PHYSICAL SCIENCES

MATERIAL FOR GRADE 12

SECOND TERM

WORK-ENERGY THEOREM

MEMORANDA

COMPILED BY EXPERTS: K. NCUBE & T. MJIKWA

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QUESTION 7/*VRAAG 7*

7.1 $200 \times 1\,000 = 2 \times 10^5$ kg ✓ [12.2.3] (1)

7.2 $E_{ki} + E_{pi} = E_{kf} + E_{pf}$ ✓ or/of $E_{mech\ i} = E_{mech\ f}$ or/*of* $\Delta E_p = \Delta E_k$

$0 + mgh_i = E_{kf} + 0$

$0 + (2 \times 10^5)(9,8)(150)$ ✓ $= E_{kf} + 0$ ✓

$\therefore E_{kf} = 2,94 \times 10^8$ J ✓

OR/*OF*

$W_{net} = \Delta E_k$

$F\cos\theta\ \Delta y = E_{kf} - E_{ki}$ ✓

$(200\,000)(9,8)(\cos 0^\circ)(150)$ ✓ $= E_{kf} - 0$ ✓

$\therefore E_{kf} = 2,94 \times 10^8$ J ✓ [12.2.3] (4)

7.3 $E_{kf} = \frac{1}{2} m v_f^2$ ✓

$2,94 \times 10^8$ J $= \frac{1}{2}(2 \times 10^5)v_f^2$ ✓

$v_f = 54,22\ m \cdot s^{-1}$ ✓ [12.2.3] (3)

7.4 $P = \frac{85}{100} \times \frac{W}{\Delta t} = \frac{85}{100} \times \frac{2,94 \times 10^8}{1}$ ✓

$= 2,499 \times 10^8$ W ✓ Accept/*Aanvaar* $2,5 \times 10^8$ W

OR/*OF*

E_k(effective/*effektief*) $= \frac{85}{100} \times 2,94 \times 10^8$ ✓ $= 2,499 \times 10^8$ J

$P = \frac{W}{\Delta t} = 2,499 \times 10^8$ W ✓ Accept/*Aanvaar* $2,5 \times 10^8$ W [12.2.3] (2)

7.5 Converted to sound / heat in turbine / other forms of energy. ✓
Omgeskakel na klank / hitte in die turbine / ander vorms van energie [12.2.3] (1)

[11]

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QUESTION 6/*VRAAG 6*

6.1.1 $W_{net} = \Delta E_p + \Delta E_k$ ✓

$\therefore W_{net} = (mgh_f - mgh_i) + (\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2)$

$\therefore 7 \times 10^5$ ✓ $- 8{,}5 \times 10^4$ ✓ $= 10\,000(9{,}8)(h_f - 0)$ ✓ $+ 0$ ✓

$\therefore 6{,}15 \times 10^5 = 10\,000(9{,}8)h_f$

$\therefore h_f = 6{,}28$ m ✓

OR/*OF*

Useful work done = gain in Ep ✓ = mgh ✓

Bruikbare arbeid verrig = *wins aan* Ep ✓ = mgh ✓

$\therefore 7 \times 10^5$ ✓ $- 8{,}5 \times 10^4$ ✓ $= 10\,000(9{,}8)h$ ✓

$\therefore 6{,}15 \times 10^5 = 10\,000(9{,}8)h_f$

$\therefore h = 6{,}28$ m ✓ [12.1.3] (6)

6.1.2 $W = F\Delta x \cos\theta$ ✓

$\therefore 7 \times 10^5 = F(23)(1)$ ✓

$\therefore F = 3{,}04 \times 10^4$ N ✓

$P = Fv$ ✓

$= (3{,}04 \times 10^4)(\frac{20\,000}{60 \times 60})$ ✓

$= 1{,}6 \times 10^5$ W ✓ [12.1.3] (6)

6.2 Any TWO/*Enige TWEE:*

Surface must provide sufficient friction like sand ✓

Must be long enough for vehicle to stop. ✓

Oppervlak moet genoeg wrywing lewer soos sand ✓

Moet lank genoeg wees om die voertuig tot stilstand te bring✓ [12.3.2] (2) **[14]**

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QUESTION 5/*VRAAG 5*

5.1 0 (N)/Zero/*nul* ✓
no acceleration/constant velocity ✓
geen versnelling/konstante snelheid [12.2.3] (2)

5.2 0 (J)/Zero/*nul* ✓ [12.2.3] (1)

5.3.1

Option 1/*Opsie 1*:
$U_i + K_i + W_{friction/wrywing} + W_{applied/toegepas} = U_f + K_f$ ✓
$0 + f\Delta x\cos\theta + W_{applied/toegepas} = mgh \quad (K_i = K_f)$
$0 + (50)(10)(-1)$ ✓ $+ W_{applied/toegepas} = (120)(9,8)(1,5)$ ✓ ✓
$\therefore W_{applied/toegepas} = 2\,264$ J ✓ $(2,26 \times 10^3$ J)

Accept/*Aanvaar*: E_k, E_p

Option 2/*Opsie 2*:
For equilibrium:/*Vir ewewig:*
$F = f + W_{parallel\ to\ incline/parallel\ met\ helling} = f + mg\sin\alpha$ (α - angle of incline with horizontal/*hoek van helling met horisontaal*)
$F = 50$ ✓ $+ (120)(9,8)(\frac{1,5}{10})$ ✓
$\therefore F = 226,4$ N
$W_{applied/toegepas} = F\Delta x\cos\theta$ ✓
$= (226,4)(10)(\cos 0°)$ ✓ OR $(226,4)(10)$
$= 2\,264$ J ✓ $(2,26 \times 10^3$ J)

+

Option 3/*Opsie 3*:
$W_{net/netto} = \Delta K$ ✓
$W_{applied/toegepas} + W_{friction/wrywing} + W_{gravity/gravitasie} = \Delta K$
$W_{applied/toegepas} + (50)(10)(-1)$ ✓ $- (120)(9,8)(1,5)$ ✓ $= 0$ ✓
$\therefore W_{applied/toegepas} = 2\,264$ J ✓ $(2,26 \times 10^3$ J)

Option 4/*Opsie 4*:
W(external forces/*eksterne kragte*) $= \Delta U + \Delta K$ ✓
OR/*OF*
$W_{applied/toegepas} + W_{friction/wrywing} = (U_f - U_i) + (K_f - K_i)/\Delta U + \Delta K$
$W_{applied/toegepas} + (50)(10)(-1)$ ✓ $= (120)(9,8)(1,5) - 0)$ ✓ $+ 0$ ✓
$\therefore W_{applied/toegepas} = 2\,264$ J ✓ $(2,26 \times 10^3$ J)

[12.1.3] (5)

5.3.2 $W_{applied/toegepas} = F\Delta x\cos\theta$ ✓
$2\,264$ J ✓ $= F(10)(1)$ ✓
$\therefore F = 226,4$ N ✓ $(2,26 \times 10^2$ N)

OR/*OF*
$F = f + W_{par\ to\ incline/par\ met\ helling} = f + mg\sin\beta$ ✓ (α - angle of incline with horizontal/*hoek van helling met horisontaal*)
$F = 50$ ✓ $+ (120)(9,8)(\frac{1,5}{10})$ ✓
$\therefore F = 226,4$ N ✓ $(2,26 \times 10^2$ N)

[12.2.3] (4)
[12]

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QUESTION 6/*VRAAG 6*

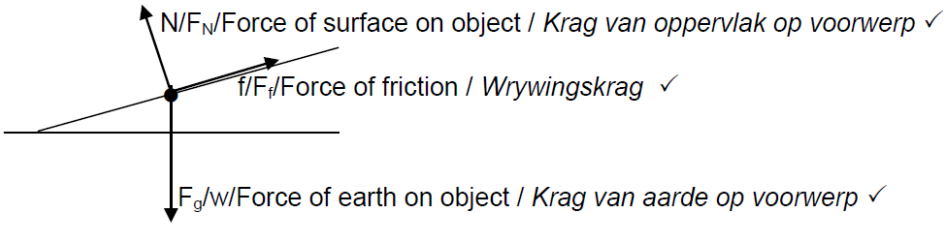
6.1 The net work done on an object is equal to the change in the object's kinetic energy. ✓✓
Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp.

Only/*Slegs* $\frac{2}{2}$ or/*of* $\frac{0}{2}$

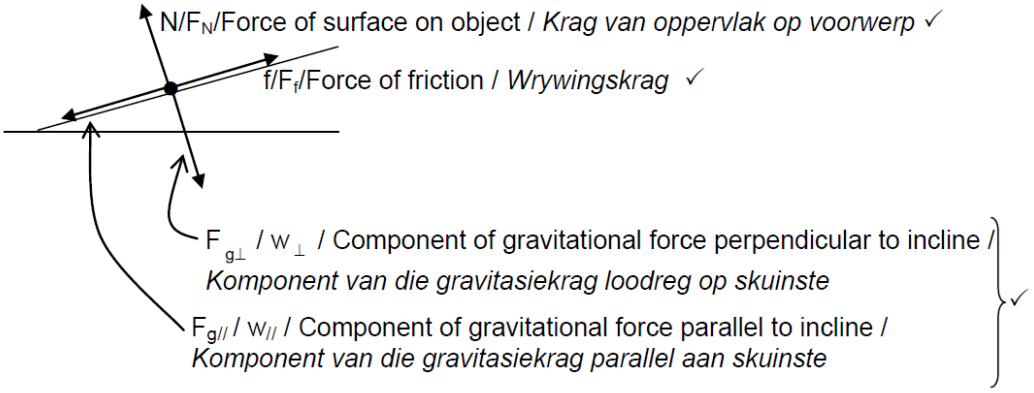
OR/*OF*
The work done on an object by a net force is equal to the change in the object's kinetic energy. / *Die arbeid verrig op 'n voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp.*

[12.2.1] (2)

6.2



OR/*OF*



[12.1.2] (3)

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6.3.1 $v_f^2 = v_i^2 + 2a\Delta x$ ✓
$= (0)^2 + (2)(2)(10)$ ✓
$= 40\ m^2 \cdot s^{-2}$

$E_{kf} = \frac{1}{2}m v_f^2$ ✓
$= \frac{1}{2}(60)(40)$ ✓
$= 1\ 200\ J$ ✓

OR/*OF*

$\Delta x = v_i \Delta t + \frac{1}{2}a\Delta t^2$ ✓
$10 = (0)\Delta t\ \ \frac{1}{2}(2)\ \Delta t^2$
$\therefore\ \Delta t = 3{,}16\ s$

$v_f = v_i + a\Delta t = 0 + (2)(3{,}16)$ ✓ $= 6{,}32\ m \cdot s^{-1}$

$E_{kf} = \frac{1}{2}m v_f^2$ ✓
$= \frac{1}{2}(60)(6{,}32)^2$ ✓
$= 1\ 200\ J$ ✓

Accept/*Aanvaar:*
E_k / K
$v^2 = u^2 + 2as$ / $s = ut + \frac{1}{2}at^2$ / $v = u + at$
A mixture of the two allowed formulae is not accepted. / *'n Mengsel van die twee erkende formules word nie aanvaar nie.*

[12.1.3] (5)

6.3.2 $W_g = w_{//}\ \Delta x \cos\theta$ ✓
$= mg\sin 25°$ ✓ $(10)(\cos 0°)$ ✓
$= (60)(9{,}8)\sin 25° 10(1)$
$= 2\ 485\ J$ ✓

OR/*OF*

$W_g = w\Delta x \cos\theta$ ✓
$= mgh\cos 0°$
$= (60)(9{,}8)$ ✓ $(10)\sin 25°(1)$ ✓
$= 2\ 485\ J$ ✓

OR/*OF*

$W_g = -\Delta U$ ✓
$= -(0 - mgh)$ ✓
$= -(0 - (60)(9{,}8)(10)\sin 25°$ ✓
$= 2\ 485\ J$ ✓

[12.2.3] (4)

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6.3.3

OPTION 1/*OPSIE 1:*

$W_{net} = \Delta E_k$ ✓

$W_{g(\text{parallel to slope/}parallel\ aan\ helling)} + W_f = \Delta E_k$ ✓

$2\,485 + W_f = 1\,200$ ✓

$W_f = -1\,285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

OPTION 2/*OPSIE 2:*

$W_{net} = W_g + W_f$ ✓

$ma\Delta x = W_g + W_f$

$(60)(2)(10)$ ✓ $= 2\,485$ ✓ $+ W_f$

$\therefore W_f = -1\,285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

OPTION 3/*OPSIE 3:*

$W_{(\text{applied/}toegepas)} = \Delta E_k + \Delta E_p - W_f$

$0 = (\frac{1}{2}m v_f^2 - 0) + (0 - mgh) - W_f$ **Max./*Maks.*:** $\frac{3}{4}$

$0 = \frac{1}{2}m v_f^2 - mgh - W_f$ ✓

$0 = 1\,200 - 2\,485 - W_f$ ✓

$\therefore W_f = -1\,285$ J ✓

$W_{appl/toegep} = \Delta U + \Delta K + W_f$ $\frac{0}{4}$

Marking rule 1.6
Nasienreël 1.6

OPTION 4 / *OPSIE 4*:

$(U + K)_i + W_f = (U + K)_f$ **Max./*Maks.*:** $\frac{3}{4}$

$mgh + 0 + W_f = 0 + \frac{1}{2}m v_f^2$ ✓

$2\,485 + W_f = 1\,200$ ✓

$W_f = -1\,285$ J✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

$(U + K)_i - W_f = (U + K)_f$ $\frac{0}{4}$

Marking rule 1.6
Nasienreël 1.6

OPTION 5/*OPSIE 5:*

$W_{nc} = \Delta E_k + \Delta E_p$ ✓

$= (\frac{1}{2}m v_f^2 - 0) + (0 - mgh)$

$= \frac{1}{2}m v_f^2 - mgh$ ✓

$= 1\,200 - 2\,485$ ✓

$\therefore W_{nc} = W_f = -1\,285$ J ✓ (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)

Marking rule 1.6
Nasienreël 1.6

(4)

[12.2.3]

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6.3.3

OPTION 1/*OPSIE 1*

$W_f = F_f \Delta x \cos\theta$ ✓

$-1\,285 = f(10)\cos 180°$ ✓

$F_f = 128{,}5$ N ✓

OPTION 2/*OPSIE 2*

$F_{net} = F_{g(\text{parallel to slope/}parallel\ aan\ helling)} - F_f$ ✓

$ma = mg\sin 25° - F_f$

$(60)(2) = (60)(9{,}8)\sin 25° - F_f$ ✓

$F_f = 128{,}5$ N ✓

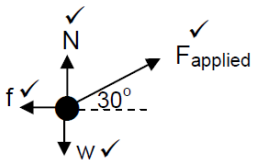
[12.2.3] (3)

[21]

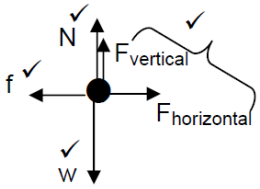
QUESTION 5

Accepted Labels	
N	Normal / Force of surface on crate / F_N / 269 N / 275 N
w	F_g / force of Earth on crate / weight / 294 N /300 N mg / gravitational force
$F_{applied}$	F / force of worker on crate / 50 N / F_A
f	$F_{friction}$ / 20 N / F_f / friction
$F_{horizontal}$ / F_x / $F_{//}$	43,30 N
$F_{vertical}$ / F_y / $F_\perp$	25 N

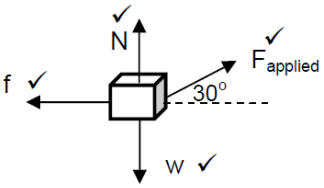
5.1



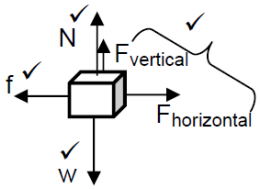
OR



Accept: Force diagram



OR



[12.1.2] (4)

5.2 $W = F\Delta x \cos 90° ✓✓ = 0$

OR

They (normal force and the gravitational force) are perpendicular /at 90° to the (direction of the) displacement / motion / Δx ✓✓ of the crate.

OR

The angle between the force and displacement / motion / Δx is 90°. ✓✓

OR

The crate moves horizontally and the forces act vertically. ✓✓ [12.2.2] (2)

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5.3

Accepted symbols for applied force: F_{appl} / F / F_A
Accepted symbols for frictional force: f / F_f / $F_{friction}$
Accepted symbols for gravitational force: w / F_g / $F_{force\ of\ Earth\ on\ crate}$ / gravitational force

OPTION 1

$W_{net} = W_{appl} + W_f$ } ✓ For either formula
$= F_{app}\ \Delta x \cos\theta + f\Delta x \cos\theta$
$= \underline{(50)(6)(\cos 30°)}$✓ + $\underline{(20)(6)(\cos 180°)}$ ✓
$= 259{,}81 + (-120)$
$W_{net} = 139{,}81$ J ✓

OPTION 2

$W_{applied} = F_{app}\ \Delta x \cos\theta$
$= \underline{(50)(6)(\cos 30°)}$✓
$= 259{,}81$ J
$W_f = f\Delta x \cos\theta$
$= \underline{(20)(6)(\cos 180°)}$ ✓
$= -120$ J

$W_{net} = W_{applied} + W_f$ ✓ OR $F_{app}\Delta x\cos\theta + F\Delta x\cos\theta$
$= 139{,}81$ J ✓

OPTION 3

$W_{net} = W_{appl\ //} + W_f$ } ✓ For either formula
$= F_{app//}\ \Delta x \cos\theta + f\Delta x \cos\theta$
$= \underline{(50)(\cos 30°)(6)\cos 0°}$✓ + $\underline{(20)(6)(\cos 180°)}$ ✓
$= 259{,}81 + (-120)$
$W_{net} = 139{,}81$ J ✓

OPTION 4

$F_{net} = F_{horizontal} + f$
$= \underline{(50)(\cos 30°) + (-20)}$ ✓
$= 23{,}30$ N

$W_{net} = F_{net}\ \Delta x \cos\theta$ ✓
$= \underline{(23{,}30)(6)(\cos 0°)}$ ✓
$= 139{,}81$ J✓

OPTION 5

$F_{net} = F_{horizontal} + f$
$ma = \underline{(50)(\cos 30°) + (-20)}$ ✓
$(30)a = (50)(\cos 30°) + (-20)$
$a = 0{,}776...\ m\cdot s^{-2}$

✓one mark for all three formulas

$v_f^2 = v_i^2 + 2a\Delta x$
$= (0)^2 + 2(0{,}78...)(6)$
$v_f = 3{,}052...\ m\cdot s^{-1}$

$W_{net} = \Delta K = \frac{1}{2}\ m(v_f^2 - v_i^2)$
$= \underline{\frac{1}{2}\ (30)(3{,}052...^2 - 0^2)}$ ✓
$= 139{,}81$ J✓

[12.1.3] (4)

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5.4

$W_{net} = \Delta K$ / $W_{net} = \Delta E_k$ ✓
$= ½ mv_f^2 - ½ mv_i^2$
$\underline{139,81 = ½ (30)v_f^2 - 0}$ ✓
$v_f = 3,05 \text{ m·s}^{-1}$ ✓

If: W instead of W_{net} max $(2/3)$
No marks for any other method

[12.2.3] (3)

5.5 Greater than ✓

The horizontal component (of the force) / force in direction of motion will now be greater / F_{net} will now be greater.✓

OR
As θ decreases cos θ increases✓

OR
For θ smaller than 30°, cos θ > cos 30°.✓

(2)
[12.3.2] **[15]**

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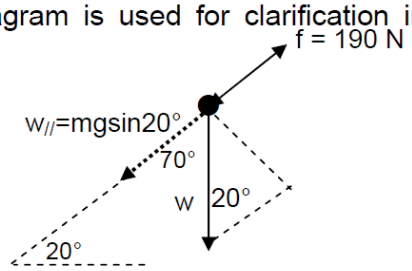
QUESTION 5

5.1 R: Force of incline (surface) on crate / N / Normal (force) / F_N ✓
S: Gravitational force / Gravity / force of Earth on crate / F_g / w / $F_{Earth\ on\ crate}$ ✓
T: Frictional force/F_f/$F_{friction}$/f✓ [12.1.2] (3)

5.2 The force is <u>perpendicular</u> <u>to</u> ✓ <u>the displacement</u> ✓of the crate.

OR
$W = F\ \Delta x \cos 90° ✓ = 0$ ✓ [12.2.1] (2)

5.3 The following diagram is used for clarification in the solutions below.



<u>OPTION 1</u>

$W_{net} = W_w + W_f$ ✓
$= mg\Delta x\cos 70° + f\Delta x\cos 180°$
$= \underline{(70)(9,8)}$ ✓ $\underline{(12)(\cos 70°)}$✓ + $\underline{(190)(12)(-1)}$ ✓
$W_{net} = 535,51$ J ✓

Accept: cos180° or -1

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OPTION 2

$F_{net} = w_{//} + f$
$= mg\sin 20° + (-190)$
$= (70)(9,8)\sin 20°$ ✓ $- 190$ ✓
$= 44,63$ N

Accept:
cos0° or 1

$\therefore W_{net} = F_{net}\Delta x\cos\theta$ ✓
$= (44,63)(12)(\cos 0°)$ ✓
$W_{net} = 535,51$ ✓

OPTION 3

$W_{net} = W_{w//} + W_f$ ✓
$= mg\sin 20°\Delta x\cos 0° + f\Delta x\cos 180°$
$= (70)(9,8)\sin 20°$ ✓ $(12)\cos 0°$ ✓ $+ (190)(12)\cos 180°$ ✓
$W_{net} = 535,51$ J ✓

Accept:
cos0° or 1
cos180° or -1

5.3

OPTION 4

$W_{net} = W_w + W_f$ ✓
$= mgh\cos 0° + f\Delta x\cos 180°$
$= (70)(9,8)$ ✓ $(12\sin 20°)\cos 0°$ ✓ $+(190)(12)\cos 180°$ ✓
$W_{net} = 535,51$ J ✓

Accept:
cos0° or 1
cos180° or -1

[12.1.3] (5)

5.4 The net 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 force is equal to the change in (the object's) kinetic energy. [12.2.1] (2)

5.5 $W_{net} = \Delta K$ ✓ (OR $W_{net} = \Delta E_k$)
$535,51 = \frac{1}{2} m(v_f^2 - v_i^2)$
$535,51$ ✓ $= \frac{1}{2}(70)(v_f^2 - 4)$ ✓
$v_f = 4,39\ m\cdot s^{-1}$ ✓

[12.2.3] (4)
[16]

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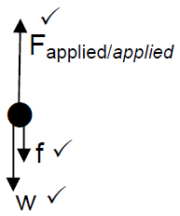
QUESTION 5 / *VRAAG 5*

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

5.2



(3)

5.3 Gravitational force/weight (of soldier) ✓
Gravitasiekrag/gewig (van soldaat) (1)

5.4 $W_{net} = \Delta K$ ✓

$F\Delta y\cos\theta + F_w\Delta y\cos\theta + W_f = \Delta K$

$(960)(20)\cos 0°$ ✓ + $(80)(9{,}8)(20)\cos 180°$ ✓ + $W_f = 0$ ✓

$19\,200 - 15\,680 + W_f = 0$

$W_f = -3\,520$ J ✓ (5)

[11]

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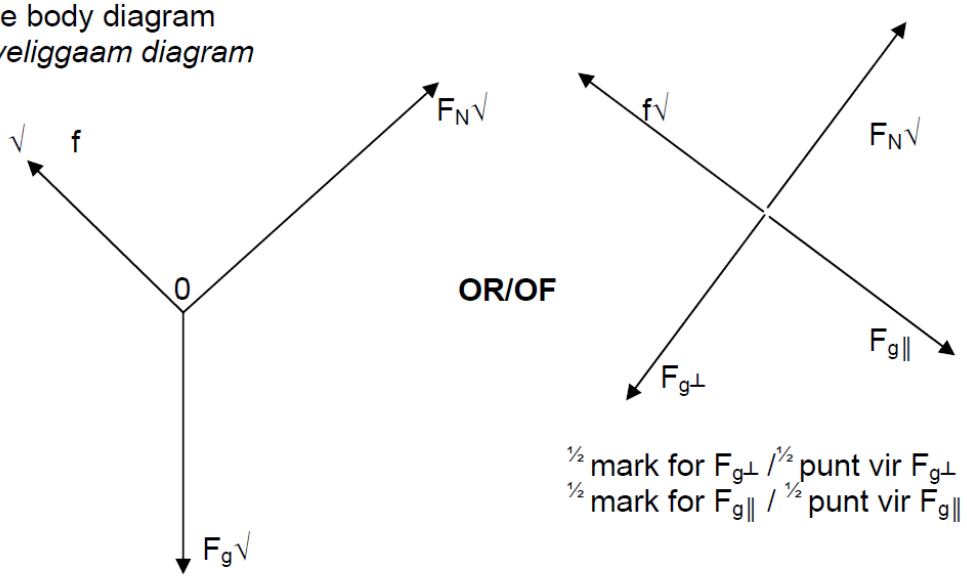
QUESTION/*VRAAG* 5

5.1 free body diagram
vryeliggaam diagram



½ mark for $F_{g\perp}$ / ½ punt vir $F_{g\perp}$
½ mark for $F_{g\parallel}$ / ½ punt vir $F_{g\parallel}$

F_N = Normal Force / normaalkrag (3)

f = Frictional Force */wrywingkrag*
F_g = Gravitational Force */gravitasiekrag*
$F_{g\perp}$ = Component of gravitational force perpendicular to the slope
Komponent van gravitasiekrag loodreg op die skuinsvlak
$F_{g\parallel}$ = Component of Gravitational Force parallel to the slope
Komponent van gravitasiekrag parallel aan die skuinsvlak (3)

5.2 5.2.1
$F_{Net} = F_{g\parallel} + f$ √
$= mg \sin \alpha + f$
$= (58)(9,8)(\sin 25°) - 70$√
$= 170,22$ N downhill/*afdraend*√ (3)

5.2.2
$W_{Net} = F_{net} \cos \theta \, \Delta x$√
$= (170,22 \cos 0°) \times 57$√
$= 9,69 \times 10^3$ J√ (3)

5.2.3
$W_{Net} = \Delta E_k$√
$= E_{kf} - E_{ki}$
$9\,690 = E_{kf} - (½\ 58\ (3,6^2))$√
$E_{kf} = 10\,065,84$ J√ (3)

5.2.4
$E_{kf} = ½ mv^2$ √
$10\,065,84 = ½\ 58\ v_f^2$ √
$v = 18,63$ m.s^{-1} √ (3)
[15]

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QUESTION 5/*VRAAG 5*

5.1 The energy of an object due to its position ✓
above the surface of the earth. ✓

Die energie van 'n voorwerp as gevolg sy posisie ✓
bokant die oppervlak van die aarde. ✓ (2)

5.2

Option 1/*Opsie 1:*

$W_{net} = \Delta K$ ✓
$mg\Delta y\cos\theta + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(2)(9,8)(2)\cos 0° \checkmark + W_f \checkmark = \frac{1}{2}(2)(5)^2 \checkmark - 0$ ✓
$\therefore W_f = -14,2$ J ✓

Option 2/*Opsie 2:*

$W_{net} = \Delta K$ ✓
$-\Delta U + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$mgh + W_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
$(2)(9,8)(2) \checkmark + W_f \checkmark = \frac{1}{2}(2)(5)^2 \checkmark - 0$ ✓
$\therefore W_f = -14,2$ J ✓ (6)

5.3 No/Nee ✓
Friction is present/*Wrywing is aanwesig*. ✓ (2)

5.4.1 $\Sigma p_{before} = \Sigma p_{after}$ ✓
$(2)(5) + (9)(0) \checkmark = 2v_{f2} + (9)(1)$ ✓

$\therefore v_{f2} = 0,5\ m\cdot s^{-1}$ ✓ (4)

Notes/*Aantekeninge:*
Other formulae/*Ander formules*:
$m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

5.4.2 K(total after/*total na*) $= \frac{1}{2}m_1v_f^2 + \frac{1}{2}m_2v_f^2$ ✓
$= \frac{1}{2}(2)(0,5)^2 \checkmark + \frac{1}{2}(9)(1)^2 \checkmark$
$= 4,75$ J ✓
K(total before) $\neq$ K(total after) ✓
$\therefore$ inelastic

K(totaal na) $\neq$ *K(totaal voor)* ✓
$\therefore$ *onelasties* (5)
[19]

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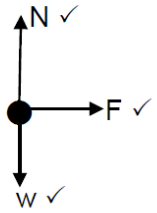
QUESTION 5/*VRAAG 5*

5.1



(3)

5.2 The net (total) work (done on an object) is equal to ✓
the change in kinetic energy (of the object.) ✓
Die netto (totale) arbeid verrig (op 'n voorwerp) is gelyk aan ✓
die verandering in kinetiese energie (van die voorwerp). ✓ (2)

5.3

5.3.1 $W_{net} = \Delta E_k/\Delta K$ ✓ **OR/*OF*** $F_{net}\Delta x\cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$

$F_{net}(1{,}02)\cos 180° \checkmark = \frac{1}{2}(1\,200)(0 - 20^2)$ ✓

$F_{net} = 235\,294{,}12$ N ✓ ($2{,}35 \times 10^5$ N)

(4)

5.3.2

OPTION 1 /*OPSIE 1*	**OPTION 2/*OPSIE 1***
$F_{net}\Delta t = m\Delta v$ ✓ $\therefore (-235\,294{,}12)\Delta t \checkmark = (1\,200)(0 - 20)$ ✓ $\therefore \Delta t = 0{,}1$ s ✓(0,102 s)	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ ✓ $1{,}02 \checkmark = \left(\frac{20 + 0}{2}\right)\Delta t$ ✓ $\Delta t = 0{,}1$ s✓

(4)
[13]

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QUESTION 5/*VRAAG 5*

5.1 The total mechanical energy remains constant / is conserved ✓
in a closed / isolated system / in absence of external forces /non-conservative forces. ✓
Die totale meganiese energie in bly konstant / bly behoue in 'n geslote / geïsoleerde sisteem /in afwesigheid van eksterne kragte /nie-konserwatiewe kragte.

OR/*OF*
The sum of the potential and kinetic energy of a system remains constant ✓
in a closed/isolated system. ✓
Die som van die potensiële en kinetiese energie van *'n sisteem bly konstant in 'n geslote / geïsoleerde sisteem.*

OR/*OF*
When the work done on an object by the non-conservative forces is zero✓,
the total mechanical energy is conserved. ✓
Wanneer die arbeid deur die nie-konserwatiewe kragte op 'n voorwerp verrig nul is, bly die totale meganiese energie behoue. (2)

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5.2

OPTION 1/*OPSIE 1*

$E_{mechanical\ at\ X} = E_{mechanical\ at\ Y}$
$(E_p + E_k)_X = (E_p + E_k)_Y$
$(mgh + ½ mv^2)_X = (mgh + ½ mv^2)_Y$ } ✓Any one/*Enige een*

$\underline{5(9,8)(5)} + ½(5)(0^2)$✓ $= \underline{(5)(9,8)(1) + ½(5)v_f^2}$ ✓
$v = 8,85\ m{\cdot}s^{-1}$ ✓

OPTION 2/*OPSIE 2*

$E_{mechanical\ at\ X} = E_{mechanical\ at\ Y}$
$(E_p + E_k)_X = (E_p + E_k)_Y$
$(mgh + ½ mv^2)_X = (mgh + ½ mv^2)_Y$ } ✓ Any one/*Enige een*

$\underline{5(9,8)(4)} + ½(5)(0^2)$✓ $= \underline{(5)(9,8)(0) + ½(5)v_f^2}$ ✓
$v = 8,85\ m{\cdot}s^{-1}$ ✓

(4

5.3 Weight / gravitational (force) / (force of) gravity ✓
Gewig / Gravitasie(krag)
Normal force / *Normaalkrag* ✓ (2

5.4 Z to/*na* Y ✓ (1

5.5

OPTION 1/*OPSIE 1*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$mg\Delta y\cos 0° + f\Delta x\cos 180° = ½ m(v_f^2 - v_i^2)$
$(5)(9,8)(1)(1)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 2/*OPSIE 2*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$-\Delta E_p + W_f = ½m(v_f^2 - v_i^2)$
$-(0 - mgh) + f\Delta x\cos 180° = ½ m(v_f^2 - v_i^2)$
$(5)(9,8)(1)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 3/*OPSIE 3*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$-\Delta E_p + W_f = ½m(v_f^2 - v_i^2)$
$-(0 - mgh) + f\Delta x\cos 180° = ½ m(v_f^2 - v_i^2)$
$(5)(9,8)(5)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 0^2)$ ✓
$\Delta x = 20,48$ m ✓

OPTION 4/*OPSIE 4*

$W_{net} = \Delta K$ ✓
$W_w + W_f = ½m(v_f^2 - v_i^2)$
$mg\Delta x\cos(90° - \theta) + f\Delta x\cos 180° = ½ m(v_f^2 - v_i^2)$
$mg\Delta x\sin\theta + f\Delta x\cos 180° = ½ m(v_f^2 - v_i^2)$
$mg\Delta x\left(\frac{1}{\Delta x}\right) + f\Delta x\cos 180° = ½ m(v_f^2 - v_i^2)$
$(5)(9,8)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= ½(5)(4^2 - 8,85^2)$ ✓
$\Delta x = 20,48$ m ✓

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OPTION 5/*OPSIE 5*

$W_{net} = \Delta K$ ✓

$W_{w||} + W_f = \frac{1}{2}m(v_f^2 - v_i^2)$

$mg\sin\theta\Delta x\cos\theta + f\Delta x\cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$

$mg\left(\frac{1}{\Delta x}\right)\Delta x\cos 0° + f\Delta x\cos 180° = \frac{1}{2} m(v_f^2 - v_i^2)$

$(5)(9,8)$ ✓ $+ (10)\Delta x(-1)$ ✓ $= \frac{1}{2}(5)(4^2 - 8,85^2)$ ✓

$\Delta x = 20,48$ m ✓

OPTION 6/*OPSIE 6*

$W_{net} = \Delta K$ ✓

$F_{net}\Delta x\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$

$(10 - 49\sin\theta)\Delta x\cos 180° = \frac{1}{2} m(v_f^2 - v_i^2)$

$(10 - 49\left(\frac{1}{\Delta x}\right))$✓$\Delta x\cos 180° = \frac{1}{2} m(v_f^2 - v_i^2)$

$(10\Delta x - 49)(-1)$✓ $= \frac{1}{2}(5)(4^2 - 8,85^2)$ ✓

$\Delta x = 20,48$ m

OPTION 7/*OPSIE 7*

$W_{nc} = \Delta E_p + \Delta E_k$✓

$f\Delta x\cos\theta = (mgh_f - mgh_i) + (\frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2)$

$(10)\Delta x\cos 180°$ ✓$= [0 - (5)(9,8)(1)]$ ✓ $+ [\frac{1}{2}(5)(4)^4 - \frac{1}{2}(5)(8,85)^2$✓

$\Delta x = 20,48$ m✓

(5)

5.6 Equal to / *Gelyk aan* ✓ (1)

[15]

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QUESTION/*VRAAG 4*

4.1 Its velocity decreases √ (from 12 $m.s^{-1}$ to 0 $m.s^{-1}$) as it moves up √/uniform deceleration as it moves up.
Sy snelheid neem af √ (van 12 $m.s^{-1}$ tot 0 $m.s^{-1}$) terwyl dit op beweeg √/uniforme vertraging terwyl dit op beweeg. [12.2.1] (2)

4.2 $\Delta E_k = E_{kf} - E_{ki}$ √
$= ½ (5)(0)^2 - ½ (5)(12)^2$ √
$= -360$ J √ [12.1.3] (3)

4.3 POSITIVE MARKING FROM 4.2/*POSITIEWE NASIEN VAN 4.2*

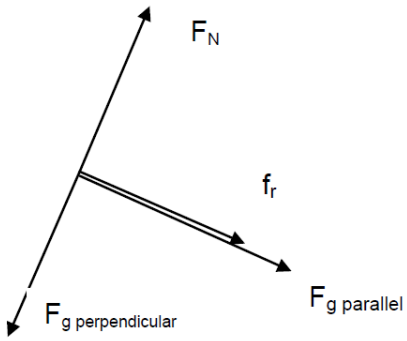
-360 J √ [12.1.3] (1)

4.4 The work done by a net force (on an object) is equal to √ the change in kinetic energy (of that particular object). √/
Die arbeid verrig deur 'n netto/resultante krag is gelyk aan √ die verandering in kinetiese energie (van die voorwerp). √

OR/OF

The net/total work (done on an object) is equal to √ the change in kinetic energy (of the object).√/
Die netto/totale arbeid verrig (op 'n voorwerp) is gelyk aan √ die verandering in kinetiese energie (van die voorwerp). √ [12.12.1] (2)

4.5



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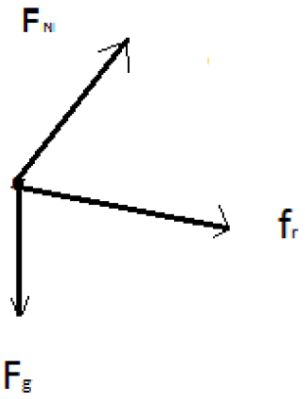
4.5



One mark for $F_{N\rightarrow}$ Normal force/ *normaalkrag*
One mark for $F_{fr\rightarrow}$ frictional force/*wrywing*
One mark for $F_{g\perp}$ and $F_{g\parallel}$ (components of gravitational force) / *komponente van gravitasiekrag*

OR/*OF*

one mark for F_g gravitational force/ *gravitasiekrag* [12.1.3] (3)

4.6 $W_{Fg} = F_g \cos \Theta \Delta x$ √

$= mg \cos \Theta \Delta x$

$= 5 \times 9,8 \cos (16^\circ + 90^\circ)(8,4)$ √

$= -113,45$ J √

OR/*OF*

$W_{Fg} = mg \Delta h$ √

$= 5\ (9,8)\ (0-8,4 \sin 16^\circ)$ √

$= -113,45$ J√ [12.1.3] (3)

4.7 POSITIVE MARKING FROM/POSITIEWE NASIEN VAN QUESTION/VRAAG 4.2 AND/EN QUESTION/VRAAG 4.6

$W_{NET} = \Delta E_k$√

$W_{fr} + W_{Fg\parallel}$ √ $= \Delta E_k$ ($W_N = 0$ J and/*en* $W_{Fg\perp} = 0$ J) since/*omdat* $\cos 90^\circ = 0$

$W_{fr} + (-113,45)$ √ $= -360$ √

$W_{fr} = -246,55$ J √

OR/*OF*

$W_{NET} = \Delta E_k$√

$F_{NET} \Delta x \cos \Theta$√ $= \Delta E_k$

$F_{NET}\ (8,4) \cos 180^\circ = -360$ √

$(F_{fr} + F_{g\parallel})\ (8,4) \cos 180^\circ = -360$

$F_{fr}\ (8,4) \cos 180^\circ + f_{g\parallel}\ (8,4) \cos 180^\circ = -360$

$W_{fr} + 13,506\ (-1)\ 8,4$ √ $= -360$

$W_{fr} = -246,55$ J √ [12.1.3] (5)

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QUESTION 4/*VRAAG 4*

4.1

$W_{net} = \Delta K$ ✓ $W_{net} = ½ (M + m)(v_f^2 - v_i^2)$ $W_{fr} = f\Delta x\cos\theta$ ✓$= ½ (M + m)(v_f^2 - v_i^2)$ $10 \times 2 \cos 180$✓$= \frac{½ (7,02)(0-v^2)}{(2,387)\ m\cdot s^{-1}}$ ✓ $v_{bb} = 2,39\ m\cdot s^{-1}$ ✓	**Notes / *Aantekeninge*** 1 mark for either of the formulae indicated *1 punt vir enige van die formule aangedui* **Accept/*Aanvaar*** $W_{nc} = \Delta K + \Delta U$ with $\Delta U = 0$

(5)

4.2

The total linear momentum of an (isolated) closed system remains constant. *Die totale lineêre momentum in 'n geslote (geïsoleerde) sisteem bly konstant* **ACCEPT/*AANVAAR*** In an isolated system the total momentum before collision equals the total momentum after collision. *In 'n (geïsoleerde) geslote sisteem is die totale momentum voor botsing gelyk aan die totale momentum na botsing.*	**Notes/*Aantekeninge*** 2 or/*of* 0

(2)

4.3.

Positive marking from QUESTION 4.1 **Positiewe nasien vanaf VRAAG 4.1** $\Sigma p_i = \Sigma p_f$ ✓ $m_1v_{1i} + m_2v_{2i} = (m_1 + m_2)v_f$ $0,02v_i + (7)(0) = (7,02)(2,39)$ $0,02v_i$✓ $= 7,02\ (2,39)$✓ $v_i = 838,89\ m\cdot s^{-1}$ ✓	**Notes / *Aantekeninge*** Accept/*Aanvaar* $(m_1 + m_2)v_i = m_1v_{1f} + m_2v_{2f}$ $837,84\ m\cdot s^{-1}$ (for learners working with $2,387\ m\cdot s^{-1}$/*vir leerders wat met* $2,387\ m\cdot s^{-1}$ *werk*)

(4)
[11]

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QUESTION 5/*VRAAG 5*

5.1 If the work done in moving an object between two points depends on the path taken (then the force applied is non-conservative) ✓✓(2 or/*of* 0).
Indien die arbeid verrig om 'n voorwerp tussen twee punte te beweeg, afhanklik is van die pad wat gevolg word, (is die krag wat toegepas word, nie-konserwatief) (2)

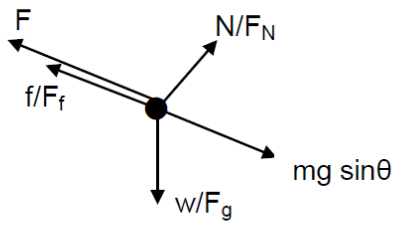
5.2.1 No/*Nee* ✓ (1)

5.2.2 Since there is no acceleration, the net force is zero ✓hence net work done (which is $F_{net}\Delta x \cos\theta$) must be zero. ✓
Omdat daar geen versnelling is nie, is die netto krag nul. Dus moet die netto arbeid verrig (wat $F_{net}\Delta x \cos\theta$ is) nul wees.

OR/*OF*
$W_{net} = \Delta K$.
Since it is moving with constant velocity ✓*Omdat dit teen konstante snelheid beweeg*
$\Delta K = 0 \therefore W_{net} = 0$✓ (2)

5.3

$F_{//} - (f + F) = 0$✓
OR/*OF*
$F = mg\sin\theta - f_k$
OR/*OF*
$F = mg\sin\theta - 266$
$F = [100(9,8)\sin 25\,°]$✓ – 266✓
414,167- 266
$F = 148,17$ N✓



(4)

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NOTE/*LET WEL*
No mark for diagram / *Geen punt vir diagram nie*
1 mark for use of any of the three formulae / *1 punt vir gebruik van enige drie van die formules*

5.4

OPTION 1/*OPSIE 1*

1 mark for any of the three/
1 punt vir enige van die drie

$W = F\Delta x\cos\theta$
$W_{net} = W_f + W_g + W_N$
$W_{net} = f_k\,\Delta x\cos 180^\circ$ ✓ $+ mg\sin\theta\,\Delta x\cos 0^\circ + 0$
$= (266)(3)(-1)$ ✓ $+ [100(9,8)\sin 25^\circ(3)(1)]$ ✓ $+ 0$
$= 444,5$ J
$W_{net} = \Delta E_K / \Delta K = \frac{1}{2} m(v_f^2 - v_i^2)$ ✓
$444,5 = \frac{1}{2}(100)(v_f^2 - 0)$ ✓
$v_f = 2,98\ m\cdot s^{-1}$ ✓ (6)

OPTION 2/*OPSIE 2*
$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$f\Delta x\cos\theta$ ✓ $= (mgh_f - mgh_i) + (\frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2)$
$266\Delta x\cos 180^\circ$ ✓ $= (0 - mg\sin 25^\circ\,\Delta x\cos 0^\circ) + (\frac{1}{2} mv_f^2 - 0)$
$266(3)(-1) = [-100(9,8)\sin 25^\circ(3)(1)]$ ✓ $-\frac{1}{2}(100)(v_f^2 - 0)$ ✓
$v_f = 2,98\ m\cdot s^{-1}$ ✓ (6)

OPTION 3/*OPSIE 3*
POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3
$W_{net} = \Delta E_k$ ✓
$F_{net}\Delta x\cos\theta$ ✓ $= \frac{1}{2} m(v_f^2 - v_i^2)$
$(148,17)$ ✓ $(3)\cos 0^0$ ✓ $= \frac{1}{2}(100)(v_f^2 - 0^2)$
$444,51 = 50v_f^2$ ✓
$v_f = 2,98\ m\cdot s^{-1}$ ✓ (6)

OPTION 4/*OPSIE 4*
POSITIVE MARKING FROM QUESTION 5.3
POSITIEWE NASIEN VANAF VRAAG 5.3
$F_{net} = ma$ ✓
$148,17$ ✓ $= 100a$ ✓
$a = 1,48\ m\cdot s^{-2}$
$v_f^2 = v_i^2 + 2a\Delta x$ ✓
$= 2(1,48)(3)$ ✓
$v_f = 2,98\ m\cdot s^{-1}$ ✓ (6)

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OPTION 5/*OPSIE 5*

POSITIVE MARKING FROM QUESTION 5.3

POSITIEWE NASIEN VANAF VRAAG 5.3

$F_{net} = ma$ ✓

$148,17$✓ $=100a$✓

$a = 1,48\ m{\cdot}s^{-2}$

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

$3 = 0 + \frac{1}{2}(1,48)\Delta t^2$ ✓

$\Delta t = 2,01\ s$

$v_f = v_i + a\Delta t$

$= 0 + (1,48)(2,01)$✓

$v_f = 2,97\ m{\cdot}s^{-1}$✓

(6)

OPTION 6/*OPSIE 6*

POSITIVE MARKING FROM QUESTION 5.3

POSITIEWE NASIEN VANAF VRAAG 5.3

$F_{net} = ma$ ✓

$148,17$✓ $=100a$ ✓

$a = 1,48\ m{\cdot}s^{-2}$

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

$3 = 0 + \frac{1}{2}(1,48)\Delta t^2$ ✓

$\Delta t = 2,01\ s$

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

$3 = \left(\frac{0 + v_f}{2}\right)(2,01)$

$v_f = 2,99\ m{\cdot}s^{-1}$✓

(6)

[15]

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QUESTION 4/*VRAAG 4*

4.1 TO THE LEFT/*NA LINKS* ✓ (1)

4.2 (Newton's) Third Law (of motion)/(*Newton) se Derde (Bewegingswet*).✓ (1)

4.3 In an isolated/closed system, ✓ the total mechanical energy is conserve remains constant. ✓
In 'n geïsoleerde/geslote sisteem ✓ bly die totale meganiese energie behoue/bly konstant. ✓

OR/*OF*

The total mechanical energy of a system remain constant ✓ provided the net work done by external non conservative forces is zero. ✓
Die totale meganiese energie van 'n sisteem bly konstant, ✓mits die arbeid verrig deur eksterne nie-konservatiewe kragte, nul is. ✓

OR/*OF*

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In the absence of a non-conservative force, ✓the total mechanical energy is conserved/remain constant. ✓
In die afwesigheid van 'n nie-konservatiewe krag, ✓ bly die totale meganiese energie behoue/konstant. ✓

OR/*OF*

In an isolated/closed system, ✓ the sum of kinetic and gravitational potential energy is conserved/remains constant. ✓
In 'n geïsoleerde/geslote sisteem, ✓bly die som van kinetiese en gravitasionele potensiële energie behoue/bly konstant. ✓

Notes/*Aantekeninge*:
Allocate ONE mark for 'isolated system" only in conjunction with energy.
Ken EEN punt toe vir "geïsoleerde/geslote sisteem" slegs indien saam met energie gebruik. 1/2

(2)

4.4

OPTION 1/*OPSIE 1*

$E_{\text{mechanical at A}} = E_{\text{mechanical at B}}$
$(E_p + E_k)_A = (E_p + E_k)_B$ ✓ Any ONE/*Enige EEN*
$(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$
$66(9,8)(0) + \frac{1}{2}(66)v^2$ ✓ $= 66(9,8)(1,6)$ ✓ $+ \frac{1}{2}(66)(0)^2$
$v = 5,6\ m.s^{-1}$ ✓ (4)

OPTION 2/*OPTION 2*

$E_{\text{mechanical at A}} = E_{\text{mechanical at B}}$
$(E_p + E_k)_A = (E_p + E_k)_B$ ✓ Any ONE/*Enige EEN*
$(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$
$v^2 = 2gh$ ✓
$= (2)(9,8)(1,6)$ ✓
$v = 5,6\ m.s^{-1}$ ✓ (4)

OPTION 3/*OPSIE 3*

$W_{net} = \Delta E_k$
$F_{net}\Delta y.\cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$ ✓ Any ONE/Enige EEN
$m(9,8)(1,6)\cos 0^\circ$ ✓ $= \frac{1}{2}m(v_f^2 - 0^2)$ ✓
$v_f = 5,6\ m.s^{-1}$ ✓ (4)

NOTES/*AANTEKENINGE*:
Accept/*Aanvaar*
$(E_p + E_k)_{top} = (E_p + E_k)_{bottom}$
$(U + K)_A = (U + K)_B$
$(U + K)_{top} = (U + K)_{bottom}$
$\Delta E_p + \Delta E_{kA} = 0 / \Delta U + \Delta K = 0$ (4)

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4.5 **POSITIVE MARKING FROM QUESTION 4.4**
POSITIEWE NASIEN VAN VRAAG 4.4

OPTION1/*OPSIE1*

$\sum p_i = \sum p_f$
$(m_B + m_P)v_{BPi} = m_B v_f + m_P V_{fP}$ ✓ Any ONE/*Enige EEN*
$(70)(5)$✓ $= (66)(5,6) + 4v_{fP}$✓
$v_{Pf} = -4,9\ m.s^{-1}$
$= 4,9\ m.s^{-1}$ to the left/na links ✓ (4)

OPTION2/*OPSIE2*

$\Delta p_{Boy} = -\Delta p_{parcel}$✓
$m_{boy}(v_f - v_i) = -m_p(v_f - v_i)$
$(66)(5,6 - 5)$✓ $= -4(v_{pf} - 5)$ ✓
$v_{Pf} = -4,9\ m.s^{-1}$
$= 4,9\ m.s^{-1}$ to the left/Na links ✓ (4)

OPTION 3/*OPSIE3*

$F_{BP} = -F_{PB}$ ✓
$m_B a_B = -m_P a_P$
$m_B \left[\frac{v_{Bf} - v_{Bi}}{\Delta t}\right] = -m_P \left[\frac{v_{Pf} - v_{Pi}}{\Delta t}\right]$

$\frac{(66)(5,6 - 5)}{\Delta t}$ ✓ $= \frac{-(4)(v_{Pf} - 4,5}{\Delta t}$ ✓
$V_{pf} = -4,9\ m.s^{-1}$
$= 4,9\ m.s^{-1}$ to the left/na links✓ (4)

Other formulae/*Ander formules*:
$m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$
$(m_1 + m_2)\ v = m_1v_{f1} + m_2v_{f2}$
$m_1v_{iB} + m_2v_{iP} = m_1v_{fB} + m_2v_{fP}$
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$p_{\text{total before}} = p_{\text{total after}}$

Accept/*Aanvaar*:
$p_{\text{before}} = p_{\text{after}}$ or/of $p_i = p_f$ (4)

4.6 INCREASES/VERHOOG ✓

Δp parcel increases, thus Δp boy increases. ✓
For the same mass of boy, v will be greater. ✓

Δp pakkie vermeerder, dus Δp seun vermeerder. ✓
Vir dieselfde massa, van die seun sal v groter wees. ✓

OR/*OF*

If v of parcel increases, the momentum of the boy increases. ✓
For the same mass of boy, the velocity of parcel increases. ✓

Indien v van die pakkie toeneem, neem die momentum van die seun toe. ✓
Vir dieselfde massa van die seun, vermeerder die snelheid van die pakkie. ✓

OR/*OF*

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F on parcel increases, therefore F on boy increases. ✓
FΔt(boy) increases, for the same mass of boy, thus v will increase. ✓

F op pakkie neem toe, dus neem F op seun toe. ✓
FΔt(seun) neem toe, dus vir dieselfde massa van seun sal V verhoog. ✓

OR/*OF*

$-m_Bv_{Bf} = m_Pv_{Pf}$ **AFR**: $-m_Sv_{Sf} = m_Pv_{Pf}$

$v_B = -\frac{m_Pv_{Pf}}{m_B}$ ✓for same m_B, if v_P increases, ✓then v_B increases.

$v_S = -\frac{m_Pv_{Pf}}{m_S}$ ✓ *vir dieselfde* m_S, as v_P *toeneem*, ✓ *neem* v_S *toe*

(3)
[15]

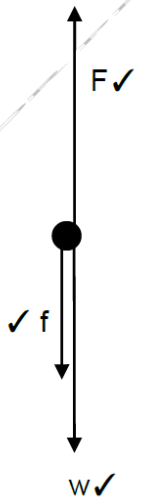
QUESTION 5/VRAAG 5

5.1 The net/total work done ✓is equal to the change in the object's kinetic energy.✓
Die netto/totale arbeid verrig ✓op 'n voorwep 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 die voorwerp deur 'n resulterende/netto krag ✓is gelyk aan die verandering in kinetiese energie van die voorwerp. ✓ (2)

5.2



Accepted labels/*Aanvaarde benoemings*	
w	F_g/F_w/mg/gravitational force/weight F_g/F_w/*gravitasiekrag/gewig*
F	$F_{applied}$/F_{cable}/Tension/T/17 000 N $F_{toegepas}$/F_{kabel}/*Spanning*/T/17 000 N
f	F_f/$F_{friction}$/friction/air resistance F_f/$F_{wrywing}$/*wrywing/lugweerstand*

(3)

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5.3

OPTION 1/*OPSIE1*

$W_{net} = \Delta E_k$
$W_T + W_W + W_f = \Delta E_k$ ✓ Any ONE/*Enige EEN*
$F_T \Delta y \cos \theta + F_g \Delta y \cos \theta + W_f = 0$
$\underline{(17000)(20)\cos 0°}$ ✓ + $\underline{(1680)(9,8)(20)\cos 180°}$ ✓ + $W_f = 0$ ✓
$W_f = -10720$ J ✓ (5)

OPTION 2/*OPSIE 2*

Downwards as positive

$F_{net} = ma$
$-F + f + W = ma$
$\underline{-17000 + f + (1680)(9,8)}$ ✓ $= 0$ ✓ ✓
$f = 536$ N
$W_f = f \Delta y \cos \theta$
$= (536)(20)\cos 180°$ ✓
$= (536).(20).(-1)$
$= -10\,720$ J ✓ (5)

Upwards as positive

$F_{net} = ma$
$F + f + W = ma$
$\underline{17000 - f - (1680)(9,8)}$ ✓ $= 0$ ✓ ✓
$f = 536$ N
$W_f = f \Delta y \cos \theta$
$= (536)(20)\cos 180°$ ✓
$= (536)(20)(-1)$
$= -10720$ J ✓ (5)

[10]

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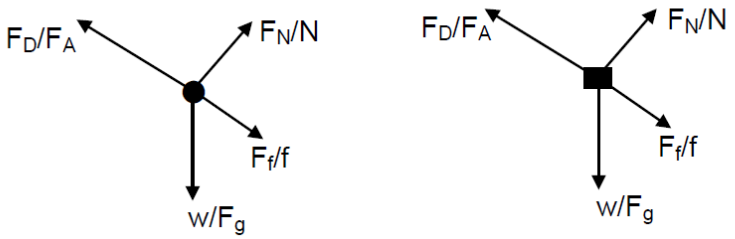
QUESTION 5/*VRAAG 5*

5.1

OPTION 1/*OPSIE 1*	**OPTION 2/*OPSIE 2***
$v_{ave} = \frac{800}{75}$ ✓ $= 10{,}67 m \cdot s^{-1}$ $P_{ave} = Fv_{ave}$ ✓ $P_{ave} = 240\ (10{,}67)$ $= 2\ 560{,}8\ W\ (2{,}56\ kW)$ ✓	$v_{ave} = \frac{800}{75}$ ✓ $= 10{,}67 m \cdot s^{-1}$ ∴ Distance covered in 1s = 10,67m· ∴ Work done in 1 s = (240)(10,67) ✓ $= 2\ 560{,}8\ J\ s^{-1}$ ∴ P_{ave} = 2 560,8 W (2,56 kW)✓
OPTION 3/*OPSIE 3*	
$P_{ave} = \frac{W}{\Delta E}$ ✓ $= \frac{F\Delta x \cos\theta}{\Delta E}$ $= \frac{240\Delta \times 800 \cos 0}{75}$ ✓ = 2 560 W✓	

(3)

5.2



	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 *$F_{wrywing}$ / F_w / wrywing*
N	F_N / F_{normal} / normal force F_N / $F_{normaal}$ / *normaalkrag*
F_D	$F_{Applied/toegepas}$ $F_{driving/dryfkrag}$

(4)

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 verrig op 'n voorwerp is geyk aan die verandering in die voorwerp se kinetiese energie.
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 krag is gelyk aan die verandering in die voorwerp se kinetiese energie.

(2)

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5.4

OPTION 1/*OPSIE 1*

$W_{net} = \Delta K$✓

$W_{net} = W_D + W_g + W_f + W_N$

$= (F_D \Delta x \cos\theta) + (mg \sin\alpha)\Delta x \cos\theta) + (f\Delta x \cos\theta) + 0$

$W_{net} = [350(450)](\cos 0)$✓ $+ (300)(9,8)\ \frac{5}{450}(450)(\cos 180)$✓ $+$

$294(450)(\cos 180^\circ)$✓

$= 157\ 500 - 14\ 700 - 132\ 300$

$= 10500$ J

OR/*OF*

$\alpha = \sin^{-1}\frac{5}{450}$

$= 0,64^\circ$

$W_{net} = \Delta K$

$\underline{10\ 500 = \frac{1}{2}(300)(v_f^2 - 0)}$ ✓

$v_f = 8,37\ m{\cdot}s^{-1}$ ✓ (6)

OPTION 2/*OPSIE 2*

$W_{nc} = \Delta U + \Delta K$✓

$W_f + W_D = \Delta U + \Delta K$

$f\Delta x \cos\theta + W_D = mg(h_f - h_i) + \frac{1}{2}(m)(v_f^2 - v_i^2)$

$(f\Delta x \cos\theta + F_D \Delta x \cos\theta = mg(h_f - h_i) + \frac{1}{2} m(v_f^2 - v_i^2)$

$(294)(450)(\cos 180^\circ)$✓ $+ (350)(450)\cos 0^\circ$✓$= (300)(9,8)(5 - 0)$✓ $+ \frac{1}{2}(300)(v_f^2 - 0)$✓

$v_f = 8,37\ m{\cdot}s^{-1}$✓ (6)

OPTION 3/*OPSIE 3*

$W_{net} = W_D + W_g + W_f + W_N$

$= (F_D \Delta x \cos\theta) + mg\Delta x \cos\theta) + f\Delta x \cos\theta + 0$

$W_{net} = (350)(450)(\cos 0^\circ)$✓$+(300)(9,8)(450)\cos(90+0,64)$ ✓ $+ 294(450)(\cos 180^\circ)$✓

$= 157\ 500 - 14\ 777,74 - 13\ 2300$

$= 10\ 430,51$ J

OR/*OF*

$\alpha = \sin^{-1}\frac{5}{450}$

$= 0,64^\circ$

$W_{net} = \Delta K$ ✓

$\underline{10\ 430,51 = \frac{1}{2}(300)(v_f^2 - 0)}$✓

$v_f = 8,34\ m{\cdot}s^{-1}$ ✓ (6)

OPTION 4/*OPSIE 4*

$F_{net} = F_D + mg\sin\alpha + f$

$= 350$ ✓$- (300)(9,8)\sin 0,64$✓ $+ (-294)$✓

$= 350 - 32,84 - 294$

$= 23,16$ N

$W_{net} = F_{net} \Delta x \cos\theta$

$= (23,16)(450)\cos 0$

$= 10\ 422$ J

$W_{net} = \Delta K$ ✓

$\underline{10\ 422 = \frac{1}{2}(300)(v_f^2 - 0)}$✓

$v_f = 8,34\ m{\cdot}s^{-1}$ ✓ (6)

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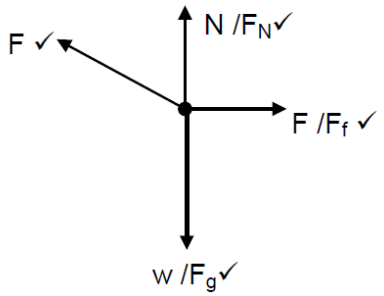
QUESTION 5/*VRAAG 5*

5.1 It is a ratio of two forces ✓ (hence units cancel out)./*Dit is 'n verhouding van twee kragte ✓ (dus word eenhede uitgekanseleer)* (1)

5.2 The net work done on an object is equal ✓to the change in kinetic energy of the object✓/*Die netto arbeid wat op 'n voorwerp verrig word, is gelyk ✓ aan die verandering in kinetiese energie van die voorwerp*✓ (2)

5.3



(4)

5.4 $F\sin 20^\circ + N = mg$✓

$N = mg - F\sin 20^\circ$

$W_{fk} = fk\Delta x \cos\theta = \mu_k N\Delta x \cos\theta$✓

$= \mu_k(mg - F\sin 20)(3)\cos\theta$

$= (0{,}2)[200(9{,}8) - F \sin 20](3)\cos 180^\circ$✓

$= (-1176 + 0{,}205\ F)$ J✓ (4)

5.5 $W_{tot} = [W_g] + W_f + W_F$ ✓

0 ✓ = [0] +[(-1176 + 0,205 F)] + [F (cos 20) (3) (cos 0)]✓

F = 388,88 N✓

NOTE: Do not penalise if value of W_g is not indicated/

LET WEL: *Moenie penaliseer indien die waarde van W_g nie aangedui word nie.* (4)

[15]

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QUESTION/*VRAAG* 4

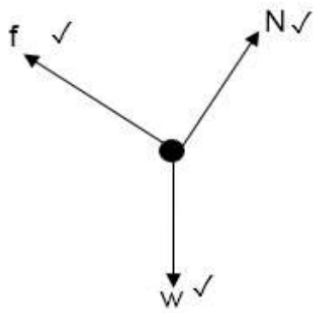
4.1 The total mechanical energy in an isolated (closed) system ✓ remains constant (is conserved). ✓
Die totale meganiese energie in 'n geïsoleerde (geslote) sisteem bly konstant (bly behoue).

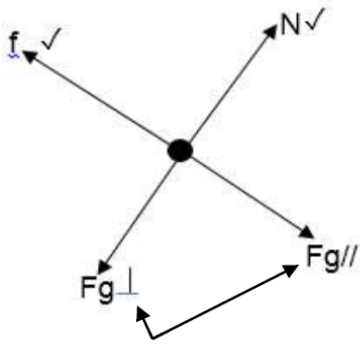
NOTE/LET WEL
If total or isolated/closed is omitted (max:1/2)
Indien totale of geslote(geïsoleeerde) weggelaat is (maks:1/2) (2)

4.2 E_{mech} at A = E_{mech} at B/E_{meg} *by A* = E_{meg} *by B* ✓
$(mgh + ½ mv^2)_A = (mgh + ½ mv^2)_B$
$m (9,8 \times 0,5 + ½ \times 0^2)$ ✓ $= m (9,8 \times 0 + ½ \times v^2)$ ✓
$4,9 = ½ v^2$
$v = 3,13 \text{ m·s}^{-1}$ ✓ (4)

4.3 4.3.1 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 die 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. ✓
Arbeid verrig deur 'n netto krag is gelyk aan die verandering in die kinetiese energie van die voorwerp. (2)

4.3.2





✓ for both/*vir albei* (3)

4.3.3 $W_{net} = \Delta E_K$ ✓
$W_{net} = 0$
$W_f + Wg// = 0$ ✓
$f. \Delta x \cdot \cos\theta + mg. \frac{1}{\Delta x} \Delta x \cdot \cos\theta = 0$
$14,7 \cdot \mathbf{d} \cdot \cos 180°$✓ $+ 3 \times 9,8 (\frac{1}{\mathbf{d}})$. ✓$\mathbf{d} \cos 0° = 0$
$-14,7\mathbf{d} + 29,4 = 0$
$d = 2$ m ✓ (5)

4.4 REMAINS THE SAME/*BLY DIESELFDE* ✓ (1)
[17]

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