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WTS TUTORING

WTS

WORK,ENERGY & POWER MEMO

GRADE : 12

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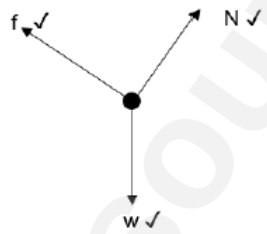
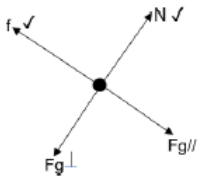
MEMO FOR PAST PAPERS

QUESTION/*VRAAG* 4

4.1		In an isolated system ✓the total mechanical energy remains constant. ✓ In 'n geïsoleerde sisteem ✓ bly die totale meganiese energie konstant. ✓	(2)
4.2		**OPTION 1 / *OPSIE 1*** E_{mech} at/*by* A = E_{mech} at/*by* B $(mgh + \frac{1}{2}mv^2)$ at/*by* A = $(mgh + \frac{1}{2}mv^2)$ at/*by* B } ✓ Any one / Enige een $4 \times 9{,}8 \times (7 \sin 60°)$ ✓$+ \frac{1}{2} \times 4 \times 0 = 4 \times 9{,}8 \times (4 \sin 60°)$✓$+ \frac{1}{2} \times 4 \times v^2$ $v = 7{,}14\ m \cdot s^{-1}$ ✓ **OPTION 2 / *OPSIE 2*** E_{mech} at/*by* A = E_{mech} at/*by* B ✓ $(mgh + \frac{1}{2}mv^2)$ at A = $(mgh + \frac{1}{2}mv^2)$ at B $4 \times 9{,}8 \times (3 \sin 60°)$ ✓$+ \frac{1}{2} \times 4 \times 0 = 4 \times 9{,}8 \times (0)$✓$+ \frac{1}{2} \times 4 \times v^2$ $v = 7{,}14\ m \cdot s^{-1}$ ✓		(4)
4.3	4.3.1	Work done by a net force is equal✓ to the change in kinetic energy✓ of an object. **OR** The net (total) work done ✓is equal to the change in kinetic energy of the object. ✓ *Arbeid verrig deur 'n netto krag is gelyk ✓ aan die verandering in kinetiese energie van 'n voorwerp ✓* **OF** *Die netto (totale) arbeid op 'n voorwerp is gelyk ✓ aan die verandering in kinetiese energie van die voorwerp ✓*	(2)
	4.3.2	  ✓ for both components of weight ✓ *vir albei gewigskomponente*	(3)
	4.3.3	**OPTION 1 / *OPSIE 1*** $W_{net} = \Delta E_K$ $W_f + W_{g//} = \frac{1}{2} m(v_f^2 - v_i^2)$ } ✓ any one (*enige een*) $f \cdot \Delta x \cdot \cos\theta + mg\sin 60 \cdot \Delta x \cdot \cos\theta = \frac{1}{2} \times 4(3^2 - 7{,}14^2)$ ✓ $f \times \frac{2}{\cos 60°}$ ✓ $\times -1 + 4 \times 9{,}8 \sin 60$ ✓ $\times \frac{2}{\cos 60°} \times 1 = -83{,}9592$ $-4f + 135{,}7927833 = -83{,}9592$ $f = 54{,}94\ N$ ✓ **OPTION 2 / *OPSIE 2*** $W_{nc} = \Delta E_p + \Delta E_K$ $W_f = mgh_f - mgh_i + \frac{1}{2} mv_f^2 - \frac{1}{2} m v_i^2$ $f \cdot \cos\theta \cdot \Delta x = mg(h_f - h_i) + \frac{1}{2} m (v_f^2 - v_i^2)$ } ✓ any one / *enige een* $f \cdot \cos 0 \times 4$ ✓ $= 4 \times 9{,}8 (0 - 4 \sin 60°)$✓ $+ \frac{1}{2} \times 4 (3^2 - 7{,}14^2)$✓ $f = 54{,}94\ N$ ✓		(5)
4.4		Remains the same / *Bly dieselfde* ✓	(1)
			[17]

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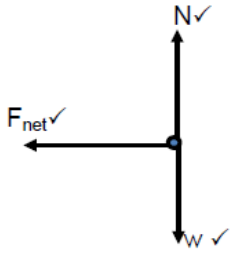
QUESTION / *VRAAG* 3

3.1



(3)

3.2 $120\ kmh^{-1} = \frac{120 \times 1000}{3\,600} = 33{,}33 m \cdot s^{-1}$ ✓ (1)

3.3 **Work-energy theorem:** The net work done on an object is equal to the change in the objects kinetic energy. ✓✓
Arbeid energie beginsel: Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie. (2)

3.4 3.4.1 $W_{net} = E_{kf} - E_{ki}$ ✓
$= 0 - ½ mv^2$
$= 0 - ½ (1000) \times 33{,}33^2$ ✓
$= -555\,444{,}45$ J
$F_{net}\Delta x\cos\theta = 555\,444{,}45$ ✓
$F_{net}(0{,}8)\cos180$✓ $= 555\,444{,}45$
$F_{net} = -694\,305{,}56$ N
$F_{net} = 694\,305{,}56$ N to the left✓ / away from the wall/opposite direction of initial motion
Na links / weg van die muur / teenoorgestelde rigting van die aanvanklike beweging (5)

3.4.2 Time lapse / *Tydperk* $F_{net}\Delta t = \Delta p = m(v_f - v_i)$ ✓

$$\Delta t = \frac{1\,000(0 - 33{,}33)}{-694\,305{,}56} \checkmark\checkmark$$

$= 0{,}05$ s ✓

(4)

3.4.3
- Crumbling <u>increases stopping time</u>✓ / *frommeling vergroot stop-tyd*
- thus <u>reducing F_{net}</u> ✓ / *dus verminder F_{net}*
- $F_{net} = \frac{\Delta p}{\Delta t}$ ✓

(3)
[18]

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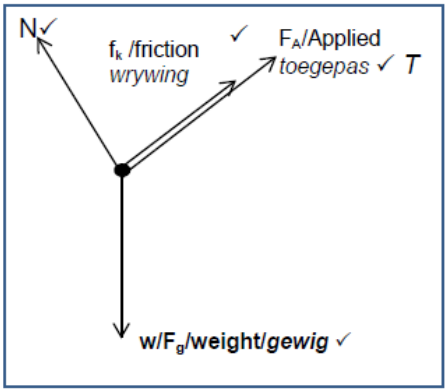
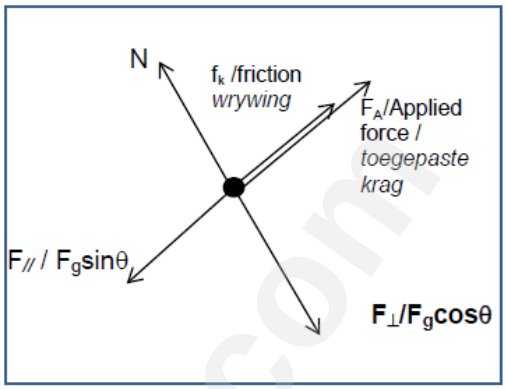
QUESTION / *VRAAG* 4

4.1 Option 1 / *Opsie 1* Option 2 / *Opsie 2*





(4)

Accepted labels/*Aanvaarde benoemings*	
w	F_g/F_w/weight/mg/gravitational force *F_g/F_w/gewig/mg/gravitasiekrag*
f	$F_{friction}/F_f$/friction/f_k *$F_{wrywing}/F_w$/wrywing/f_k*
N	F_N/F_{normal}/normal force $F_N/F_{normaal}$/*normaalkrag*
	Deduct 1 mark for any additional force. / *Trek een punt af vir enige ekstra krag*
	Mark is given for both arrow and label. / *Punt word toegeken vir beide 'n pyl en byskrif.*

4.2 0 N ✓

Box slides at constant velocity / ΔE_k = 0 / acceleration = 0 ✓
Boks gly teen konstante snelheid / versnelling = 0

(2)

4.3 A non-conservative force is that force for which the work done in moving an object between two points depends on the path taken.
'n Nie-konserwatiewe krag is daardie krag waarvan die arbeid verrig afhang van die padlengte gevolg tussen twee punte. (2)

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4.4 $\theta = \sin^{-1}\frac{1,2}{6}$ ✓ $= 11,537^0$

Option 1 / *Opsie 1*

$W_{nett} = \Delta E_k$ ✓

$W_A + W_f + W_N + W_\perp + W_{//} = 0$ ✓

$W_A + F_f\Delta \times \text{Cos}180 + 0 + 0 + 100 \times 9,8\text{Sin } 11,537$✓$\times 6\text{Cos}0$ ✓$= 0$

$W_A + 60 \times 6\text{Cos}180$✓ $+ 100 \times 9,8\text{Sin } 11,537 \times 6\text{Cos}0 = 0$

$W_A = -816$ J

Work done by man = 816 J ✓

Arbeid verrig deur man

Option 2 / *Opsie 2*

$F_{nett} = F_A + f + F_{//} + N + F_\perp$

$= F_A + f + F_{//}$

$0 = F_A - 60 + 100 \times 9,8 \times \text{Sin } 11,537$

$= F_A + 136$

$F_A = -136$ N

$\therefore W_A = F_A \times \Delta x$

$= -136 \times 6$

$= -816$ J

∴ work done by man is 816 J✓

Arbeid verrig deur man

Option 3 / *Opsie 3*

$W_{nc} = \Delta E_k + \Delta E_p$

$W_{man} + W_f = 0 + mg(h_f - h_i)$

$W_{man} + 60 \times 6 \times (-1) = 100 \times 9.8\ (0-1,2)$

$W_{man} = -1176 + 360$

$= -816$ J

∴ work done by man is 816 J

Arbeid verrig deur man

(6)

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4.5 W_A = $F\Delta x \cos\theta$ ✓ = - 816

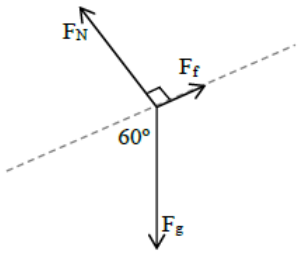
= F x 6 cos 180✓ = - 816 ✓

F_A = 136 N

Magnitude of force applied by man is 136 N.✓
Grootte van krag toegepas deur man is 136 N (4)
[18]

QUESTION 5

5.1



F_g = gravitational force or weight✓
F_N = Normal force✓
F_f = frictional force✓ (3)

5.2 $W_{net} = F_{net}\Delta x \cos\theta$✓ = $(F_{g\parallel}+(-F_f))\Delta x$ = (343✓ – 150✓)(120✓) = 23160 J ✓ (5)

5.3 The work done by a net force ✓on an object is equal to the change in the kinetic energy✓ of the object.
OR
Net work done✓ on an object is equal to the change in the kinetic energy✓ of the object. (2)

Mark positively from 5.2

5.4 $W_{net} = \Delta E_k$ ✓= ½ mv_f^2 – ½ mv_i^2
23160✓ = ½ (70)v_f^2 - 0✓
v_f = 25,72 $m.s^{-1}$ ✓ (4)
[14]

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QUESTION 5 // *VRAAG 5*

5.1

NB: See Question 2.5 for NOTES and Accepted labels!

LW! *Sien VRAAG 2.5 vir NOTAS en aanvaarbare byskrifte*

(2)

5.2 Gravitational force✓ // *Gravitasiekrag* (1)

5.3 The net/total work done on an object is equal✓ to the change in the object's kinetic energy.✓ // *die netto/totale arbeid op 'n voorwerp verrig is gelyk aan die verandering in die voorwerp se kinetiese energie.*

OR // *OF:*

The work done on an object by a net/resultant force is equal to the change in the object's kinetic energy.// *die arbeid op 'n voorwerp verrig deur 'n netto/resultante krag is gelyk aan die verandering in die voorwerp se kinetiese energie.* (2)

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5.4 Take clockwise as positive // *Vat klokgewys as positief*

For block **B** // *vir blok **B**:*

$F_{net} = ma$

$w + (-T)m = ma$ ✓

$mg - T = ma$

$(10)(9,8) - T = 10 \cdot a$ ✓

$98 - T = 10 \cdot a \ldots (1)$

For block **A** //*vir blok **A*** :

$F_{net} = ma$

$\therefore T = (-w) = ma$

$\therefore T - mg = ma$

$\therefore T - (4,0)(9,8) = (4,0) \cdot a$ ✓

$\therefore T - 39,2 = (4,0) \cdot a \ldots (2)$

$\therefore 98 - T = (10)\, a \ldots (1)$

$\therefore -39,2 + T = (4,0)\, a$

$(1) + (2) : 58,8 = (14)\, a$

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

From (2): $T - 39,2 = (4,0)(4,2$

$\therefore T - 39,2 = 16,8$

$\therefore T = 56\ N$ ✓

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$$W_{net} = \triangle k \checkmark$$

$$W_w + W_T = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$mg\cdot \triangle x\cdot\cos\theta + T\cdot\triangle x\cdot\cos\beta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\underline{(10)(9,8)(4,0)(\cos 0°) + (56)(4,0)(180°)}\checkmark = \frac{1}{2}(10)v_f^2 - 0 \checkmark$$

$$392 + (-224) = 5v_f^2$$

$$1.68 = 5v_f^2$$

$$\therefore\ v_f^2 = 33,6$$

$$\therefore\ v_f = \sqrt{33,6} = 5,797\ m\cdot s^{-1}$$ (7)

5.5 **POSITIVE MARKING FROM QUESTION 5.4 // *positiewe nasien vanaf VRAAG 5.4*:**

$$\triangle t(\mathbf{A}) = \triangle t(\mathbf{B})$$

$$\therefore v_f = v_i + \cdot \triangle t \checkmark$$

$$\underline{5,797 = 0 + (4,2)\cdot} \triangle t \checkmark$$

$$\therefore \triangle t = 1,38\ s \checkmark$$ (3)

[15]

QUESTION 4 / VRAAG 4

4.1 The energy that an object has due to its height above the ground / a reference point ✓✓
Die energie wat 'n voorwerp het as gevolg van die hoogte bo die grond / bo 'n verwysingspunt. (2)

4.2.1 $Ep = mgh \checkmark$
$= \underline{(5,05)(9,8)(0,06)} \checkmark$
$= 2,97\ J \checkmark$ (3)

4.2.2

USE ENERGY PRINCIPLES ONLY. ANY OTHER METHOD: $^0/_4$	
POSITIVE MARKING FROM Q4.2 $(mgh + ½mv^2)_R = (mgh + ½mv^2)_S \checkmark$ $\underline{0 + ½(5,05)v^2} \checkmark = 2,97 \checkmark + 0$ $v = 1,08\ m\cdot s^{-1} \checkmark$	$W_{net} = \Delta E_k \checkmark$ $\underline{(5,05\times 9,8)(0,06)\cos 180°}\checkmark = 0 - ½(5,05)v^2 \checkmark$ $v = 1,08\ m\cdot s^{-1} \checkmark$

(4)

4.2.3

POSITIVE MARKING FROM Q4.3
$\left.\begin{array}{l}\Sigma p_i = \Sigma p_f \\ (mv_i)_1 + (mv_i)_2 = (m_1+m_2)v_f\end{array}\right\}$ Any one ✓ $\underline{(0,05)v_i + 0}\checkmark = \underline{(5,05)(1,08)} \checkmark$ $v_i = 109,08\ m\cdot s^{-1} \checkmark$

(4)

[13]

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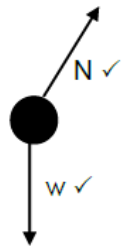
QUESTION 5 / VRAAG 5

5.1 The contact force which a surface exerts on an object ✓ and which is perpendicular to the surface. ✓
Die kontakkrag wat 'n oppervlak op 'n voorwerp uitoefen en wat loodreg op die oppervlak is. (2)

5.2



(2)

Accepted labels / Aanvaarde benoemings	
w	Fg / Fw/force of earth on block/weight / 49 N / mg / gravitational force
N	Normal force / F_N / Force of incline on trolley

5.3

OPTION 1

$(mgh + ½mv^2)_X = (mgh + ½mv^2)_Y$ ✓

$(76)(9,8)(1,5) + ½(76)(3)^2$ ✓ $= 0 + ½(76)v^2$ ✓

$v = 6,2\ m\cdot s^{-1}$ ✓

OPTION 2

$W_{net} = \Delta E_k$ ✓

$W_w = ½mv_f^2 - ½mv_i^2$

$(76\times9,8)(1,5)\cos 0°$ ✓ $= ½(76)v_f^2 - ½(76)(3)^2$ ✓

$v_f = 6,2\ m\cdot s^{-1}$ ✓

OPTION 3

$W_{nc} = \Delta E_k + \Delta E_p$ ✓

$0 = (½mv_f^2 - ½mv_i^2) + (mgh_f - mgh_i)$

$0 = [½(76)v_f^2 - ½(76)(3)^2]$ ✓ $+ [0 - (76)(9,8)(1,5)]$ ✓

$v_f = 6,2\ m\cdot s^{-1}$ ✓

(4)

5.4

$f_k = \mu_k\cdot N$ ✓

$= \mu_k\cdot mg\cos\Theta$

$= (0,21)(76\times9,8\times\cos 10°)$ ✓

$= 154,03\ N$ ✓ (3)

5.5

The normal force is perpendicular to the dispacement / motion. ✓

OR

$\Theta = 90° \rightarrow \cos 90° = 0$ ✓

OR

$W_N = N\Delta x\cos 90° = 0$ ✓ (1)

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5.6 **POSITIVE MARKING FROM Q5.3**

$W_{net} = \Delta E_k$ ✓

$W_{w//} + W_f = ½mv_f^2 - ½mv_i^2$

$(76 \times 9,8 \times \text{Sin}10°)(\Delta x)\ \text{Cos}0°$ ✓ $+ (154)(\Delta x)\ \text{Cos}180°$ ✓ $= 0 - ½(76)(6,2)^2$ ✓

$129,33\Delta x - 154\Delta x = -1460,72$

$\Delta x = 59,22$ m

$h = \Delta x\ \text{Sin}10°$

$= 59,22\ \text{Sin}10°$ ✓

$= 10,28$ m ✓ (6)

5.7 Remains the same ✓ (1)

[19]

QUESTION 5 / VRAAG 5

5.1 The total mechanical energy remains constant/is conserved ✓ in an isolated/closed system. ✓

Die totale meganiese energie bly konstant/bly behoue✓ in 'n geïsoleerde/ geslote sisteem✓

OR/*OF*

The sum of the potential and kinetic energy remains constant ✓ in an isolated/closed system. ✓

Die som van die potensiële en kinetiese energie bly konstant✓ in 'n geïsoleerde / geslote sisteem ✓

OR/*OF*

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When the work done by the non-conservatives forces is zero✓ the total mechanical energy of the system of bodies is conserved✓.
Wanneer die werk wat gedoen is deur die nie-konserwatiewe kragte nul is✓, is die totale meganiese energie van die stelsel van liggame behoue✓.

(2)

Notes/*Aantekeninge:*
The mark for 'closed/isolated system' is only awarded if used in conjunction with enery *Die punt vir 'geslote/geïsoleerde sisteem' word slegs toegeken indien saam met energie gebruik*

5.2

$$K_i + U_i = K_f + U_f$$

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

$$0 + (40)(9.8)(1.5)✓ = \frac{1}{2}(40)v^2 + 0✓$$

$$v = 5.42\ m \cdot s^{-1}✓$$

Notes/ Aantekeninge Accept/ Aanvaar
E_p and E_K

(4)

5.3

Option 1/Opsie 1	Accept/ Aanvaar
$w_{net} = \Delta K✓$ $mg\Delta x cos\theta + f\Delta x cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9.8)(3)\cos 60^0 ✓ + (1.9)(3)\cos 180^0✓ = \frac{1}{2}(22)(v_i^2 - 0^0)✓$ $v_f = 5{,}37 m \cdot s^{-1}✓$	Δy / Δx
Option 2/Opsie 2	Accept/ Aanvaar

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$w_{net} = \Delta K$ ✓ $mgsin\theta\Delta xcos\theta + f\Delta xcos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9.8)sin30^0(3)\cos 0^0$ ✓ $+ (1.9)(3)\cos 180^0$ ✓ $= \frac{1}{2}(22)(v_i^2 - 0^0)$ ✓ $v_f = 5{,}37m \cdot s^{-1}$ ✓	Δy / Δx
Option 3/Opsie 3 $w_{net} = \Delta K$ ✓ $mghcos\theta + f\Delta xcos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ $(22)(9.8)(1.5)\cos 0^0$ ✓ $+ (1.9)(3)\cos 180^0$ ✓ $= \frac{1}{2}(22)(v_i^2 - 0^0)$ ✓ $v_f = 5{,}37m \cdot s^{-1}$ ✓	Accept/ Aanvaar h / Δy / Δx
$w_{net} = \Delta K$ ✓ $-\Delta U + f\Delta xcos\theta = \frac{1}{2}mv^2 - \frac{1}{2}mv^2$ $-(0 - (22)(9{,}8)(1.5))$ ✓ $+ (1.9)(3)\cos 180^0$ ✓ $= \frac{1}{2}(22)(v_i^2 - 0^0)$ ✓ $v_f = 5{,}37m \cdot s^{-1}$ ✓	Accept/ Aanvaar h / Δy / Δx

(5)

5.4 Equal to / Gelyk aan ✓ (1)

[12]

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QUESTION 5/*VRAAG 5*

5.1 The force which a surface excerts on an object with which it is in contact✓ and which is perpendicular to the surface.✓
Die krag wat 'n oppervlak uitoefen op 'n voorwerp waarmee dit in kontak is en wat loodreg op die voorwerp is. (2)

5.2 $F_{net} = ma$ ✓
$F_{applied} - F_{g//} = ma$
$600✓ - m(9,8)(\sin 25^0)$ ✓ $= 0$✓
$m = 144,87$ kg✓ (5)

5.3 Total mechanical energy in a closed system✓ remains constant. ✓
Totale meganiese energie in 'n geslote sisteem bly konstant. (2)

5.4.1 **POSITIVE MARKING FROM 5.2/*POSITIEWE NASIEN VANAF 5.2***

OPTION 1/ *OPSIE 1*
$(E_p + E_k)_X = (E_p + E_k)_B$✓
$(144,87)(9,8)h$ ✓ $+ 0 = 0 + ½(144,87)(6)^2$✓
$h = 1,84$ m✓

OPTION 2/ *OPSIE 2*
$W_{nc} = \Delta U + \Delta K$ ✓/ $W_{nc} = \Delta E_p + \Delta E_k$
$0 = \underline{0 - (144,87)(9,8)(5)h}$ ✓ $+ \underline{½(144,87)(6)^2 - 0}$✓
$h = 1,84$ m✓ (4)

5.4.2 **POSITIVE MARKING FROM 5.2/*POSITIEWE NASIEN VANAF 5.2***

OPTION 1/ *OPSIE 1*
$W_{net} = \Delta K$ ✓
$W_f = \Delta K$
$\mu_k(144,87)(9,8)$✓$(5)\cos 180^0$✓$= ½(144,87)2^2 - ½(144,87)(6^2)$ ✓
$\mu_k = 0,33$ ✓

OPTION 2/ *OPSIE 2*
$W_{nc} = \Delta U + \Delta K$ ✓
$W_f = \Delta U + \Delta K$
$\mu_k(144,87)(9,8)$✓$(5)\cos 180^0$✓$= 0 + ½(144,87)2^2 - ½(144,87)(6^2)$ ✓
$\mu_k = 0,33$ ✓ (5)
[18]

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QUESTION / VRAAG 4

4.1 The total (linear) momentum of a closed system remains constant/is conserved. ✓✓
(2 marks or zero)

Die totale (liniêre) momentum van 'n geslote sisteem bly konstant/bly behoue. ✓✓
(2 punte or niks) (2)

4.2 $\Sigma p_i = \Sigma p_f$ ✓
$m_1v_2 + m_2v_2 = (m_1 + m_2)v_c$
(68×20) ✓ $+ (12 \times 0) = (68 + 12)v_c$ ✓
$\therefore v_c = 17\ m\cdot s^{-1}$ ✓ (4)

4.3 **POSITIVE MARKING FROM *QUESTION 4.2* / POSITIEWE NASIEN VAN VRAAG 4.2.**

OPTION / *OPSIE* 1
$(E_p + E_k)_i = (E_p + E_k)_f$ ✓
$(mgh + ½mv_c^2)_i = (mgh + ½ mv_c^2)_f$
$0 + ½(80)(17)^2$ ✓ $= (80)(9,8)h + 0$ ✓
$\therefore h = 14,75\ m$

Distance up the incline, d/ *Afstand opwaarts teen skuinsvlak*
$\sin\theta = \frac{h}{\Delta x}$
$\sin 25° = \frac{14,75}{\Delta x}$ ✓
$\therefore \Delta x = 34,89\ m$ ✓

OPTION / *OPSIE* 2
$W_{net} = \Delta E_k$ ✓
$W_w = E_{kf} - E_{ki}$
$mg\sin 25° \cos 180° = \frac{1}{2}m(v_f^2 - v_i^2)$
$(80)(9,8)\sin 25°$ ✓ $\Delta x \cos 180°$ ✓ $= \frac{1}{2}(80)(0^2 - 17^2)$ ✓
$\Delta x = 34,89\ m$ ✓
(5)

4.4 Decreases / *verminder* ✓

Friction is a non-conservative force/ opposes motion/removes kinetic energy from the system. ✓

Wrywing is 'n nie-konserwatiewe krag /opponeer beweging / verwyder kinetiese energie van die sisteem. ✓ (2)
[13]

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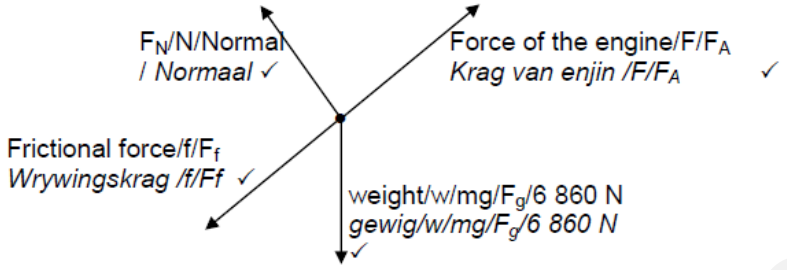
QUESTION / VRAAG 5

5.1 Zero/0 (J) ✓ (1)

5.2



(4)

5.3 5.3.1 The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓ **(2 marks or zero.)**

Die netto/totale werk verrig op 'n voorwerp is gelyk aan die verandering in die voorwerp se kinetiese energie. ✓✓ **(2 punte or niks.)** (2)

5.3.2

Marking guidelines / *nasienriglyne*

- Formula/ *Formule*: $W_{net} = \Delta E_k$ or $W_{nc} = \Delta E_p + \Delta E_k$ ✓
- Formula / *Formule*: $W = F\Delta x\cos\theta$ ✓
- Substitution to calculate / *Vervanging in formule*$f = \mu_k mg\cos 30°$ ✓
- Substitute to calculate / *Vervanging om te bereken:* W_f ✓
- Substitute to calculate / *Vervanging om te bereken:* W_w OR ΔE_p ✓
- Substitute to calculate / *Vervanging om te bereken:* W_F ✓
- Substitute to calculate / *Vervanging om te bereken:* ΔE_k ✓
- Final answer / *Finale antwoord*: $11{,}59\ m\cdot s^{-1}$ ✓

OPTION / *OPSIE* 1:

$W_{net} = \Delta E_k$ ✓

$$W_N + W_f + W_w + W_F = \Delta E_k$$

$$0 + f\Delta x\cos 180° + w\Delta x\cos 180° + F\Delta x\cos 0° \checkmark = E_{kf} - E_{ki}$$

$$\mu_k mg\cos 30°\Delta x\cos 180° + mg\Delta x\sin 30°180° + F\Delta x\cos 0° = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$0{,}32(700)(9{,}8)\cos 30°\checkmark(70)\cos 180°\checkmark + (700)(9{,}8)\sin 30°(70)\cos 180°\checkmark + (6000)(70)\cos 0° \checkmark = \frac{1}{2}(700)(v_f^2 - 0)\checkmark$$

$$-1{,}33 \times 10^5 - 2{,}4 \times 10^5 + 4{,}2 \times 10^5 = 350v_f^2$$

$$v_f = 11{,}59\ m\cdot s^{-1} \checkmark$$

OPTION / *OPSIE* 2:

$$W_{nc} = \Delta E_p + \Delta E_k \checkmark$$

$$W_f + W_F = mg\Delta h + \tfrac{1}{2}m(v_f^2 - v_i^2)$$

$$f\Delta x\cos 180° + F\Delta x\cos 0° \checkmark = mg\Delta h + \tfrac{1}{2}m(v_f^2 - v_i^2)$$

$$0{,}32(700)(9{,}8)\cos 30°\checkmark(70)\cos 180° \checkmark + (6000)(70)\cos 0° \checkmark =$$

$$(700)(9{,}8)(70\sin 30° - 0) \checkmark + \tfrac{1}{2}(700(v_f^2 - 0) \checkmark$$

$$v_f = 11{,}59 m\cdot s^{-1} \checkmark$$

(8)

[15]

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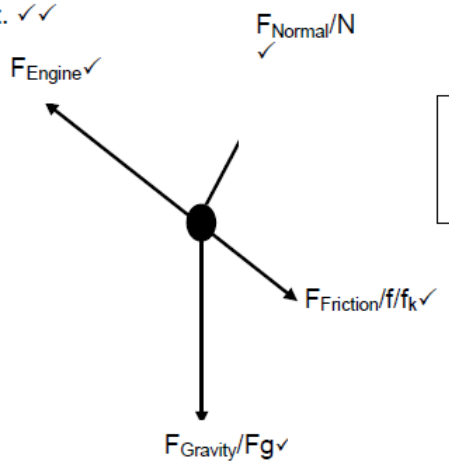
QUESTION 5

5.1 Net work done on an object is equal to the change in the kinetic energy of the object. ✓✓ (2)

5.2



-1 for additional forces
Direction and label must be correct

(4)

5.3

$f_k = \mu_k N$ ✓
$= (0{,}017)$ ✓ $(1500)(9{,}8)(\cos 10{,}21^0)$ ✓
$= 245{,}94$ N (3)

5.4

$\sin 10{,}21 = 59/AB$
$AB = 332{,}85$ m

$W_{net} = \Delta Ek$✓
$W_{Fe} + W_N + W_{Ff} + W_{Fg\perp} + W_{Fgp} = 0$✓
$F_e\Delta x \cos\theta + 0 + F_f\Delta x \cos\theta + 0 + F_{gp}\Delta x \cos\theta = 0$
$\underline{F_e(332{,}85)(\cos 0^0)}$ ✓ $+ \underline{(245{,}94)(332{,}85)(\cos 180^0)}$ ✓ $+ mg\sin\theta\,\Delta x \cos\theta = 0$
$332{,}85\,F_e - 81861{,}13 + \underline{(1500)(9{,}8)(\sin{,}10{,}21^0)(332{,}85)(\cos 180^0)}$ ✓ $= 0$
$332{,}85\,F_e = 949158{,}63$
$F_e = 2851{,}61$ N
$P = F.v$✓
$= (2851{,}61)(10)$
$= 28516{,}10$ W✓ *(Accept: 28 539,33 W)* (7)

OR

$W_{nc} = \Delta Ep + \Delta Ek$✓
$W_f + W_{Fe} = mg\Delta h + \underline{0}$ ✓
$F_f\Delta x \cos\theta + F_e\Delta x \cos\theta = (1500)(9{,}8)(59)$ ✓
$\underline{(245{,}94)(332{,}85)(-1)}$ ✓ $+ \underline{332{,}85\,F_e}$✓ $= 867300$
$F_e = 2851{,}62$ N
$P = F.v$✓
$= (2851{,}62)(10)$
$= 28516{,}20$ W✓ (7)

[16]

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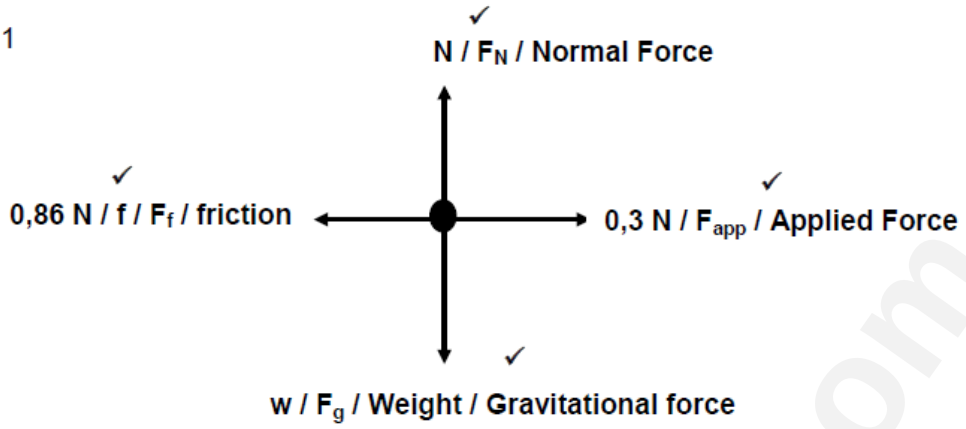
QUESTION 4

4.1



(4)

4.2 $F_{net} = F_{applied} + F_f = 0,30 + (-0,86) = -0,56$ N = 0,56 N opposite direction of motion/ to the left (3)

4.3 Work Energy theorem states that, the net/total work done on an object is equal to the change in the object's kinetic energy.
OR
the work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. (2)

4.4

$$W_{NET} = \Delta E_K$$
$$F_{net}\ \Delta x \cos \Theta = \tfrac{1}{2} mv_f^2 - \tfrac{1}{2} mv_i^2$$
$$0,56\ \Delta x \cos 180 = \tfrac{1}{2}(0,8)(0,2)^2 - \tfrac{1}{2}(0,8)(1,2)^2$$
$$(0,56) \times (\Delta x) \times (-1) = 0,016 - 0,576$$
$$\Delta x = 1 \text{ m}$$

OR

$$W_{NC} = \Delta E_K + \Delta E_P$$
$$f\ \Delta x \cos 180 + F_{APPL}\ \Delta x \cos 0 = \tfrac{1}{2} mv_f^2 - \tfrac{1}{2} mv_i^2 + 0$$
$$0,86.\ \Delta x \cos 180 + 0,3.\ \Delta x \cos 0 = \tfrac{1}{2}(0,8)(0,2^2) - \tfrac{1}{2}(0,8)\ 1,2^2$$
$$(-0,86 + 0,3).\ \Delta x = 0,016 - 0,576$$
$$\Delta x = 1 \text{ m}$$

(4)

4.5 Friction **OR** applied force (**note: symbols not accepted**) (1)

[14]

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QUESTION 5

5.1 The net (total) work done on an object ✓ is equal to the change in the object's kinetic energy. ✓ ***OR***
The work done on an object by a net (resultant) force ✓is equal to the change in the object's kinetic energy. ✓

(2)

5.2 $W_g = F_g \Delta y \cos\theta$ ✓
$= mg\Delta y \cos\theta$
$= (75)(9{,}8)(2{,}4 - 1{,}6)$✓ $\cos 0°$ ✓
$= 588\ \text{J}$ ✓

OR

work due to a conservative forces is equal to negative change in potential energy associated with that conservative force:

$W_c = -\Delta E_p$
$W_g = -mg(h_f - h_i)$ ✓
$= -(75)(9{,}8)$ ✓$(1{,}6 - 2{,}4)$ ✓
$= 588\ \text{J}$ ✓

(4)

5.3

$W_{net} = \Delta E_k$
$W_f + W_g$✓ $= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓
$W_f + 588$✓ $= \frac{1}{2}(75)(3{,}75^2$✓ $- 0^2$ ✓$)$
$W_f = -60{,}66\ \text{J}$ ✓

OR

$W_{nc} = \Delta E_p + \Delta E_k$
$W_f = mg(h_f - h_i) + \frac{1}{2}m(v_f^2 - v_I^2)$ ✓
$= (75)(9{,}8)$✓$((1{,}6 - 2{,}4))$✓ $+ \frac{1}{2}(75)((3{,}75^2$✓ $- 0^2)$)✓
$= -60{,}66\ \text{J}$ ✓

(6)

5.4.1 REMAINS THE SAME ✓ (1)

5.4.2 The gravitational force is conservative (non-contact) force✓, so the work done by the gravitational force will not depend on the path taken. ✓ The starting and ending points are the same. Therefore the work done by the gravitational force will remain the same.

(2)
[15]

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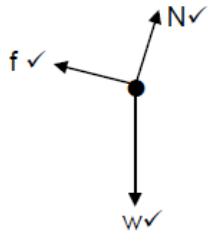
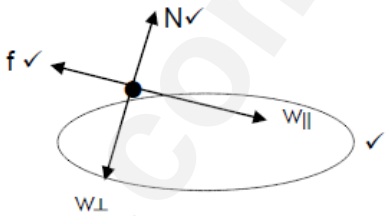
QUESTION 5/*VRAAG 5*

5.1

Accepted Labels/*Aanvaarde benoemings*	
w	F_g/F_w/force of Earth on crate/weight/39,2 N/mg/gravitational force *F_g/F_w/krag van Aarde op krat/gewig/39,2 N/mg/gravitasiekrag*
f	f / friction *f / wrywing*
N	Normal force / F_N / Force of surface on block *Normale krag / F_N / Krag van oppervlak op blok*





Notes / *Aantekeninge*

- Any additional forces max $\frac{2}{3}$

  Enige addisionel kragte maks $\frac{2}{3}$
- No arrows max $\frac{2}{3}$

  Geen pylpunte maks $\frac{2}{3}$
- Forces not touching dot max $\frac{2}{3}$

  Kragte wat nie kolletjie raak nie maks $\frac{2}{3}$

(3)

5.2 The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓
Die netto / totale arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp
OR/*OF*
The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy.✓✓
Die arbeid verrig op 'n voorwerp deur 'n resulterende / netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp . (2)

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5.3 **Incline/*Skuinsvlak***

$W_{fk} = f_k\Delta x\cos\theta$ ✓$= \mu_k N\Delta x\cos\theta$ ✓$= \mu_{k(}mg\cos30^o\Delta x\cos180^o$ ✓

$= (0,2)(4)(9,8)\cos 30^o(3)(-1)$✓

$= -20,3689$ J

$W_w = w\Delta x\cos60^o = (4)(9,8)(3)\cos 60^o = 58,8$ J

$W_{net} = \Delta K = K_f - K_i$. ✓

$W_w + W_N + W_f = K_f - 0$

$\underline{58,8 + 0 \ -620,3689)}$ ✓$= K_f$

$K_f = 38,431$J✓

Horizontal surface/*Horisontale opplervlak*

$W_{net} = \Delta K$

$W_w + W_N + W_f = K_f - K_i$

$0 + 0 + \mu_k N\Delta x\cos\theta = 0 - 38,431$

$\underline{(0,5)(4)(9,8)\Delta x\cos180^o = -38,431}$ ✓

$\Delta x = 1,96$ m ✓ (8)

[16]

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