**MULTIPLE-CHOICE QUESTIONS**

1. C 2. C 3. B 4. B 5. D 6. D

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| **STRUCTURED QUESTIONS**QUESTION 1/*VRAAG 1*  |  |  |

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| 1.1.1**Option 1/*Opsie 1*:**(U + K)bottom + Wtruck – Wf = (U + K)top ✓(0 + (10 000)(5,56)2) ✓+ 7 x 105 ✓– 8,5 x 104 ✓ = (10 000)(9,8)hf + (10 000)(5,562) ✓ hf = 6,28 m ✓ | **Option 2/*Opsie 2*:**Useful work done = gain in U ✓ = mgh ✓*Bruikbare arbeid verrig = wins aan U* = mgh  7 x 105 ✓– 8,5 x 104 ✓ = 10 000(9,8)hf ✓ 6,15 x 105 = 10 000(9,8)hf hf = 6,28 m ✓**Option 3/*Opsie 3*:**Wnet = Ek✓ Wg + Wf + Wtruck = 0 -10 000(9,8)hf ✓– 8,5 x 104 ✓+ 7 x 105 ✓ = 0 ✓ hf = 6,275 = 6,28 m ✓**Option 4/*Opsie 4*:**W(external forces/*eksterne kragte*)= U + K ✓ Wexternal/ekstern = (mghf – mghi) + ( - ) 7 x 105 ✓– 8,5 x 104 ✓ = 10 000(9,8)(hf – 0) ✓ + 0 ✓6,15 x 105 = 10 000(9,8)hf hf = 6,28 m ✓ **Option 5/*Opsie 5*:**Ff =  =  = 3 695,65 NFapplied =  =  = 3,04 x 104 NFnet = 0  w(down incline) + Ff + Fappl = 0 ✓ mgsin + Ff + Fappl = 0- (10 000)(9,8) ✓ - 3 695,65 ✓+ 3,04 x 104 ✓= 0 ✓ (sin  = ) hf = 6,28 m ✓ |  | (6) |

-1 if/*indien* g = 10 m∙s-2 – penalise once in this Question 6/*penaliseer eenmalig in Vraag 6*

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| 1.1.2 | **Option 1/*Opsie 1:***W = Fxcos ✓7 x 105 = F(23)(1) ✓  F = 3,04 x 104 N P = Fv ✓ = (3,04 x 104) ✓ () ✓ = 1,69 x 105 W ✓**Option 2/*Opsie 2:***v =  ✓  ✓ =  ✓ t = 4,14 sP =  ✓= ✓ = 1,69 x 105 W ✓ |  | (6) |

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| 1.2 | * Surface must provide sufficient friction (e.g. sand) ✓

 *Oppervlak moet genoeg wrywing lewer (bv. sand)* * Must be long enough for vehicle to stop. ✓

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

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| QUESTION 2/*VRAAG 2*  |  |  |

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| 2.1 | The net work done on an object is equal to the change in the Only/*Slegs* or/*of* object's kinetic energy. ✓✓*Die netto 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 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.* |  | (2) |

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| 2.2 |  |  |  |

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Fg/w/Force of earth on object / *Krag van aarde op voorwerp* 🗸

N/FN/Force of surface on object / *Krag van oppervlak op voorwerp* 🗸

f/Ff/Force of friction / *Wrywingskrag*  🗸

OR/*OF*

●

F / w / Component of gravitational force perpendicular to incline / *Komponent van die gravitasiekrag loodreg op skuinste*

N/FN/Force of surface on object / *Krag van oppervlak op voorwerp* 🗸

f/Ff/Force of friction / *Wrywingskrag*  🗸

Fg// / w// / Component of gravitational force parallel to incline / *Komponent van die gravitasiekrag parallel aan skuinste*

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|  |  |  | (3) |

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| 2.3.1🗸 **+** |  =  + 2aΔx 🗸 = (0)2 + (2)(2)(10) 🗸 = 40 m2·s-2Ekf = ½m 🗸 = ½(60)(40) 🗸  = 1 200 J 🗸OR/*OF*10 = (0)Δt ½(2) Δt**2** Δt = 3,16 svf = vi + aΔt = 0 + (2)(3,16) 🗸 = 6,32 m·s-1Ekf = ½m 🗸 = ½(60)(6,32)**2** 🗸  = 1 200 J 🗸 |  | (5) |
| 2.3.2 |

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|  | W**g** = w**//** Δxcosθ 🗸 = mgsin 25°🗸 (10)(cos 0°)🗸 = (60)(9,8)sin25°10(1) = 2 485 J 🗸OR/*OF*W**g** = wΔxcosθ 🗸 = mghcos 0°  = (60)(9,8) 🗸 (10)sin25°(1) 🗸 = 2 485 J 🗸OR/*OF*W**g** = -ΔU 🗸 = - (0 – mgh) 🗸 = - (0 – (60)(9,8)(10)sin25° 🗸 = 2 485 J 🗸 |  |  (4) |

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| 2.3.3 | **OPTION 1/*OPSIE 1:***Wnet = ΔEk🗸Wg(parallel to slope/*parallel aan helling*) + Wf = ΔEk 🗸2 485 + Wf = 1 200 🗸Wf = - 1 285 J 🗸 (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)Marking rule 1.6 *Nasienreël 1.6*Marking rule 1.6 *Nasienreël 1.6*Marking rule 1.6 *Nasienreël 1.6*(U + K)i – Wf = (U + K)f Marking rule 1.6 *Nasienreël 1.6*Marking rule 1.6 *Nasienreël 1.6*Wappl/toegep = U + K + Wf **OPTION 3/*OPSIE 3*:**W(applied/*toegepas*) = ΔEk + ΔEp - Wf 0 = (½m - 0) + (0 – mgh) - Wf **Max./*Maks.*:** 0 = ½m- mgh - Wf 🗸0 = 1 200 - 2 485 - Wf 🗸Wf = -1 285 J 🗸**OPTION 4 / *OPSIE 4*:**(U + K)i + Wf = (U + K)f **Max./*Maks.*:** mgh + 0 + Wf = 0 + ½m 🗸2 485 + Wf = 1 200 🗸Wf  = - 1 285 J🗸 (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*)**OPTION 5/*OPSIE 5:***Wnc = ΔEk + ΔEp 🗸 = (½m - 0) + (0 – mgh) = ½m- mgh 🗸 = 1 200 - 2 485 🗸Wnc = Wf = -1 285 J 🗸 (If/*Indien* + 1 285 J deduct 1 mark/*trek 1 punt af*) |  | (4) |

**Accept/*Aanvaar:***

Ek / K

v2 = u2 + 2as / s = ut + ½at**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.*

**OPTION 2/*OPSIE 2***

Fnet = Fg(parallel to slope/*parallel aan helling* – Ff 🗸

ma = mgsin25° – Ff

(60)(2) = (60)(9,8)sin25° –Ff 🗸

Ff = 128,5 N 🗸

**OPTION 1/*OPSIE 1***

Wf = Ff Δxcosθ 🗸

- 1 285 = f(10)cos180° 🗸

Ff = 128,5 N 🗸

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| 2.3.4 | **OPTION 2/*OPSIE 2***Fnet = Fg(parallel to slope/*parallel aan helling* – Ff 🗸ma = mgsin25° – Ff(60)(2) = (60)(9,8)sin25° –Ff 🗸Ff = 128,5 N 🗸**OPTION 1/*OPSIE 1***Wf = Ff Δxcosθ 🗸- 1 285 = f(10)cos180° 🗸Ff = 128,5 N 🗸 |  | (3)**[21]** |

**QUESTION 3/*VRAAG 3***

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| 3.1 | R: Force of incline (surface) on crate / N / Normal (force) / FN ✓S: Gravitational force / Gravity / force of Earth on crate /  Fg / w / FEarth on crate ✓T: Frictional force/Ff /Ffriction /f✓  |  | (3) |

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| 3.2 | The force is perpendicular to ✓ the displacement ✓of the crate. **OR**W = F ∆x cos 90° ✓ = 0 ✓ |  | (2) |

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| 3.3 | The following diagram is used for clarification in the solutions below.●70°f = 190 N w//=mgsin20°20° w20°**OPTION 1**Wnet = Ww + Wf ✓ = mgΔxcos70° + fΔxcos180°  = (70)(9,8) ✓ (12)(cos70°)✓ + (190)(12)(-1) ✓Wnet = 535,51 J ✓Accept:cos180° or -1 |  |  |

**OPTION 3**

Wnet = Ww// + Wf ✓

 = mgsin20°Δxcos0° + fΔxcos180°

 = (70)(9,8)sin20°✓ (12)cos0°✓+ (190)(12)cos180°✓

Wnet = 535,51 J ✓

Accept:

cos0° or 1

cos180° or -1

**OPTION 2**

Fnet = w// + f

###  *=* mgsin20° + (-190)

 = (70)(9,8)sin 20°✓ – 190 ✓

 = 44,63 N

∴Wnet = FnetΔxcosθ✓

 = (44,63)(12)(cos0°) ✓

 Wnet = 535,51 ✓

Accept:

cos0° or 1

3.3

**OPTION 4**

Wnet = Ww + Wf ✓

 = mghcos0° + fΔxcos180°

 = (70)(9,8) ✓ (12sin20°)cos0°✓+(190)(12)cos180°✓

Wnet = 535,51 J ✓

Accept:

cos0° or 1

cos180° or -1

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| 3.4 | 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. |  | (2) |

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| 3.5 | Wnet = ΔK✓ (OR Wnet = ΔEk)535,51 = ½ m( – ) 535,51✓= ½ (70)( - 4) ✓vf = 4,39 m·s-1✓ |  | (4)**[16]** |

**QUESTION 4/*VRAAG 4***

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| 4.1 | Impulse is the product of the (net/average) force and the time during which the force acts. ✓✓*Impuls is die produk van die (netto/gemiddelde) krag en die tyd waartydens die krag inwerk.* ✓✓**OR/*OF***Impulse is the change in momentum. ✓✓*Impuls is gelyk aan verandering in momentum.* ✓✓ |  | (2) |

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| 4.2 | **Option 1/*Opsie 1:***Upward positive:/*Opwaarts positief*✓ = m(vf – vi)  = 0,15(3,62 - (-6,2)) ✓ = 1,473 N∙s / kg∙m∙s-1✓upward/*opwaarts* | **Option 2/*Opsie 2:***Upward negative:/O*pwaarts negatief*✓ = m(vf – vi)  = 0,15[(-3,62 - (6.2)) ✓ = -1,473 N∙s /kg∙m∙s-1 = 1,473 N∙s /kg∙m∙s-1 ✓ upward/*opwaarts*  |  |  |
|  | **Option 3/*Opsie 3:***Upward positive: /*Opwaarts positief*✓ = mvf – mvi  = (0,15)(3,62) – (0,15)(-6,2) ✓ = 1,473 N∙s / kg∙m∙s-1✓upward/*opwaarts* | **Option 4/*Opsie 4:***Upward negative: /O*pwaarts negatief*✓ = mvf – mvi)  = (0,15)(-3,62) – (0,15)(6,2) ✓ = -1,473 N∙s /kg∙m∙s-1 = 1,473 N∙s /kg∙m∙s-1✓upward/*opwaarts* |  | (3) |
| 4.3 | (U + K)top/*bo* = (U + K)bottom/*onder*✓mghf + ½ m= mghi + ½ m(0,15)(9,8)h + 0 ✓ = 0 + ½(0,15)(6,2)2 ✓ h = 1,96 m✓ = 0,65 m Yes/Meets requirements ✓ *Ja/Voldoen aan vereistes.* ✓ | **K(bottom/*onder*) = U(top/*bo*)**Max.:  | (5)**[10]** |
| **Other formulae/*Ander formules*:**Emech(A) = Emech(B) / Emech(i) = Emech(f)  Emech(top) = Emech(bottom)(Ep + Ek)A = (Ep + Ek)B (Ep + Ek)bottom = (Ep + Ek)top  Ep + Ek)i = (Ep + Ek)f (U + K)i = (U + K)f (U + K)A = (U + K)B mghB +  = mghB +   |

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| **QUESTION 5/*VRAAG 5***  |  |  |

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| 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) |

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| 5.2 | **Option 1/*Opsie 1:***Wnet = ∆K ✓mg∆ycosθ + Wf = ½m– ½m(2)(9,8)(2)cos0° ✓+ Wf ✓= ½(2)(5)2✓– 0 ✓ Wf = -14,2 J ✓ |  |  | (6) |
| **Option 2/*Opsie 2:***Wnet = ∆K ✓-∆U + Wf = ½m– ½mmgh + Wf = ½m– ½m(2)(9,8)(2) ✓+ Wf ✓= ½(2)(5)2✓– 0 ✓ Wf = -14,2 J ✓ |

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

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| 5.4.1 | pbefore = pafter✓(2)(5) + (9)(0) ✓= 2vf2 + (9)(1) ✓vf2 = 0,5 m·s-1 ✓ | **Notes/*Aantekeninge:*****Other formulae/*Ander formules*:**m1vi1 + m2vi2 = m1vf1 + m2vf2m1u1 + m2u2 = m1v1 + m2v2  | (4) |

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| 5.4.2 | K(total after/*total na*) = ½m1+ ½m2✓ = ½(2)(0,5)2 ✓+ ½(9)(1)2 ✓ = 4,75 J ✓K(total before)  K(total after) ✓ inelastic *K(totaal na)  K(totaal voor)* ✓ *onelasties* |  | (5)**[19]** |

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| QUESTION 6/*VRAAG 6*  |  |  |

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| 6.1+ | 200 x 1 000 = 2 x 105 kg ✓ |  | (1) |

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| 6.2 | Eki + Epi = Ekf + Epf✓ or/of Emech i= Emech f or/*of* ΔEp = ΔEk 0 + mghi = Ekf + 00 + (2 x 105)(9,8)(150) ✓= Ekf + 0 ✓ Ekf = 2,94 x 108 J ✓OR/*OF*Wnet = EkFcosy = Ekf - Eki ✓(200 000)(9,8)(cos 0o)(150) ✓= Ekf - 0✓ Ekf = 2,94 x 108 J ✓ |  | (4) |

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| 6.3 | Ekf = ½m✓2,94 x 108 J = ½(2 x 105)vf2 ✓ vf = 54,22 m∙s-1 ✓ |  | (3) |

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| 6.4 | P =  x  = x  ✓ = 2,499 x 108 W ✓ OR/*OF*Ek(effective/*effektief*) =  x 2,94 x 108 ✓= 2,499 x 108 JP =  = 2,499 x 108 W ✓  |  | (2) |

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| 6.5 | Converted to sound / heat in turbine / other forms of energy. ✓ O*mgeskakel na klank / hitte in die turbine / ander vorms van energie* |  | (1)**[11]** |

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| QUESTION 7/*VRAAG 7*  |  |  |

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| 7.1 |   |  |  |

**Option 1/*Opsie 1*:**

Direction of motion as positive / *Rigting van beweging as positief:*

Fnet = ma ✓

-30 = (3)a ✓

a = - 10 m·s-2

 ✓

= (7)2 ✓+ 2(-10)(2) ✓

vf = 3 m·s-1

If/*Indien* K =  -  done separately before substitution into wrong formula/*apart gedoen voor substitusie in verkeerde formule: *

**Option 2/*Opsie 2*:**

Wnet = K✓ or/*of* Ek

Fnetxcos✓ =  - 

(30)(2)cos180° ✓ = (3) ✓- (3)(7)2 ✓

- 60 = 1,5 - 73,5  vf = 3 m·s-1

**Option 3/*Opsie 3*:**

Wappl = U + K - Wf **Max./*Maks.*: ****

0 = 0 + ( - ) - Ffxcos ✓

0 = 0 + (3) ✓- (3)(7)2 ✓ - (30)(2)cos180° ✓

0 = 1,5 - 73,5 + 60  vf = 3 m·s-1

Wappl = U + K + Wf **

**Option 4 / *Opsie 4*:**

(U + K)i + Wf = (U + K)f **Max./*Maks.*: ****

(0 + ) + Ffxcos ✓ = 0 + 

0 + (3)(7)2 ✓+ 30(2)cos180° ✓ = 0 + (3) ✓

73,5 – 60 = 1,5  vf = 3 m·s-1

(U + K)i – Wf = (U + K)f **

**Option 5 / *Opsie 5*:**

(U + K)i = (U + K)f - Wf **Max./*Maks.*:** **

(0 + ) = 0 + - Ffxcos  ✓

0 + (3)(7)2 ✓= 0 + (3) ✓ - 30(2)cos180° ✓

73,5 = 1,5 + 60  vf = 3 m·s-1

(U + K)i = (U + K)f +Wf **

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| 7.2 |   |  |  |

Any one of the following labels / *Enige een van volgende benoemings:*

* wparallel or/of w//
* Fg(parallel) or/of Fg//
* mgsin20°
* Component of weight parallel to incline / *komponent van gewig parallel aan skuinste*

•

w//

✓

✓

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| **Checklist / *kontrolelys*** Free-body diagram / *vrye kragtediagram* |
| Direction of force indicated as parallel to and down incline (not needed to show incline)*Rigting van krag getoon as parallel aan en afwaarts teen skuinste (skuinste hoef nie getoon te word nie)* | ✓ |
| Correct label / korrekte benoeming | ✓ |

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|  |   |  | (2) |
| 7.3 |  |  |  |

As single step/*As een stap:*

(U + K)i = (U + K)f ✓

0 + (3)(3)2 ✓= (3)(9,8)h + 0 ✓

(3)(3)2 = (3)(9,8) dsin20° ✓

 d = 1,34 m ✓

**Option 1/*Opsie 1*:**

(U + K)i = (U + K)f ✓

0 +  = mgh + 0

0 + (3)(3)2 ✓= (3)(9,8)h + 0 ✓

 h = 0,46 m

sin 20°= ✓ =   d = 1,34 m ✓

**Option 2/*Opsie 2*:**

Wnet = K✓ (or/*of* Ek)

Fg//xcos =  - 

(3)(9,8)sin20° ✓ (d)cos180° ✓ = 0 - (3)(3)2 ✓

- 10,06d = - 13,5  d = 1,34 m ✓

**Option 3/*Opsie 3*:**

Wnet = K✓ (or/*of* Ek)

Wgravity = Kf – Ki

mghcos180o ✓ =  - 

(3)(9,8)h(-1) ✓ = 0 - (3)(3)2 ✓  h = 0,46 m

sin20°=  ✓=   d = 1,34 m ✓

**Option 4 / *Opsie 4*:**

Direction of motion as positive / *Rigting van beweging as positief:*

Fnet = ma ✓

mgsin20° = ma

- (3)(9,8)sin20° = 3a ✓ a = - 3,35 m·s-2

 ✓

 02= (3)2 + 2(-3,35)(d) ✓

d = 1,34 m✓

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|  |  |  | (5)**[12]** |

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| QUESTION 8/*VRAAG 8*  |  |  |

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| 8.1 | 0 (N)/Zero/*nul* ✓no acceleration/constant velocity ✓*geen versnelling/konstante snelheid* |  | (2) |

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| 8.2 | 0 (J)/Zero/*nul* ✓ |  | (1) |

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| 8.3.1+ | Option 4/*Opsie 4*:W(external forces/*eksterne kragte*) = U + K ✓ OR/*OF*Wapplied/t*oegepas* + Wfriction/w*rywing* = (Uf – Ui) + (Kf – Ki)/U + K Wapplied/*toegepas* + (50)(10)(-1) ✓= (120)(9,8)(1,5) - 0) ✓ + 0 ✓ Wapplied/*toegepas* = 2 264 J ✓ (2,26 x 103 J)Option 3/*Opsie 3*:Wnet/*netto* = K ✓Wapplied/*toegepas* + Wfriction/*wrywing* + Wgravity/*gravitasie* = KWapplied/*toegepas* + (50)(10)(-1) ✓- (120)(9,8)(1,5) ✓ = 0 ✓ Wapplied/*toegepas* = 2 264 J ✓ (2,26 x 103 J)Option 1/*Opsie 1*:U i + Ki + Wfriction/*wrywing* + Wapplied/*toegepas* = Uf + Kf ✓0 + fx cos + Wapplied/*toegepas* = mgh (Ki = Kf)0 + (50)(10)(-1) ✓ + Wapplied/*toegepas* = (120)(9,8)(1,5) ✓ ✓ Wapplied/*toegepas* = 2 264 J ✓ (2,26 x 103 J)Option 2/*Opsie 2*:For equilibrium:/*Vir ewewig:* F = f + wparallel to incline/*parallel met helling* = f + mgsin (- angle of incline with horizontal/*hoek van helling met horisontaal*)F = 50 ✓+ (120)(9,8)() ✓F = 226,4 N Wapplied/*toegepas* = Fxcos✓  = (226,4)(10)(cos0°) ✓ OR (226,4)(10) = 2 264 J ✓ (2,26 x 103 J)Accept/*Aanvaar*: Ek, Ep |  | (5) |

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| 8.3.2 | Wapplied/*toegepas* = Fxcos✓2 264 J ✓= F(10)(1) ✓ F = 226,4 N ✓ (2,26 x 102 N) **OR/*OF***F = f + wpar to incline/*par met helling* = f + mgsin ✓ (- angle of incline with horizontal/*hoek van helling met horisontaal*)F = 50 ✓ + (120)(9,8)() ✓F = 226,4 N ✓ (2,26 x 102 N) |  | (4)**[12]** |

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| QUESTION 9  |  |  |

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| 9.1 | The sum of the kinetic and (gravitational) potential energy is conserved / constant / remains the same / does not change✓ in an isolated / closed / system / no external work done / only conservative forces act on the system.✓ORThe (total) mechanical energy is conserved/ constant✓ in an isolated system.✓  |  | (2) |

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| 9.2 | **OPTION 1**Emech = U + K or Ep + Ek  = mgh + ½ mv2 ✓(any formulae) = (0,5)(9,8)(0,6) ✓+ ½ (0,5)(3)2 ✓  = 5,19 J ✓ (5,25 J)**OPTION 2**Ep = mgh = (0,5)(9,8)(0,6) ✓= 2,94 J (3 J)Ek = ½ mv2 = ½ (0,5)(3)2 ✓= 2,25 JEmech = Ep + Ek ✓= 2,94 + 2,25 = 5,19 J✓  |  |  (4) |

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| 9.3**Accepted formulae**Emech(A) = Emech(B) / Emech(i) = Emech(f) / Emech(top) = Emech(bottom)(Ep + Ek)A = (Ep + Ek)B / (Ep + Ek)bottom = (Ep + Ek)top (Ep + Ek)i = (Ep + Ek)f /(U + K)bottom = (U + K)top (U + K)i = (U + K)f / (U + K)A = (U + K)B / mghi +  = mghf +  **OPTION 2**Wnet = ΔEk ✓mgΔycosθ = ½ m(vf2 – vi2)(0,5)(9,8)(0,6)(1)✓= ½ (0,5)(vf2 – 32) ✓∴vf = 4,56 m·s-1**OPTION 1**(U + K)B = (U + K)C ✓mghB + ½ m= mghC + ½ m5,19 ✓ = 0 + ½ (0,5)v2 ✓ v = 4,56 m·s-1  | **Other formulae*:*** pt before = pt after  or m1vi1 + m2vi2 = m1vf1 + m2vf2 or m1u1 + m2u2 = m1v1 + m2v2 pbefore = pafter ✓ (0,5)(4,56) + 0 ✓ = (0,5)vf2 + (0,1)(3,5) ✓vf2 = 3,86 m·s-1 ✓(to the right) (3,88 m·s-1) |   | (7) **[13]** |
| **QUESTION 10/*VRAAG 10*** |  |  |
| **Accepted Labels** |
| N | Normal / Force of surface on crate / FN / 269 N / 275 N |
| w | Fg / force of Earth on crate / weight / 294 N /300 N mg / gravitational force |
| Fapplied | F / force of worker on crate / 50 N / FA  |
| f | Ffriction / 20 N / Ff / friction  |
| Fhorizontal / Fx / F// | 43,30 N |
| Fvertical / Fy / F⊥ | 25 N |

|  |  |  |  |
| --- | --- | --- | --- |
| 10.1 |  |  |  |

**Accept:** Force diagram

OR

✓

f

N

Fhorizontal

✓

✓

Fvertical

w

✓

⚫

✓

✓

⚫

N

f

Fapplied

w

✓

✓

30o

 OR

✓

f

N

Fhorizontal

✓

✓

Fvertical

w

✓

✓

✓

N

f

Fapplied

w

✓

✓

30o

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | (4) |

|  |  |  |  |
| --- | --- | --- | --- |
| 10.2 | W = F∆x cos90o✓✓= 0ORThey (normal force and the gravitational force) are perpendicular /at 90o to the (direction of the) displacement / motion / Δx✓✓of the crate. ORThe angle between the force and displacement / motion / Δx is 90o.✓✓ORThe crate moves horizontally and the forces act vertically.✓✓ |  | (2) |

|  |  |  |  |
| --- | --- | --- | --- |
| 10.3 | Accepted symbols for applied force: Fappl / F / FAAccepted symbols for frictional force: f / Ff / FfrictionAccepted symbols for gravitational force: w / Fg / Fforce of Earth on crate / gravitational force |  |  |

**OPTION 1**

Wnet = Wappl + Wf  ✓ For either formula

 = Fapp Δx cos θ + fΔx cos θ

 = (50)(6)(cos30°)✓ + (20)(6)(cos180°) ✓

 = 259,81 + (-120)

Wnet = 139,81 J ✓

**OPTION 5**

Fnet = Fhorizontal + f

ma = (50)(cos30°) + (-20) ✓

(30)a = (50)(cos30º) + (-20)

 a = 0,776... m·s-2

vf2 = vi2 + 2aΔx

 = (0)2 + 2(0,78...)(6)

vf = 3,052... m·s-1

Wnet = ∆K = ½ m(vf2 –vi2)

 = ½ (30)(3,052...2 – 02) ✓

 = 139,81 J✓

**OPTION 3**

Wnet = Wappl // + Wf  ✓ For either formula

 = Fapp// Δx cos θ + fΔx cos θ

 = (50)(cos30°)(6)cos 0°✓ + (20)(6)(cos180°) ✓

 = 259,81+ (-120)

Wnet = 139,81 J ✓

✓one mark for all three formulas

**OPTION 2**

Wapplied = Fapp Δx cos θ

 = (50)(6)(cos30°)✓

 = 259,81 J

Wf = fΔx cos θ

 = (20)(6)(cos180°) ✓

 = -120 J

Wnet = Wapplied + Wf ✓ OR FappΔxcosθ + FΔxcosθ

 = 139,81 J ✓

**OPTION 4**

Fnet = Fhorizontal + f

 = (50)(cos30°) + (-20) ✓

= 23,30 N

Wnet = Fnet ∆x cos θ ✓

 = (23,30)(6)(cos 0°) ✓

 = 139,81 J✓

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | (4) |

|  |  |  |  |
| --- | --- | --- | --- |
| 10.4 | **If:** W instead of Wnet  maxNo marks for any other methodWnet = ∆K / Wnet = ∆Ek ✓ = ½ mvf2 - ½ mvi2139,81 = ½ (30)vf2 – 0 ✓ vf = 3,05 m·s-1 ✓ |  | (3) |
| 10.5 | Greater than ✓ The horizontal component (of the force) / force in direction of motion will now be greater / Fnet will now be greater.✓OR As θ decreases cos θ increases✓ORFor θ smaller than 30°, cos θ > cos 30°.✓ |  | (2)**[15]** |

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| **QUESTION 11 / *VRAAG 11***  |  |  |

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| 11.1 | 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) |

🗸

🗸

⚫

f

Fapplied/*applied*

w

🗸

|  |  |  |  |
| --- | --- | --- | --- |
| 11.2 |  |  |  |

|  |  |  |
| --- | --- | --- |
|  |  | (3) |

|  |  |  |  |
| --- | --- | --- | --- |
| 11.3 | Gravitational force/weight (of soldier) 🗸*Gravitasiekrag/gewig (van soldaat)* |  | (1) |

|  |  |  |  |
| --- | --- | --- | --- |
| 11.4 | Wnet = ∆K 🗸 F∆ycos+ Fw∆ycos+ Wf = ∆K (960)(20)cos0° 🗸+ (80)(9,8)(20)cos180° 🗸 + Wf = 0 🗸19 200 – 15 680 + Wf = 0Wf = - 3 520 J 🗸 |  | (5) |
|  |  |  | **[11]** |

**QUESTION 12/*VRAAG 12***

12.1

⚫

F 🗸

N 🗸

w 🗸

(3)

12.2 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)

12.3

12.3.1 Wnet = ΔEk/ΔK 🗸 OR/OF FnetΔxcosθ = ½ m(vf2 – vi2)

Fnet(1,02)cos180° 🗸= ½ (1 200)(0 – 202) 🗸

|  |  |  |  |
| --- | --- | --- | --- |
| 12.3.2 | **OPTION 1 /*OPSIE 1***FnetΔt = mΔv 🗸(-235 294,12)Δt 🗸= (1 200)(0 - 20) 🗸Δt = 0,1 s 🗸(0,102 s) | **OPTION 2/*OPSIE 1***🗸1,02 🗸= 🗸Δt = 0,1 s🗸 | (4) |
|  |  |  | **[13]** |

Fnet = 235 294,12 N 🗸 (2,35 x 105 N) (4)

**KEY FOR QUESTION PAPER REFERENCE FOR TEACHERS.**

**MULTIPLE QUESTIONS**

|  |  |  |
| --- | --- | --- |
| **Question in revision guide** | **Question Paper** | **Question in paper** |
| 1 | March 2009 | 4.2 |
| 2 | March 2011 | 2.3 |
| 3 | March 2012 | 2.2 |
| 4 | November 2008 | 4.2 |
| 5 | November 2011 | 2.2 |
| 6 | November 2012 | 2.3 |

**STRUCTURED QUESTIONS**

|  |  |  |
| --- | --- | --- |
| **Question in revision guide** | **Question Paper** | **Question in paper** |
| 1 | March 2009 | 6 |
| 2 | March 2010 | 6 |
| 3 | March 2011 | 5 |
| 4 | March 2012 | 4 |
| 5 | March 2012 | 5 |
| 6 | November 2008 | 7 |
| 7 | November 2009 | 5 |
| 8 | November 2009 (leacked) | 5 |
| 9 | November 2010 | 4 |
| 10 | November 2010 | 5 |
| 11 | November 2011 | 5 |
| 12 | November 2012 | 5 |