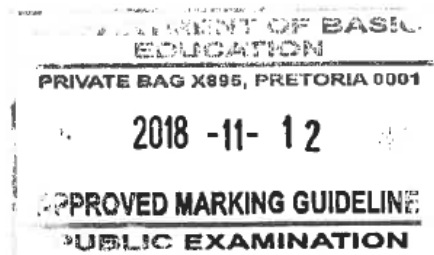
Note/Let wel:

Accept if calculation is done with direction up the slope as positive

Aanvaar indien berekening gedoen is met rigting teen die helling op as positief

(4)

[12]



QUESTION 6/VRAAG 6

- 6.1 Each particle in the universe attracts every other particle with a gravitational force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓

Elke deeltjie in die heelal trek elke ander deeltjie aan met 'n krag wat direk eweredig is aan die produk van hulle massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hulle middelpunte.

[Penalise -1 if key words/phrase is omitted/

Penaliseer -1 indien sleutelwoorde/frase is uitgelaaf]

(2)

6.2

$$F = \frac{Gm_1m_2}{r^2} \quad \checkmark$$

$$3\,338 \checkmark = \frac{(6,67 \times 10^{-11})(6,39 \times 10^{23})(m)}{(3\,390 \times 10^3)^2} \quad \checkmark$$

$$m = 900 \text{ kg} \quad \checkmark$$

OR/OF

$$g = \frac{Gm}{r^2} \quad \checkmark$$

$$g = \frac{(6,67 \times 10^{-11})(6,39 \times 10^{23})}{(3\,390 \times 10^3)^2} \quad \checkmark$$

$$g = 3,71 \text{ m}\cdot\text{s}^{-2}$$

$$F_g = mg$$

$$3\,338 = m(3,71) \quad \checkmark$$

$$m = 900 \text{ kg} \quad \checkmark \quad (899,73 \text{ kg})$$

(4)

- 6.3 **POSITIVE MARKING FROM QUESTION 6.2**
POSITIEWE NASIEN VANAF VRAAG 6.2

$$w = mg$$

$$= 900(9,8) \quad \checkmark$$

$$= 8\,820 \text{ N} \quad \checkmark$$

(2)

[8]

Newton Memo
November 2017/1

1.1	D ✓✓	(2)
1.2	A ✓✓	(2)
1.3	D ✓✓	(2)
1.4	C ✓✓	(2)

QUESTION/VRAAG 2

- 2.1 The vector sum of two or more vectors. ✓✓
 Die vektorsom van twee of meer vektore. ✓✓

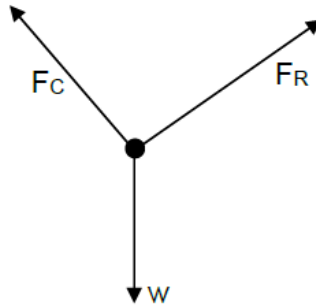
OR/OF

The single vector which has the same effect as two or more vectors (acting) together.

Die enkele vektor met dieselfde effek as twee of meer vektore saam. (2)

- 2.2 0 N ✓ (Accept 0/Zero Aanvaar 0/Nul) (1)

- 2.3 (3)



Notes: Accepted Labels/Aanvaarbare Byskrifte		Mark/Punt
W	weight/ F_G/F_g gewig/gravitasiekrags/swaartekrag	✓
F_C	Tension force in cable/ T_C Spanningskrags in kabel/ T_C	✓
F_R	Tension force in rope/ T_R Spanningskrags in tou/ T_R	✓
	Any additional force: deduct 1 mark (maximum $\frac{2}{3}$) Enige addisionele krag: trek 1 punt af (maksimum $\frac{2}{3}$)	
	Lines must touch object otherwise (maximum $\frac{2}{3}$) Lyne moet voorwerp raak anders (maksimum $\frac{2}{3}$)	
	Subtract one mark if arrows are not shown Trek een punt af indien pylpunte nie gewys word nie	

- 2.4 200 N ✓ (to the left/links) (1)

**2.5 POSITIVE MARKING FROM QUESTION 2.4
 POSITIEWE NASIEN VANAF VRAAG 2.4**

$$F_{RY} = \frac{200}{\tan 35^\circ} \checkmark = 285,63 \text{ N}$$

$$F_g = mg = 56(9,8) \checkmark = 548,8 \text{ N}$$

$$\left. \begin{aligned} F_{RY} + F_{CY} &= F_g \\ 285,63 + F_{CY} &= 548,8 \end{aligned} \right\} \checkmark \text{ any one/enige een}$$

$$F_{CY} = 263,17 \text{ N} \checkmark \text{ (upwards/opwaarts)}$$

Mark allocation: Punttoekenning

- Calculating/Bereken F_{RY} ✓
- Calculating weight/Bereken gewig ✓
- Vector sum/vektorsom ✓
- Answer/Antwoord ✓

(4)

Newton Memo

November 2017/2

2.6 **POSITIVE MARKING FROM QUESTION 2.4 and 2.5**
POSITIEWE NASIEN VANAF VRAAG 2.4 en 2.5

$$\tan \theta = \frac{263,17}{200} \checkmark$$

$$\theta = 52,77^\circ \checkmark$$

(2)
[13]

QUESTION/VRAAG 3

3.1	Criteria for hypothesis/ <i>Riglyne vir hipotese</i>	
	State the relationship between the correct dependent and independent variables. <i>Stel die verwantskap tussen die korrekte afhanklike en onafhanklike veranderlike.</i>	✓
	The controlled variable is stated as part of the hypothesis <i>Die gekontroleerde veranderlike word genoem as deel van die hipotese</i>	✓
	Dependent variable/ <i>afhanklike veranderlike</i> : acceleration/ <i>versnelling</i> Independent variable/ <i>onafhanklike veranderlike</i> : (net) force/ <i>(netto) krag</i>	

Example/*Voorbeeld*:

The acceleration is directly proportional to (net) force ✓ if the mass of the trolley is kept constant ✓

Die versnelling is direk eweredig aan die (netto) krag ✓ indien die massa van die trollie konstant bly ✓

(2)

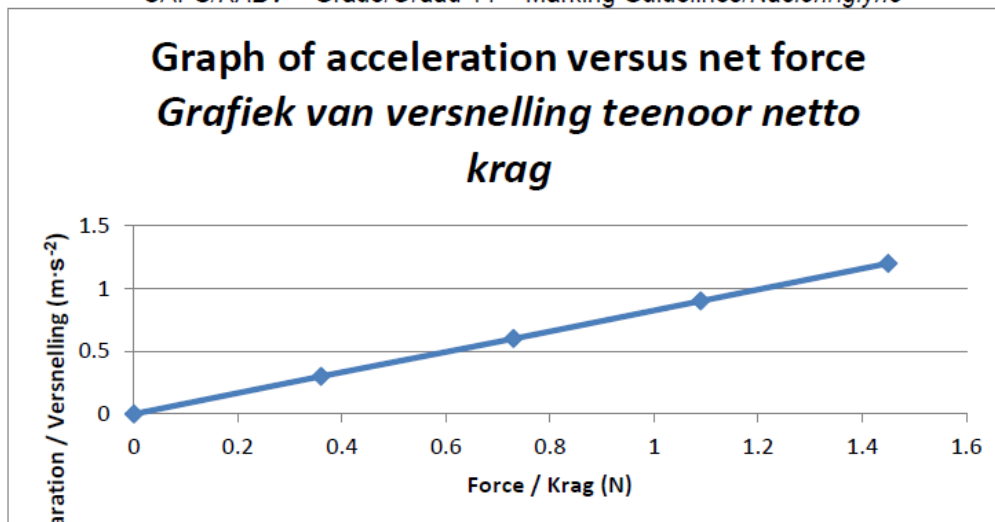
3.2.1 (Net) Force ✓
(Netto) Krag ✓

(1)

3.2.2 Mass of trolley ✓
Massa van die trollie ✓

(1)

3.3



Refer to back of memo for graph drawn to scale

Verwys na die laaste bladsy van memorandum vir skaalgrafiek

Marking criteria for graph Nasienkriteria vir grafiek	
Axes with correct/appropriate scale Asse met korrekte/toepaslike skaal	✓
3 or more coordinates correctly plotted 3 of meer koördinate korrek gestip If 2 coordinates correctly plotted - one mark Indien 2 koördinate korrek gestip – een punt	✓✓
Drawing a line of best fit through the origin Teken 'n lyn van beste passing deur die oorsprong	✓

(4)

3.4

Accept any set of coordinates from the graph, for example:

Aanvaar enige kombinasie van koördinate vanaf die grafiek, byvoorbeeld:

$$\text{gradient} = \frac{1,45 - 0,36}{1,2 - 0,3} \checkmark = 1,21 \checkmark$$

OR/OF

$$\text{gradient} = \frac{1,09 - 0}{0,9 - 0} \checkmark = 1,21 \checkmark$$

OR/OF

$$\text{gradient} = \frac{0,73 - 0}{0,6 - 0} \checkmark = 1,22 \checkmark$$

OR/OF

$$\text{gradient} = \frac{0,36 - 0}{0,3 - 0} \checkmark = 1,2 \checkmark$$

If the origin is used and zeros are not shown, max ²/₃

Indien die oorsprong gebruik word en nulwaardes word nie getoon, maks ²/₃ (3)

3.5

POSITIVE MARKING FROM QUESTION 3.4

POSITIEWE NASIEN VANAF VRAAG 3.4

$$\text{Gradient} = \frac{a}{F} = \frac{1}{m}$$

$$m = \frac{1}{1,21} \checkmark = 0,83 \text{ kg } \checkmark$$

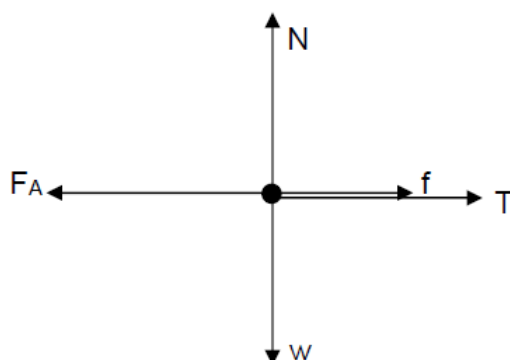
(2)
[13]

QUESTION/VRAAG 4

4.1 Frictional force is the force that opposes the motion of an object and which acts parallel to the surface. ✓✓
Wrywingskrag is die krag wat die beweging van 'n voorwerp teenstaan en ewewydig aan die oppervlak inwerk. ✓✓ (2)

4.2 (−) Newton's Third law: ✓
 (−) When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A. ✓✓
Newton se Derde wet: ✓
 (−) Wanneer voorwerp A 'n krag op voorwerp B uitoefen sal voorwerp B gelyktydig 'n krag van gelyke grootte in die teenoorgestelde rigting op voorwerp A uitoefen. ✓✓ (3)

4.3



(5)

Notes: Accepted Labels/Aanvaarbare Byskrifte		Mark/Punt
w	weight/gravitational force/ $F_G/F_g/12\ 740\ \text{N}$ <i>gewig/gravitasiekrag/swaartekrag/$F_G/F_g/12\ 740\ \text{N}$</i>	✓
T	Tension force / F_T <i>Spanningskrag/F_T</i>	✓
f	friction/ F_f <i>Wrywing/F_f</i>	✓
N	Normal/ $F_N/12\ 740\ \text{N}$ <i>Normaal/$F_N/12\ 740\ \text{N}$</i>	✓
F_A	Applied force/ $F_{\text{applied}}/F_{\text{engine}}/F$ <i>Toegepaste krag/$F_{\text{toegepas}}/F_{\text{engin}}/F$</i>	✓
	Any additional force: deduct 1 mark (maximum $4/5$) <i>Enige addisionele krag: trek 1 punt af (maksimum $4/5$)</i>	
	Lines must touch object otherwise (maximum $4/5$) <i>Lyne moet voorwerp raak anders (maksimum $4/5$)</i>	
	Subtract one mark if arrows are not shown <i>Trek een punt af indien pylpunte nie gewys word nie</i>	

4.4 4.4.1 $F_{\text{net}} = ma$ } ✓
 $F_{\text{engine}} - f - T = 0$
 $9\ 000 - 0,45(F_g) - T = 0$
 $9\ 000 \checkmark - 0,45(1\ 300)(9,8) \checkmark - T = 0 \checkmark$
 $T = 3\ 267\ \text{N} \checkmark$ (5)

4.4.2 **POSITIVE MARKING FROM QUESTION 4.4.1**
POSITIEWE NASIEN VANAF VRAAG 4.4.1

$$\left. \begin{array}{l} F_{\text{net}} = ma \\ F_{\text{net}} = 0 \\ T - f_k = 0 \end{array} \right\} \checkmark \text{ Any one / enige een}$$

$$\begin{array}{l} 3\,267 - f_k = 0 \checkmark \\ f_k = 3\,267 \text{ N (backwards/terugwaarts)} \\ f_k = \mu_k N \checkmark \\ f_k = \mu_k mg \\ 3\,267 = \mu_k(950)(9,8) \checkmark \\ \mu_k = 0,35 \checkmark \end{array}$$

<p>OR</p> $\begin{array}{l} f_k = \mu_k N \checkmark \\ f_k = \mu_k mg \\ 3\,267 \checkmark = \mu_k(950)(9,8) \checkmark \\ \mu_k = 0,35 \checkmark \end{array}$

(5)

4.5 Newton's second law \checkmark the object experiences a net force slowing it down to stop $\checkmark\checkmark$

OR

Newton's first law, \checkmark an object will continue moving at a constant velocity unless a non-zero net force acts on it. $\checkmark\checkmark$

Newton se tweede wet \checkmark die voorwerp ervaar 'n netto krag wat dit laat stadiger beweeg totdat dit stop. $\checkmark\checkmark$

OF

Newton se eerste wet, \checkmark sal 'n voorwerp aanhou beweeg teen 'n konstante snelheid tensy 'n nie-nul netto krag daarop inwerk. $\checkmark\checkmark$

(3)

4.6 **POSITIVE MARKING FROM QUESTION 4.4.1**
POSITIEWE NASIEN VANAF VRAAG 4.4.1

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

$$-3\,267 = 950a \checkmark$$

$$a = -3,44 \text{ m}\cdot\text{s}^{-2}$$

$$= 3,44 \text{ m}\cdot\text{s}^{-2} \checkmark \text{ backwards/to the right / terugwaarts/regs } \checkmark$$

(3)

[26]

QUESTION/VRAAG 5

5.1 Weight is the gravitational force exerted on an object by the earth. \checkmark

Gewig is die gravitasiekrag wat die Aarde op 'n voorwerp uitoefen. \checkmark

Mass is the amount of matter in a body. \checkmark

Massa is die hoeveelheid materie in 'n liggaam. \checkmark

(2)

5.2
$$g = \frac{GM}{r^2} \checkmark$$

$$2,7 = \frac{6,67 \times 10^{-11} M}{\left(\frac{1}{3} \times 6,38 \times 10^6\right)^2} \checkmark$$

$$M = 1,83 \times 10^{23} \text{ kg } \checkmark$$

(4)

5.3
$$\frac{9,8}{2,7} = 3,63 \text{ times smaller } \checkmark\checkmark \text{ on planet X than on Earth}$$

3,63 keer kleiner op planeet X as op die Aarde

(2)

[8]

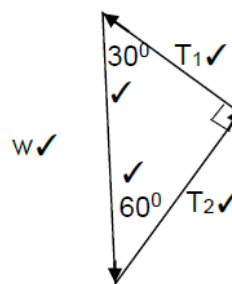
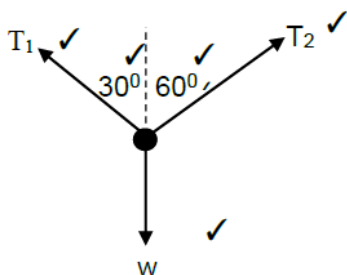
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- 1.1 A ✓✓ (2)
 1.2 C ✓✓ (2)
 1.4 C ✓✓ (2)
 1.5 B ✓✓ (2)
 1.7 A ✓✓ (2)

QUESTION/VRAAG 2

2.1 $W = mg \checkmark = 122,5 \times 9,8 \checkmark = 1\,200,50 \text{ N} \checkmark$ (3)

2.2.1



(5)

2.2.2 **Option/Opsie 1:**

$$\cos 30^\circ = \frac{T_{1y}}{T_1} \checkmark$$

(resolve vectors/los vektore op)

$$T_{1y} = T_1 \cdot \cos 30^\circ$$

$$\cos 60^\circ = \frac{T_{2y}}{T_2}$$

$$T_{2y} = T_2 \cdot \cos 60^\circ$$

$$T_{1y} + T_{2y} = w \checkmark$$

$$T_1 \cos 30^\circ + T_2 \cos 60^\circ = 1200,50 \checkmark \quad (1)$$

$$T_1 \sin 30^\circ = T_2 \sin 60^\circ \checkmark \quad (2)$$

$$\text{From (2):} \quad T_2 = \frac{T_1 \sin 30^\circ}{\sin 60^\circ}$$

$$T_1 \cos 30^\circ + \frac{T_1 \sin 30^\circ}{\sin 60^\circ} \cdot \cos 60^\circ \checkmark = 1200,50$$

$$T_1 = 1\,039,66 \text{ N} \checkmark$$

$$T_2 = \frac{1039,66 \sin 30^\circ}{\sin 60^\circ}$$

$$T_2 = 600,25 \text{ N} \checkmark$$

Option/Opsie 2

$$\frac{T_1}{\sin 60^\circ} = \frac{w}{\sin 90^\circ} \checkmark$$

(sine rule/sin reël)

$$\frac{T_1}{\sin 60^\circ} = \frac{1200,50}{\sin 90^\circ} \checkmark$$

$$T_1 = \frac{1200,50 \sin 60^\circ}{\sin 90^\circ} \checkmark$$

$$T_1 = 1039,66 \text{ N} \checkmark$$

$$\frac{T_2}{\sin 30^\circ} \checkmark = \frac{1200,50}{\sin 90^\circ}$$

$$T_2 = \frac{1200,50 \sin 30^\circ}{\sin 90^\circ} \checkmark$$

$$T_2 = 600,25 \text{ N} \checkmark$$

(7)

2.3.1 $F_{\text{net}} = 0$ /Balanced/at equilibrium/opposite forces are equal. ✓✓

$F_{\text{net}} = 0$ /Balanseer/by ewewig/teenoorgestelde kragte is gelyk.

(2)

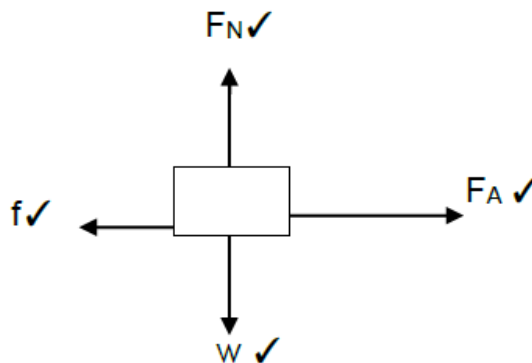
2.3.2 Newton's first law of motion/Newton se eerste bewegingswet ✓✓

(2)

[19]

QUESTION/VRAAG 3

3.1



(4)

- 3.2 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration that is directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓
Wanneer 'n resulterende/netto krag op 'n voorwerp inwerk, versnel die voorwerp in die rigting van die krag teen 'n versnelling direk eweredig aan die krag en omgekeerde eweredig aan die massa van die voorwerp.

OF/OR

The resultant/net force on an object is equal to the rate of change in momentum. ✓ ✓
Die resulterende/netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van die verandering van momentum.

(2)

3.3.1 **UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

$$\begin{aligned} F_{\text{net}} &= 0 \quad \checkmark \\ F_N + (-W) &= 0 \quad \checkmark \\ F_N + (-mg) &= 0 \\ F_N + (5)(-9,8) &\checkmark = 0 \\ F_N &= 49 \text{ N} \quad \checkmark \text{ upwards/opwaarts} \end{aligned}$$

(4)

3.3.2 $f_k = \mu_k \cdot F_N \quad \checkmark$
 $= (0,4)(49) \quad \checkmark$
 $= 19,6 \text{ N} \quad \checkmark$

(3)

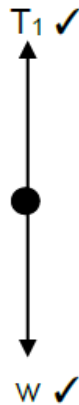
3.4 $F_{\text{net}} = F_A + f_k \quad \checkmark$
 $= 25 + (-19,6) \quad \checkmark$
 $= 5,40 \text{ N}$
 $a = \frac{F_{\text{net}}}{m} = \frac{5,40}{5} \quad \checkmark$
 $= 1,08 \text{ m}\cdot\text{s}^{-2} \quad \checkmark$

(4)

[17]

QUESTION/VRAAG 4

4.1.1



(2)

4.1.2 **UPWARDS AS POSITIVE/OPWAARTS AS POSITIEF**

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

$$T_1 + (-W) \checkmark = 0$$

$$T_1 + (-mg) = 0$$

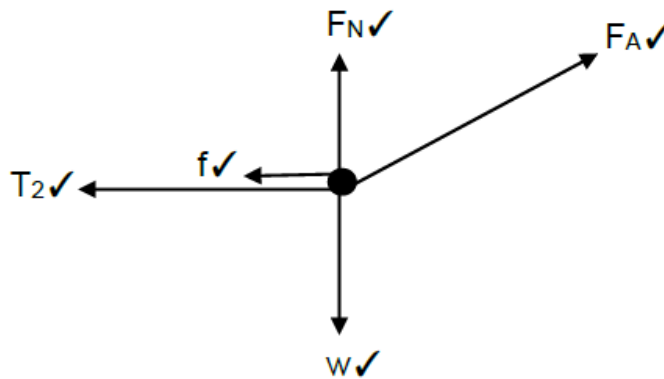
$$T_1 + (3)(-9,8) \checkmark = 0$$

$$T_1 = 29,40 \text{ N}$$

$$T_1 = 29,40 \text{ N} \checkmark \text{ upwards/opwaarts}$$

(4)

4.2



(5)

4.3 $T_2 = 29,40 \text{ N} \checkmark$

(1)

4.4 **Right is positive/Regs as positief**

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

$$f + (-T_2) + (F_A \cos 30^\circ) \checkmark = 0$$

$$f - 29,40 \checkmark + 36 \cos 30^\circ = 0 \checkmark$$

$$f = -1,78 \text{ N}$$

$$= 1,78 \text{ N left/links} \checkmark$$

(5)

[17]

QUESTION/VRAAG 5

5.1 Every body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓
Elke liggaam in die heelal trek elke ander liggaam aan met 'n krag wat direk eweredig aan die produk van hul massas en omgekeerde eweredig is aan die kwadraat van die afstand tussen hul middelpunte. (2)

5.2 Equal to/Gelyk aan ✓ (1)

5.3 When body A exerts a force on a body B, body B exerts a force of equal magnitude ✓ in the opposite direction ✓ on body A.
Wanneer liggaam A 'n krag uitoefen op liggaam B, oefen liggaam B 'n krag van gelyke grootte in die teenoorgestelde rigting op liggaam A uit.

OR/OF

If body A exerts a force on object B, then body B exerts an equal ✓ and opposite force ✓ on body A.
Indien liggaam A 'n krag uitoefen op liggaam B, dan sal liggaam B 'n gelyke maar teenoorgestelde krag op liggaam A uitoefen.

Accept/Aanvaar:

For every action, there is an equal ✓ and opposite reaction. ✓
Vir elke aksie is daar 'n gelyke en teenoorgestelde reaksie.

OR/OF

Action and reaction are equal ✓ and opposite. ✓
Aksie en reaksie is gelyk maar teenoorgesteld. (2)

5.4 Increase. ✓ F_{net} is inversely proportional to the square of the distance between their centres. ✓ Acceleration is directly proportional to F_{net} . ✓
Toeneem. F_{net} is omgekeerd eweredig aan die kwadraat van die afstand tussen hul middelpunte. Versnelling is direk eweredig aan F_{net} . (3)

5.5
$$F = \frac{GM_E M_C}{r^2} \checkmark$$
$$F = \frac{(6,67 \times 10^{-11})(6 \times 10^{24}) \checkmark (1 \times 10^{15}) \checkmark}{(1,3 \times 10^{11})^2 \checkmark}$$
$$= 2,37 \times 10^7 \text{ N } \checkmark \text{ attraction/aantrekkend} \quad (5)$$

[13]

Newton Memo
November 2015/1

1.1 A ✓✓

1.2 A ✓✓

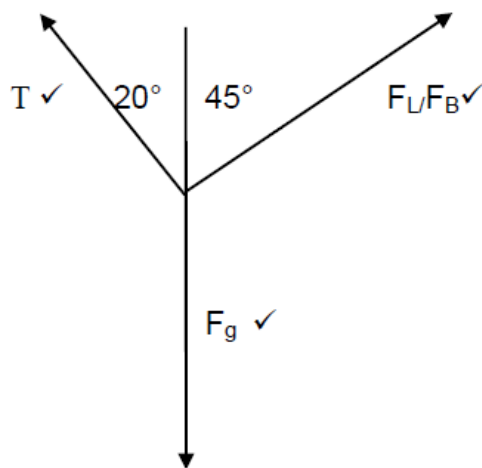
1.3 A ✓✓

1.4 D ✓✓

QUESTION/VRAAG 2

2.1 The resultant of the forces is zero. ✓
Die resultant van die kragte is nul. ✓ (1)

2.2



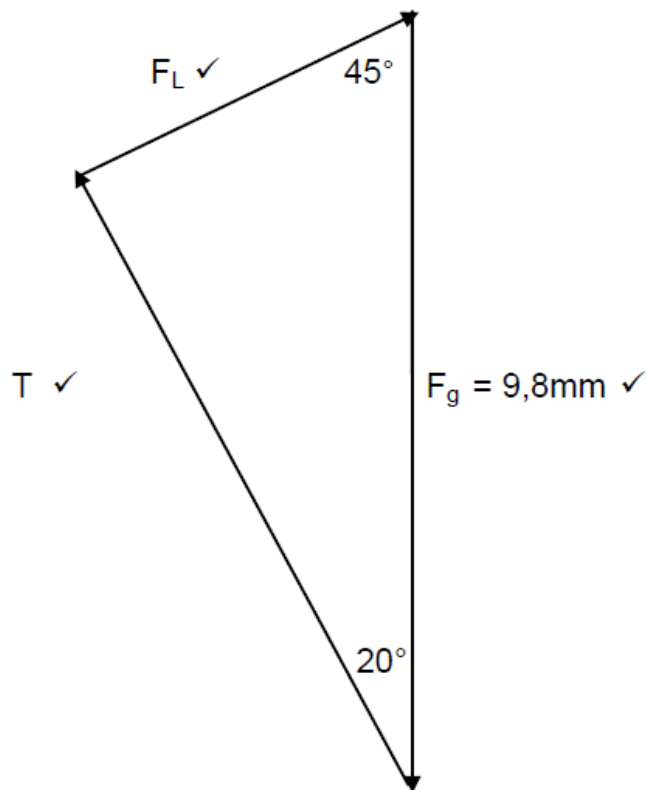
ACCEPTED LABELS/AANVAARDE BYSKRIFTE	
F_g	$F_w/W/Weight/mg/gravitational\ force/force\ due\ to\ gravity$ $F_w/W/gewig/mg/gravitasiekrag$
T	$F_T/Tension/Tension\ in\ rope$ $F_T/Spinning/Spinning\ in\ tou$
F_L F_B	$F_{legs}/Force\ of\ legs\ on\ wall$ $F_{bene}/Krag\ van\ bene\ op\ muur$

(3)

Newton Memo

November 2015/2

2.3 $F_g = mg = (50)(9,8) = 490 \text{ N} \checkmark$
SCALE/SKAAL 10 mm = 50 N
 $F_g = 490 \text{ N} = 98 \text{ mm}$ (Accept/Aanvaar 97 – 99mm)



$T = 76,5 \times 5 = 382,5 \text{ N} \checkmark$ (Accept/Aanvaar 76,4 – 76,6 mm)
 $F_L = 37,0 \times 5 = 185 \text{ N} \checkmark$ (Accept/Aanvaar 184,5 – 186,5 mm) (8)

NOTES/AANTEKENINGE

- Mark awarded for correct label and direction./
- Punt toegeken vir korrekte benoeming en pyltjie.
- ANY TWO angles indicated./✓✓
- ENIGE TWEE hoeke aangedui. ✓✓

OR/OF

CALCULATIONS instead of CONSTRUCTION/
BEREKENINGE in plaas van KONSTRUKSIES

max/maks $\frac{5}{8}$

$$\frac{F_g}{\sin 115^\circ} = \frac{F_T}{\sin 45^\circ} \Rightarrow F_T = \frac{490 \checkmark \sin 45^\circ \checkmark}{\sin 115^\circ} = 382,50 \text{ N} \checkmark$$

$$\frac{F_r}{\sin 20^\circ} = \frac{F_g}{\sin 115^\circ} \Rightarrow F_R = \frac{490 \sin 20^\circ \checkmark}{\sin 115^\circ} = 184,91 \text{ N} \checkmark$$

[12]

Newton Memo

November 2015/3

QUESTION/VRAAG 3

3.1 $f_s = F_{g\parallel} = mg \sin \theta = (60)(9,8) \sin 30^\circ \checkmark = 294 \text{ N} \checkmark$
Any one/Enige een \checkmark (3)

3.2 $\mu_s = \tan \theta \checkmark = \tan 30^\circ \checkmark = 0,58 \checkmark$
OR/OF
 $f_s = \mu_s F_N = \mu_s F_{g\perp} = \mu_s mg \cos \theta \checkmark$
 $294 = \mu_s (60)(9,8) \cos 30^\circ \checkmark$
 $\mu_s = 0,58 \checkmark$ (3)

3.3 3.3.1 REMAINS THE SAME/BLY DIESELFDE \checkmark (1)

3.3.2 DECREASES/NEEM AF \checkmark
 \ominus
 $F_{g\perp}$ will decrease, \checkmark therefore F_N will decrease/ $f_k \propto F_N \checkmark$
 $F_{g\perp}$ sal afneem, \checkmark dus sal F_N afneem \checkmark / $f_k \propto F_N \checkmark$ (3)

[10]

QUESTION/VRAAG 4

4.1 When a resultant/net force acts on an object, the object accelerates in the direction of the force. This acceleration is directly proportional to the force \checkmark and inversely proportional to the mass of the object. \checkmark

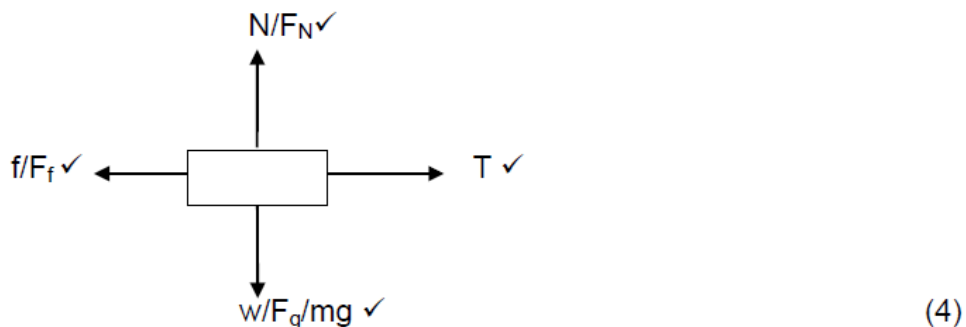
Indien 'n resulterende/netto krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die (resulterende/netto) krag \checkmark en omgekeerd eweredig aan die massa van die voorwerp. \checkmark

OR/OF

The net force acting on an object is equal to the rate of change of momentum $\checkmark\checkmark$ of the object (in the direction of the force). (2 or 0)

Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering in momentum $\checkmark\checkmark$ van die voorwerp (in die rigting van die krag). (2 of 0) (2)

4.2



NOTES/AANTEKENINGE

- Mark awarded for label and arrow./Punt toegeken vir benoeming en pyltjie.
- Any other additional force(s)/Enige ander addisionele krag(te). Max/Maks $\frac{3}{4}$
- If force(s) do not make contact with body/Indien krag(te) nie met die voorwerp kontak maak nie. Max/Maks $\frac{3}{4}$

Newton

November 2015/4

Newton Memo

4.3 4.3.1 **OPTION/OPSIE 1**

For the 6kg block./Vir 6kg blokkie:

$$\begin{aligned} F_{\text{net}} &= ma \checkmark \\ T + (-f_f) &= ma \\ T - 11,76 \checkmark &= 6a \quad \dots\dots\dots(1) \end{aligned}$$

For the 2kg block./Vir 2kg blokkie:

✓ For either/vir of/6a or/of 2a

$$\begin{aligned} F_{\text{net}} &= ma \\ 2 + w + (-T) &= ma \\ \underline{2 + (2 \times 9,8) - T} \checkmark &= 2a \\ T &= 21,6 - 2a \quad \dots\dots\dots(2) \end{aligned}$$

Substitute (2) into (1)/Stel (2) in (1):

$$\begin{aligned} 21,6 - 2a - 11,76 &= 6a \\ a &= 1,23 \text{ m.s}^{-2} \checkmark \end{aligned}$$

OPTION/OPSIE 2:

$$\begin{aligned} F_{\text{net}} &= ma \checkmark \\ 2 + w + (-F_f) \checkmark &= ma \\ 2 + (2 \times 9,8) - F_f \checkmark &= 8a \checkmark \\ 2 + (2 \times 9,8) - 11,76 &= 8a \\ a &= 1,23 \text{ m.s}^{-2} \checkmark \end{aligned} \quad (5)$$

4.3.2 **POSITIVE MARKING** from QUESTION 4.3.1
POSITIEWE NASIEN van VRAAG 4.3.1

$$\begin{aligned} T &= 21,6 - 2a \\ &= 21,6 - 2(1,23) \checkmark \\ &= 19,14 \text{ N} \checkmark \end{aligned}$$

OR/OF

$$\begin{aligned} T - 11,76 &= 6a \\ T &= 11,76 + 6(1,23) \checkmark \\ &= 19,14 \text{ N} \checkmark \end{aligned} \quad (2)$$

4.4 INCREASES/TOENEEM ✓ (1)

[14]

QUESTION/VRAAG 5

5.1 BACKWARDS/AGTERTOE ✓ (1)

5.2 An object continues in a state of rest or uniform velocity, unless it is acted upon by an external unbalanced force (resultant force). ✓

'n Voorwerp sal in 'n toestand van rus bly of teen 'n konstante snelheid bly voortbeweeg, tensy 'n eksterne ongebalanseerde (resulterende krag) daarop inwerk. ✓

OR/OF

The tendency of an object to maintain its state of rest or constant motion in a straight line. ✓

Die weerstand van 'n voorwerp wat enige verandering in sy toestand rus of beweging teenstaan. ✓ (2)

November 2015/5

Newton Memo

5.3 5.3.1 EQUALS/GELYK ✓ (1)

5.3.2 Kay will have a greater acceleration, ✓ because her mass is smaller. ✓
Kay sal 'n groter versnelling het, ✓ want haar massa is kleiner. ✓ (2)
[6]

QUESTION/VRAAG 6

6.1 Action: Force of seat on astronaut (upwards) ✓
Reaction: Force of astronaut on seat (downwards) ✓
Aksie: Krag van sitplek op ruimtevaarder (opwaarts) ✓
Reaksie: Krag van ruimtevaarder op sitplek (afwaarts) ✓ (2)

6.2 $F_{RES} = \frac{m \Delta v}{\Delta t} \checkmark = \frac{(2,6 \times 10^6)(160 - 0)}{400} \checkmark = 1,04 \times 10^6 \text{ N} \checkmark$ upwards/opwaarts ✓

Mark direction independently/Merk rigting onafhanklik (5)

QUESTION/VRAAG 7

7.1 $F = \frac{G m_1 m_2}{r^2} \checkmark$
 $= \frac{(6,67 \times 10^{-11})(7,35 \times 10^{22})(6 \times 10^{24})}{(3 \times 10^9)^2} \checkmark$
 $= 1,99 \times 10^{18} \text{ N} \checkmark$ (4)

7.2 NEWTON's LAW OF GRAVITATION/NEWTON se GRAVITASIEWET. ✓ (1)

7.3 The distance between the earth and the moon changes due to the elliptical orbit. ✓
Die afstand tussen die aarde en die maan verander as gevolg van elliptiese omwenteling. ✓

OR/OF

$F \propto 1/r^2 \checkmark$ (1)

7.4 $F_{EM(new)} = \frac{GM_E 1/4 M_M}{(2r)^2} \checkmark = F_{EM} (1/4)(1/4) \checkmark = 1/16 F_{EM} \checkmark$

OR/OF

$F_{EM(new)} = 1/16 (1,99 \times 10^{18}) \checkmark$

OR/OF

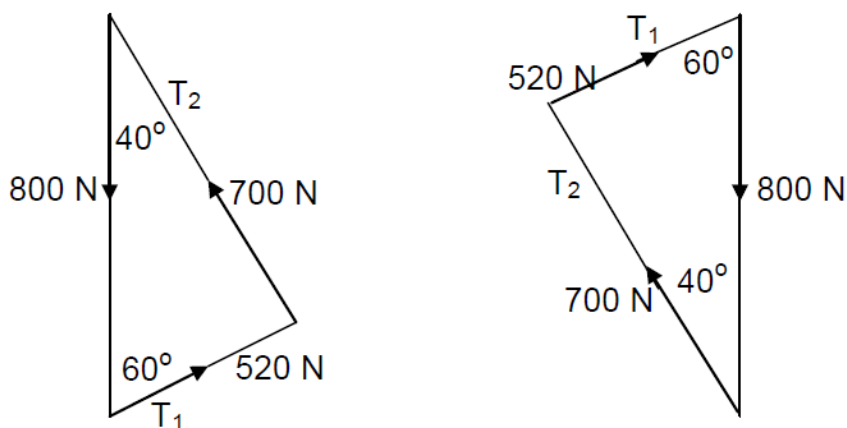
$F_{EM(new)} = 1,24 \times 10^{17} \text{ N} \checkmark$ (1,24375 × 10¹⁷ N) (3)
[9]

Newton Memo
November 2014/1

- 1.1 D ✓✓ (2)
- 1.2 A (2)
- 1.3 D ✓✓ (2)
- 1.4 C ✓✓ (2)

QUESTION 2/VRAAG 2

**2.1 CHECK ANSWER BY CONSTRUCTION AND MEASUREMENT
 VERGELYK ANTWOORD DEUR KONSTRUKSIE EN METING**



NOTES/AANTEKENINGE	
Weight (w) measured to accuracy of ± 5 N / Gewig (w) gemeet tot akkuraatheid van ± 5 N Anything beyond ± 10 N should attract 1 mark only <i>Enigiets bo ± 10 N kan slegs 1 punt kry</i>	✓
Tension force T_1 measured to accuracy of ± 10 N <i>Spanning T_1 korrek gemeet tot 'n akkuraatheid van ± 10 N</i>	✓✓
Tension force T_2 measured to accuracy of ± 10 N <i>Spanning T_2 korrek gemeet tot 'n akkuraatheid van ± 10 N</i>	✓✓
Angle of 60° and 40° accurately obtained (may not be indicated, but must be measured to ascertain). <i>Hoek van 60° en 40° akkuraat verkry (mag nie aangedui word nie, maar moet gemeet word om te bepaal).</i>	✓✓

Penalise 1 mark if distance (cm) instead of forces indicated on diagram (if final answer is correctly written). <i>Penaliseer 1 punt indien afstand (cm) in plaas van kragte op diagram aangedui word (indien finale antwoord korrek geskryf is).</i>	
Penalise 1 mark if no scale is indicated. <i>Penaliseer 1 punt indien geen skaal aangedui is nie</i>	
If no answer is given but sketch correctly shown in cm, award only 3 marks. <i>Indien geen antwoord gegee is nie, maar die skets is korrek in cm getoon, ken slegs 3 punte toe.</i>	

2.1 **BY CALCULATION / DEUR BEREKENING**

OPTION 1/OPSIE 1

$$T_1 \sin 30 + T_2 \sin 50 \checkmark = 800 \checkmark \dots\dots\dots(1)$$

$$T_1 \cos 30 = T_2 \cos 50 \checkmark \dots\dots\dots(2)$$

$$T_2 = \frac{T_1 \cos 30}{\cos 50}$$

$$\therefore \frac{(T_1 \cos 30)(\sin 50)}{\cos 50} + T_1 \sin 30 = 800$$

$$1,532 T_1 = 800$$

$$T_1 = 522,19 \text{ N} \checkmark$$

$$T_2 = \frac{(522,19)(\cos 30)}{\cos 50} \checkmark$$

$$= 703,54 \text{ N} \checkmark$$

OPTION 2/OPSIE 2

$$\frac{T_2 \checkmark}{\sin 60} = \frac{800 \checkmark}{\sin 80}$$

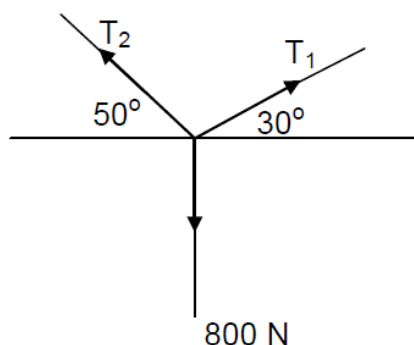
$$T_2 = \frac{(800)(\sin 60)}{\sin 80} \checkmark$$

$$T_2 = 703,51 \text{ N} \checkmark$$

$$\frac{T_1 \checkmark}{\sin 40} = \frac{800}{\sin 80}$$

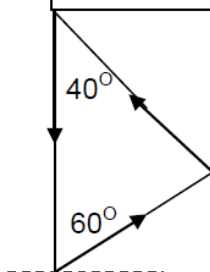
$$T_1 = \frac{(800)(\sin 40)}{\sin 80} \checkmark$$

$$= 522,16 \text{ N} \checkmark$$



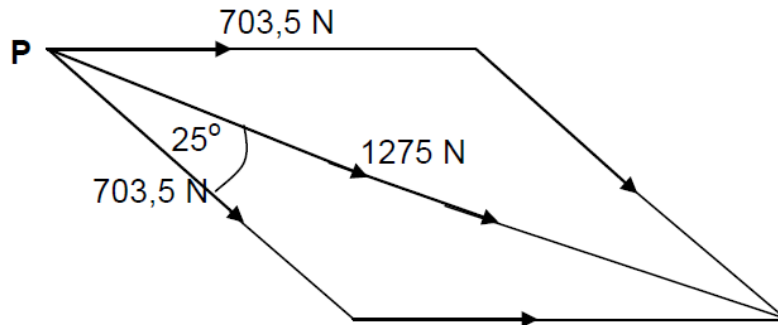
NOTE/LET WEL:
 Do not penalise if sketch is not shown.
Moenie penaliseer indien skets nie getoon is nie

NOTE/LET WEL:
 Do not penalise if sketch is not shown
Moenie penaliseer indien skets nie getoon is



(7)

2.2 **BY CONSTRUCTION AND MEASUREMENT: DEUR KONSTRUKSIE EN METING**
POSITIVE MARKING FROM QUESTION 2.1/ POSITIEWE NASIEN VANAF VRAAG 2.1

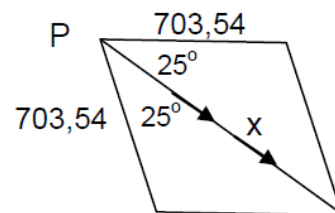


Parallelogram drawn with adjacent sides equal to T_2 <i>Parallelogram getrek met aangrensende kante gelyk aan T_2.</i>	✓✓
Angle of 50° or 25° accurately obtained May not be indicated, but must be measured to ascertain. <i>Hoek van 50° of 25° akkuraat verkry</i> <i>Mag nie aangedui word nie, maar moet gemeet word om te bepaal.</i>	✓
Reaction force recorded as $1\,275\text{ N} \pm 10\text{ N}$ <i>Reaksiekrag aangeteken as $1\,275\text{ N} \pm 10\text{ N}$</i>	✓
Penalise 1 mark if distance (cm) instead of forces indicated on diagram (if final answer is correct). <i>Penaliseer 1 punt indien afstand (cm) in plaas van kragte aangedui word op diagram (indien finale antwoord korrek is).</i>	
If no answer is given but sketch shown in cm, award only 1 mark. <i>Indien geen antwoord gegee word nie, maar skets getoon in cm, ken slegs 1 punt toe.</i>	

2.2 **BY CALCULATION: (POSITIVE MARKING FROM QUESTION 2.1)**
DEUR BEREKENING (POSITIEWE NASIEN VANAF VRAAG 2.1)
OPTION 1/OPSIE 1

$$\frac{703,54 \checkmark}{\sin 25} = \frac{x \checkmark}{\sin 130}$$

$$x = \frac{(703,54)(\sin 130)}{\sin 25}$$

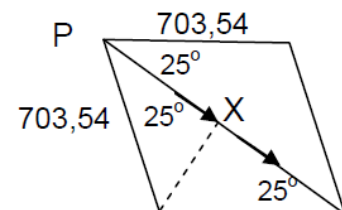


reaction force / reaksiekrag = $1275,25\text{ N}$ ✓ at 25° below the horizontal/ onder die horisontaal ✓ (or/of 335°)

OPTION 2/OPSIE 2

$$\sin 65 = \frac{PX}{703,54} \checkmark$$

$$PX = 637,62$$

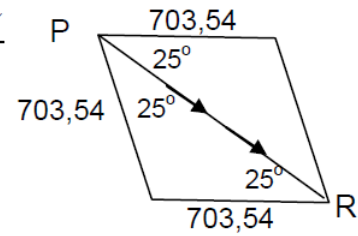


Reaction force/Reaksiekrag = $2PX$ ✓ = $1275,25\text{ N}$ ✓ at 25° below the horizontal/onder die horisontaal ✓ (or/of 335°)

OPTION 3/OPSIE 3

$$c^2 = a^2 + b^2 - 2abc \cos C \checkmark$$

$\therefore PR^2 = 703,54^2 + 703,54^2 - 2(703,54)(703,54) \cos 130^\circ$
 $PR = 1275,25 \text{ N}$ at 25° below the horizontal / onder die horisontaal (or/of 335°)



(4)
[11]

QUESTION 3/VRAAG 3

3.1 The force that opposes the tendency of motion of a stationary object relative to a surface. ✓✓ / Die krag wat die neiging tot beweging van 'n stilstaande liggaam relatief tot 'n oppervlak teenwerk.

OR/OF

The force of friction developed between two surfaces that are at rest. / Die krag of wrywing wat ontwikkel word tussen twee oppervlakke wat in rus is. (2)

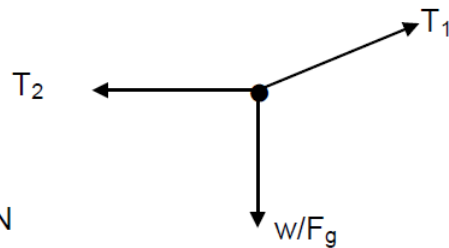
3.2 The resultant of all forces ✓ acting at point S is zero ✓ / Die resultaat van al die kragte wat op punt S inwerk, is nul.

Net force ✓ at S equals zero ✓ / Netto krag by S is gelyk aan nul.

There is no acceleration ✓✓ / Daar is geen versnelling nie (2)

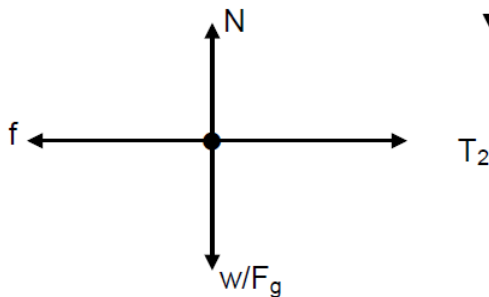
3.3.1

(3)



Do not penalise if angle is not shown. / Moenie penaliseer indien die hoek nie aangedui is nie. Deduct maximum 1 mark if arrows do not touch the dot. Trek 'n maksimum van 1 punt af as pyltjies nie die kolletjie raak nie

3.3.2



Deduct maximum 1 mark if arrows do not touch the dot. Trek 'n maksimum van 1 punt af as pyltjie nie die kolletjie raak nie. (4)

- 3.4 For the string/ *Vir die toutjie*
 $-T_2 + T_1 \cos 35^\circ = 0$
 $\therefore T_1 \cos 35^\circ = T_2 \dots\dots\dots(1) \checkmark$
 $T_1 \sin 35^\circ = w_P \dots\dots\dots(2) \checkmark$

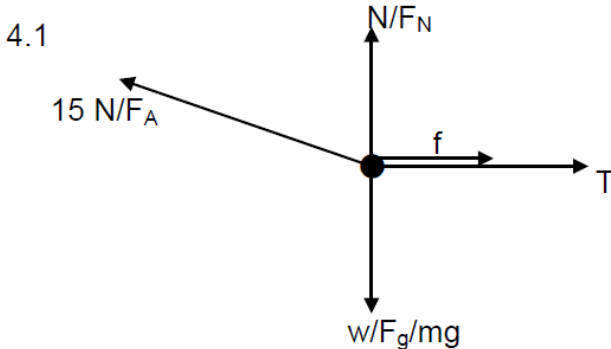
For the block/ *Vir die blok*
 $T_2 - f_s = 0$
 $T_2 = f_s = \mu_s N \checkmark$
 $T_2 = 0,25 (70)(9,8) \dots\dots\dots(3) \checkmark$

$$T_1 = \frac{(0,25)(70)(9,8)}{\cos 35^\circ} \text{ from (1)/ vanaf (1)}$$

From (2) and (3)/ *Vanaf (2) en (3)*
 $0,25(70)(9,8) \sin 35^\circ \checkmark = w_P$
 $120,09 \text{ N} \checkmark$

(7)
[18]

QUESTION 4/VRAAG 4



(5)

NOTE/LET WEL:
 1 mark for each force correctly shown *emanating from the dot.*
 1 punt vir elke krag korrek aangetoon wat uit die kolletjie voortspruit.

- 4.2 When a net force is applied to an object of mass m , it accelerates in the direction of the force at an acceleration directly proportional to the force and inversely proportional to the mass of the object. $\checkmark \checkmark$
Wanneer 'n netto krag op 'n liggaam met massa m toegepas word, versnel dit in die rigting van die krag teen 'n versnelling wat direk eweredig is aan die krag en omgekeerd eweredig is aan die massa van die liggaam.

OR/OF

When a net force acts on an object of mass m , the acceleration that results is directly proportional to the net force, has a magnitude that is inversely proportional to the mass and a direction that is the same as that of the net force. $\checkmark \checkmark$

Wanneer 'n netto krag op 'n liggaam met massa m inwerk, is die gevolglike versnelling direk eweredig aan die netto krag, het 'n grootte wat omgekeerd eweredig is aan die massa en 'n rigting wat diedelfde is as dié van die netto krag.

(2)

- 4.3 $N = w - F_A \sin \theta \checkmark$
 $= 8(9,8) - 15 \sin 30 \checkmark$
 $= 70,9 \text{ N} \checkmark$

(3)

4.4 **POSITIVE MARKING FROM QUESTION 4.3**
POSITIEWE NASIEN VANAF VRAAG 4.3

For the 8 kg block/Vir die 8 kg-blok

$$15 \cos 30^\circ - T - f_k = ma \checkmark$$

$$15 \cos 30^\circ - T - \mu_k N = 8a$$

$$\underline{15(0,866) - T - (0,25)(70,9) = 8a \checkmark}$$

$$-4,735 - T = 8a \dots \dots \dots (1)$$

For the 5 kg block/Vir die 5 kg-blok

$$T - w = ma \checkmark$$

$$T - 5(9,8) = 5a \checkmark \dots \dots \dots (2)$$

From (1) and (2)/ Vanaf (1) en (2)

$$-53,735 = 13a$$

$$a = -4,133 \text{ m}\cdot\text{s}^{-2}$$

from/vanaf (1)

$$-4,735 - T = 8(-4,133) \checkmark$$

$$T = 28,32(9) \text{ N} \checkmark$$

OR/OF

From /vanaf (2)

$$T - 5(9,8) = 5(-4,133) \checkmark$$

$$T = 28,33(5) \text{ N} \checkmark$$

(6)
[16]

QUESTION 5/VRAAG 5

5.1 Every body in the universe attracts every other body with a force that is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres. ✓
Elke liggaam in die heelal trek 'n elke ander liggaam aan met 'n krag wat direk eweredig is aan die produk van hul massas en omgekeerd eweredig is aan die kwadraat van die afstand tussen hul middelpunte. (2)

5.2

$$w = mg \checkmark$$

$$m = 14,29 \text{ (14,286 kg)} \checkmark$$

$$F = G \frac{m_1 m_2}{r^2} \quad \text{OR/OF} \quad F = G \frac{M_E m}{R_E^2} \checkmark$$

$$= 6,67 \cdot 10^{-11} \times \frac{(5,98 \times 10^{24})(14,286)}{[(6,38 \times 10^6)^2]} \checkmark$$

$$= 33,31 \text{ N}$$

Change /Verandering = $(140 - 33,31) = 106,69 \text{ N}$

$$\% \text{ change/verandering} = \frac{106,699}{140} \times 100$$

$$= 76,21 \% \checkmark$$

OPTION B/OPSIE B

$$w = mg \checkmark$$

$$m = 14,29 \text{ (14,286 kg)} \checkmark$$

$$w = mg = G \frac{M_E m}{R_E^2}$$

$$g' = G \frac{M_E}{R_E^2} \checkmark$$

$$= 6,67 \times 10^{-11} \frac{(5,98 \times 10^{24})}{[(6,38 + 6,7) \times 10^6]^2}$$

$$g' = 2,331 \text{ m}\cdot\text{s}^{-2}$$

$$\begin{aligned} \text{(New weight / Nuwe gewig)} w' = mg' &= 14,286 \times 2,331 \\ &= 33,301 \text{ N} \end{aligned}$$

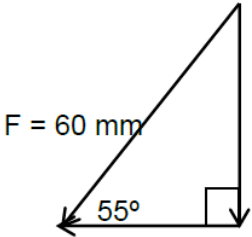
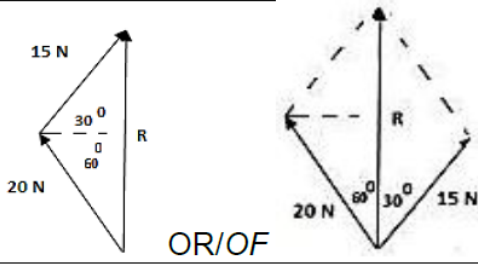
$$\text{Change/Verandering} = (140 - 33,30) = 106,699 \text{ N}$$

$$\begin{aligned} \% \text{ change/verandering} &= \frac{106,699}{140} \times 100 \\ &= 76,21 \% \checkmark \end{aligned}$$

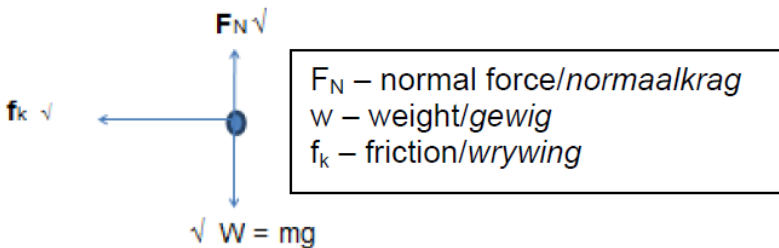
(8)
[10]

- 2.1 C (2)
- 2.2 D (2)
- 2.3 C (2)

QUESTION/VRAAG 3

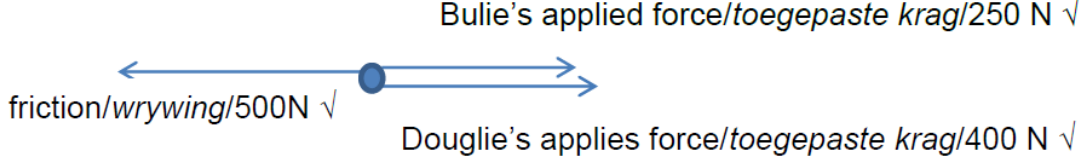
3.1	3.1.1		<p> $F = 60 \text{ mm} \checkmark$ $= 55^\circ \checkmark$ $X = 34 \text{ mm} \checkmark$ (accept/aanvaar 33 – 35) $102 \text{ N} \checkmark$ (accept/aanvaar 99 N – 105 N) left/links $Y = 49 \text{ mm}$ (accept/aanvaar 48 – 50) \checkmark $147 \text{ N} \checkmark$ (accept/aanvaar 144 N – 150 N) down/af \checkmark All 3 arrows correct/AI 3 pyle korrek \checkmark </p> <p> If a calculation was done instead of a construction – max 4 out of 7 Indien 'n berekening gedoen is i.p.v. 'n konstruksie – maks. 4 uit 7 Right angled triangle with information shown/Reghoekige driehoek met inligting getoon \checkmark All 3 arrows correct/AI 3 pyle korrek \checkmark $X = 180 \cos 55^\circ = 103,24 \text{ N} \checkmark$ $Y = 180 \sin 55^\circ = 147,45 \text{ N} \checkmark$ </p>	(7)
	3.1.2	<p>Positive marking from Q3.1.1/Positiewe nasien vanaf Vr3.1.1</p> <p> $w = mg = 30(9,8) \checkmark = 294 \text{ N} \checkmark$ normal force/normaalkrag = $294 + 147 = 441 \text{ N} \checkmark$ </p>		(3)
3.2	<p>A single vector \checkmark with the same effect as a number of vectors acting on an object. \checkmark</p> <p><i>'n Enkel vektor \checkmark wat dieselfde effek het as 'n aantal vektore wat saam op 'n voorwerp inwerk. \checkmark</i></p>		(2)	
3.3	3.3.1	<p>one mark for correct vector diagram/een punt vir korrekte vektordiagram</p> <p>$R = \sqrt{20^2 + 15^2} = 25 \text{ N} \checkmark \checkmark$</p>		(3)
	3.3.2	<p> $\tan \theta = \frac{15}{20}$ $\theta = 36,87^\circ \checkmark$ thus/dus $6,87^\circ \checkmark$ (clockwise from the positive y-axis/ kloksgewys vanaf die y-as) </p>	 <p>OR/OF</p>	(2)
3.4	<p>When three or more vectors drawn <u>head to tail</u> form a closed figure, \checkmark their resultant is zero or they are in equilibrium/balanced. \checkmark</p> <p><i>Wanneer drie of meer vektore <u>kop-stert geteken</u> word en 'n geslote figuur vorm, \checkmark is hul resultant nul of is hulle in ewewig/gebalanseerd \checkmark</i></p>		(2)	

QUESTION/VRAAG 4

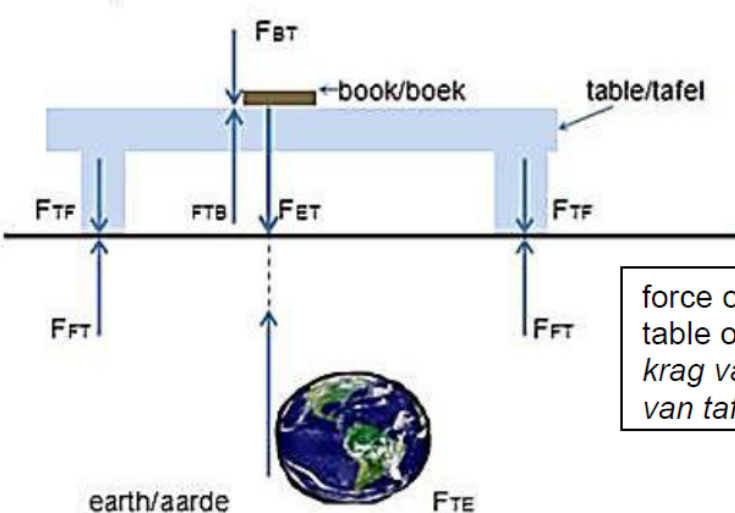
4.1		(3)
4.2	<p>4.2.1 The kinetic frictional force is the only force acting on the sled in x direction and opposes the motion of the sled so the net force is given by/Die kinetiese wrywingskrag is die enigste krag op die skild in x-rigting en staan die beweging van die slee teen sodat die krag gegee word deur:</p> <p> $F_{net} = ma$ ✓ OR/OF $f_k = \mu_k N$ ✓ = 0,06 m (9,8) ✓ = 0,588 m N $\mu_k mg$ ✓ = ma $F_{net} = ma$ ✓ 0,588 m = m a $\mu_k g = a$ $a = 0,588 \text{ m.s}^{-2}$ ✓ or/of 0,59 m.s⁻² $6 \times 10^{-2} \times 9,8 = a$ ✓ $a = 0,588 \text{ m.s}^{-2}$ ✓ or/of 0,59 m.s⁻² </p>	(4)
	<p>4.2.2 POSITIVE MARKING FROM QUESTION 4.2.1 POSITIEWE NASIEN VAN VRAAG 4.2.1</p> <p> $v_f^2 = v_i^2 + 2a\Delta x$ ✓ $0^2 = 6^2 + 2(-0,588)\Delta x$ ✓ (the sled decelerates/die slee vertraag) $\Delta x = 30,61 \text{ m}$ ✓ (if/as a = 0,59 m.s⁻² then/dan $\Delta x = 30,51 \text{ m}$) </p>	(3)

[10]

QUESTION/VRAAG 5

5.1		(3)
5.2	<p> $F_{net} = ma = 400 + 250 + (-500)$ ✓ = 2000 a ✓ $150 = 2000 \times a$ $a = 0,075 \text{ m.s}^{-2}$ ✓ to the right/na regs ✓ </p>	(4)
5.3	<p> $F_{g//} = F_g \sin \theta = mg \sin \theta$ ✓ $= 2000 (9,8) \sin 5^\circ$ $= 1708,25 \text{ N}$ ✓ </p>	(2)
5.4	<p>accelerate down the incline/versnel teen die steilte af ✓</p>	(1)
5.5	<p>Inertia is the tendency of an object to resist change ✓ Traagheid is 'n voorwerp se vermoë om verandering teen te staan ✓</p>	(1)

Newton Memo
November 2013/3

<p>5.6</p>	<p>A person will keep on moving forward in a straight line at constant velocity unless acted on by a resultant force ✓ The seatbelt acts as a net force ✓ which hold you safely in the seat. <i>in Liggaam sal aanhou beweeg in 'n reguit lyn teen 'n konstante snelheid tensy 'n resultante krag daarop inwerk. ✓ Die veiligheids gordel is die net krag ✓ wat jou veilig in die sitplek hou.</i> OR/OF In an accident seatbelts hold you safely in place because of Newton's First law of motion and inertia. ✓ When a car suddenly slows down the seatbelt acts as net force ✓ which helps the passengers from being hurt. <i>In 'n ongeluk hou die veiligheids gordel jou veilig in plek a.g.v. Newton se eerste wet/traagheid. ✓ Wanneer 'n motor skielik stadiger ry, tree die veiligheids gordel as die netto krag op ✓ wat help dat die passasier nie seerkry nie.</i></p>	<p>(2)</p>
<p>5.7</p>	<p>Newton's third law of motion states that when object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object B. ✓✓ <i>Volgens Newton se derde bewegingswet: as voorwerp A 'n krag op voorwerp B uitoefen, oefen voorwerp B terselfde tyd 'n teenoorgestelde krag van dieselfde grootte op A uit. ✓✓</i></p>	<p>(2)</p>
<p>5.8</p>	 <p>force of book on table – force of table on book ✓ <i>krag van boek op tafel – krag van tafel op boek</i></p> <p>force of floor on table - force of table on floor ✓ <i>krag van vloer op tafel – krag van tafel op vloer</i></p> <p>force of earth on table - force of table on earth ✓ <i>krag van aarde op tafel – krag van tafel op aarde</i></p>	<p>(3)</p>

Newton Memo

November 2013/4

QUESTION/VRAAG 6

6.1	$F_{\text{sun earth}} = G \frac{M_{\text{sun}} M_{\text{earth}}}{d^2} \checkmark$ $= \frac{6,67 \times 10^{-11} \checkmark (1,99 \times 10^{30})(5,98 \times 10^{24}) \checkmark}{(2 \times 10^{11})^2 + (4 \times 10^8)^2 \checkmark}$ $= 1,98 \times 10^{22} \text{ N} \checkmark$	(5)
6.2	$g_{\text{moon}} = \frac{GM_{\text{moon}}}{d^2} \checkmark \quad \text{OR/OF} \quad F = m g = \frac{G m M}{d^2}$ $= \frac{6,67 \times 10^{-11} (7,35 \times 10^{22}) \checkmark}{(1,6 \times 10^6)^2 \checkmark}$ $= 1,92 \text{ m.s}^{-2} \checkmark$	(4)
6.3	$W = mg \checkmark = 50 \times 10^{-3} \times 9,8 \checkmark = 0,49 \text{ N} \checkmark$	(3)

[12]

Newton Memo

Modelvraestel 2013/1

- 1.1 C ✓✓ (2)
- 1.2 A ✓✓ (2)
- 1.3 C ✓✓ (2)
- 1.4 A ✓✓ (2)

QUESTION 2/VRAAG 2

- 2.1 A single force ✓
having the same effect as all other forces acting together. ✓
- 'n Enkele krag ✓
wat dieselfde effek het as al die ander kragte tesame. ✓* (2)
- 2.2
- 2.2.1 Magnitude of P/Grootte van P = $\sqrt{2^2 + 4^2}$
= 4,47 (force units/krageenhede) ✓✓ (2)
- 2.2.2 $\tan\theta = \frac{-1}{-3} \therefore \theta = 18,43^\circ$ ✓
Direction/Rigting: $270^\circ - 18,43^\circ$ ✓ = $251,57^\circ$ ✓
- OR/OF**
- $\tan\theta = \frac{-3}{-1} \therefore \theta = 71,57^\circ$ ✓
Direction/Rigting: $71,57^\circ + 180^\circ$ ✓ = $251,57^\circ$ ✓ (3)

Newton Memo

Modelvraestel 2013/2

$$\begin{aligned} 2.3 \quad R_x &= P_x + Q_x \\ &= 2 + (-3) \\ &= -1 \text{ (force units/kragteenhede) } \checkmark \\ R_y &= P_y + Q_y \\ &= 4 + (-1) \\ &= 3 \text{ (force units/kragteenhede) } \checkmark \end{aligned}$$

$$\begin{aligned} R &= \sqrt{R_x^2 + R_y^2} \\ &= \sqrt{(-1)^2 + 3^2} \\ &= 3,16 \text{ (force units/kragteenhede) } \checkmark \end{aligned} \quad (3)$$

$$\begin{aligned} 2.4 \quad \tan\theta &= \frac{3}{-1} \checkmark \therefore \theta = -71,57^\circ \\ \text{Direction/Rigting: } &270^\circ + 71,57^\circ = 341,57^\circ \checkmark \end{aligned}$$

OR/OF

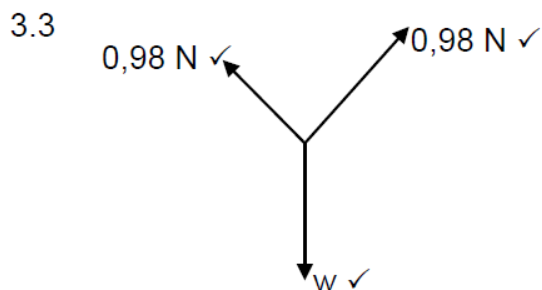
$$\begin{aligned} \tan\theta &= \frac{-1}{3} \checkmark \therefore \theta = -18,43^\circ \\ \text{Direction/Rigting: } &360^\circ - 18,43^\circ = 341,57^\circ \checkmark \end{aligned} \quad (2)$$

[12]

QUESTION 3/VRAAG 3

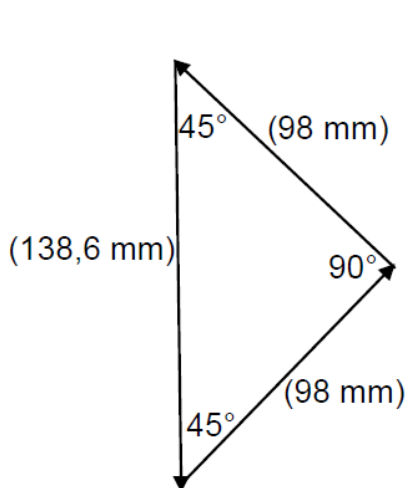
3.1 The resultant of the forces is zero./Die resultant van die kragte is nul. \checkmark (1)

3.2 Parallax error/Error in marking the position of the strings (because the observer's eye and the strings are not in a line perpendicular to the plane of the paper). \checkmark
Parallaksfout/Fout in die merk van die posisie van die toutjies (omdat die waarnemer se oog en die toutjies nie in lyn loodreg tot die vlak van die papier is nie). \checkmark (1)



(3)

3.4 CONSTRUCTION AND MEASUREMENT / KONSTRUKSIE EN METING



Marking criteria for scale drawing: <i>Kriteria vir nasien van skaaltekening:</i>		
A vector of 98 mm at 45° with vertical. <i>'n Vektor van 98 mm teen 45° met vertikaal.</i>		✓
Another vector of 98 mm at 90° to first vector. <i>'n Ander vektor van 98 mm teen 90° met eerste vektor.</i>		✓
A third vector drawn from head of one vector to tail of the other. <i>Derde vektor geteken van kop van een vektor na stert van ander.</i>		✓
Length of vertical vector in range of 137–139 mm. <i>Lengte van vertikale vektor in gebied 137–139 mm.</i>		✓
All vectors represented as arrows. <i>Alle vektore as pyltjies voorgestel.</i>		✓
The unknown weight given in range 1,37–1,39 N. <i>Die onbekende gewig gegee in gebied 1,37–1,39 N.</i>		✓

Mass/Massa = 141 g ✓

(Accept answers in range/Aanvaar antwoorde in gebied: 139 g–142 g)

**OR / OF
CALCULATION / BEREKENING**

$$\sum F_y = 0 \checkmark$$

$$(0,98) \checkmark \sin 45^\circ \checkmark + (0,98) \checkmark \sin 45^\circ \checkmark = m(9,8) \checkmark$$

$$m = 141,42 \text{ g} \checkmark$$

(7
[11

QUESTION 4/VRAAG 4

4.1 When a resultant force acts on an object, the object accelerates in the direction of the force. This acceleration is directly proportional to the force ✓ and inversely proportional to the mass of the object. ✓

Indien 'n resulterende krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die resulterende krag ✓ en omgekeerd eweredig aan die massa van die voorwerp. ✓

(2)

4.2

4.2.1 $f_k = \mu_k N \checkmark$
 $= (0,13)(1)(9,8) \checkmark$
 $= 1,27 \text{ N} \checkmark$

(3)

Newton Memo

Modelvraestel 2013/4

4.2.2 For the 2 kg mass (to the right/downwards as positive):

Vir die 2 kg-massa (na regs/afwaarts as positief):

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

$$w + F_T = ma$$

$$(2)(9,8) + F_T = 2a \checkmark$$

$$F_T = 2a - 19,6$$

For the 1 kg mass (to the right as positive):

Vir die 1 kg-massa (na regs as positief):

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

$$F_T + f = ma$$

$$-(2a - 19,6) \checkmark + (-1,27) = 1a \checkmark$$

$$F_T(1 \text{ kg}) = -F_T(2 \text{ kg})$$

$$\therefore a = 6,11 \text{ m}\cdot\text{s}^{-2} \checkmark$$

(5)

4.3 Zero acceleration \checkmark

F_{net} on the 1 kg mass is zero. \checkmark

According to Newton's second law of motion, its acceleration will be zero. \checkmark

According to Newton's first law of motion, it will continue to move at constant velocity (until it reaches the edge of the surface). \checkmark

Nul versnelling \checkmark

F_{net} op die 1 kg-massa is nul. \checkmark

Volgens Newton se tweede bewegingswet, is sy versnelling nul. \checkmark

Volgens Newton se eerste bewegingswet, sal dit teen konstante snelheid beweeg (tot aan die einde van die oppervlak). \checkmark

(4)

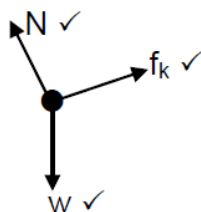
[14]

QUESTION 5/VRAAG 5

$$\begin{aligned} 5.1 \quad N = w_{\perp} &= mg \cos \theta \checkmark \\ &= (60)(9,8) \cos 15^{\circ} \\ &= 567,96 \text{ N} \checkmark \end{aligned}$$

(2)

5.2



Accepted Labels/Aanvaarde byskrifte	
w	F_g/F_w /force of Earth on skier/weight/588 N/mg/gravitational force F_g/F_w /krag van Aarde op skiër/gewig/588 N/mg/gravitasiekrag
N	F_N /normal/567,96 N F_N /normaal/567,96 N
f_k	Frictional force / F_f Wrywingskrag / F_f

(3)

Newton Memo

Modelvraestel 2013/5

5.3

$$v_f^2 = v_i^2 + 2a\Delta x \checkmark$$
$$15^2 = 0^2 + 2a(75) \checkmark$$
$$\therefore a = 1,5 \text{ m}\cdot\text{s}^{-2}$$

↓

$$F_{\text{net}} = ma \checkmark$$
$$w_{//} + f = ma$$
$$mg\sin\theta + f = ma$$
$$(60)(9,8)\sin 15^\circ \checkmark + f_k = (60)(1,5) \checkmark$$
$$\therefore f = -62,19 \text{ N}$$
$$\therefore f = 62,19 \text{ N} \checkmark \text{ up the incline/opwaarts teen skuinsvlak} \checkmark$$

(7)
[12]

QUESTION 6/VRAAG 6

6.1 Any two objects in the universe attract each other ✓
with a force directly proportional to the product of their masses and ✓
inversely proportional to the square of the distance between their centres. ✓

Enige twee voorwerpe in die heelal trek mekaar aan ✓
met 'n krag wat direk eweredig is aan die produk van hul massas en ✓
omgekeerd eweredig aan die kwadraat van die afstand tussen hul
middelpunte. ✓

(3)

6.2

$$F = \frac{Gm_1m_2}{r^2} \checkmark$$
$$5\,000 \checkmark = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(615)}{r^2} \checkmark$$
$$\therefore r = 7,0 \times 10^6 \text{ m}$$
$$\text{Height / Hoogte} = 7,0 \times 10^6 - 6,38 \times 10^6 \checkmark = 6,2432 \times 10^5 \text{ m} = 624,32 \text{ km} \checkmark$$

(5)

6.3

$$F = \frac{Gm_1m_2}{r^2}$$
$$\therefore F = \frac{Gm_12m_2}{(2r)^2} = \frac{1}{2} \frac{Gm_1m_2}{r^2} = \frac{1}{2} (5\,000) = \underline{2\,500 \text{ N}} \checkmark \checkmark$$

(2)
[10]