

Hillcrest High School

PHYSICAL SCIENCE P1

June 2025

Section A

- 1.1 D
- 1.2 B
- 1.3 D
- 1.4 D
- 1.5 B

In order for the box to be stationary the T_1 and **horizontal component of T_2** forces must equal .
BUT the T_2 force is at an angle thus the actual T_2 must be bigger than T_1 so that the $T_{2x} = T_2 \cdot \cos \theta$ will equal to T_1 .

Careful they asked the MASS (not weight) and mass DOES NOT CHANGE



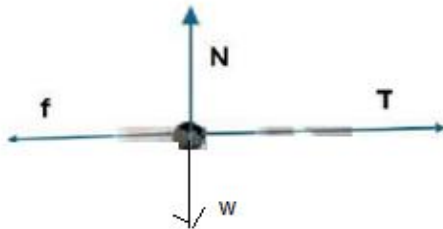
Question 2

2.1.1 When a resultant/ net force acts on an object, the object will accelerate in the direction of the force. The acceleration is directly proportional to the resultant/net force and inversely proportional to the mass of the object. ✓✓

$$\begin{aligned}
 2.2 \quad f &= \mu N \quad \checkmark \\
 &= 0,25(5)(9,8) \quad \checkmark \\
 &= 12,25 \text{ N} \quad \checkmark
 \end{aligned}$$

(3)

2.3



- ✓ N F_N /Normal/ F_{normal} / F_{normaal} /Normaal
- ✓ f (kinetic) friction F_f / f_k /(kinetiese) wrywing F_w
- ✓ w F_g / F_w /weight/mg/gravitational force
 F_g / F_w /gewig/mg/gravitasiekrag
- ✓ T F_T / F_{string} /tension/spanning/ F_{tou}
- ✓ If arrows touch the dot/Indien pyle die kolletjie raak

(5)

2.4 **For block A/ Vir blok A**

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

$$T - f = ma$$

$$T - 12,25 = 5a \quad \checkmark$$

Positive marking from Q2.2

For block B/ Vir blok B

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

$$F_x - T - f = ma$$

$$30 \cos 20^\circ \quad \checkmark - T - 0,25[2,5(9,8) - 30 \sin 20^\circ] \quad \checkmark = 2,5a \quad \checkmark$$

$$28,19 - T - 3,56 = 2,5a$$

$$24,63 - T = 2,5a$$

$$T - 12,25 = 5a \quad \text{-----1}$$

$$24,63 - T = 2,5a \quad \text{-----2}$$

$$a = 1,65 \text{ m}\cdot\text{s}^{-2}$$

2.2.1 Every body in the universe attracts every other body with a force which is directly proportional to the product of their masses ✓ and inversely proportional to the square of the distance between their centres ✓

2.2.2
$$F = \frac{Gm_1m_2}{r^2} \quad \checkmark$$

$$F_g = \frac{(6,67 \times 10^{-11})(5,98 \times 10^{24})(6,417 \times 10^{23}) \checkmark}{(6,38 \times 10^6 + 4,50 \times 10^9 + 3,3895 \times 10^6)^2 \checkmark}$$

$$F_g = 1,2585 \times 10^{19} \text{ (or } 1,26 \times 10^{19}) \text{ N } \checkmark$$

Question 3
3.1 9,8 m.s⁻²

Careful – if you choose down as negative then the ball moved below the starting point and Δy is negative.

(1)

3.2.1

UPWARD POSITIVE	UPWARD NEGATIVE
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-2 = v_i \times 0,125 + \frac{1}{2} \times (-9,8) (0,125)^2 \checkmark$ $v_i = -15,388 \text{ m.s}^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ $-15,388^2 = 0^2 + 2(-9,8) \Delta y \checkmark$ $\therefore \Delta y = 12,08 \text{ m}$ Height = 12,08 + 2 \checkmark Height = 14,08 m	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $2 = v_i \times 0,125 + \frac{1}{2} (9,8) (0,125)^2 \checkmark$ $v_i = 15,388 \text{ m.s}^{-1}$ $v_f^2 = v_i^2 + 2a\Delta y$ $15,388^2 = 0^2 + 2(9,8) \Delta y \checkmark$ $\therefore \Delta y = 12,08 \text{ m} \checkmark$ Height = 12,08 + 2 \checkmark Height = 14,08 m \checkmark

any one \checkmark

(4)

3.2.2

UPWARD POSITIVE	UPWARD NEGATIVE
$v_f = v_i + a\Delta t \checkmark$ $-15,388 = 0 + (-9,8) (\Delta t) \checkmark$ $\therefore \Delta t = 1,57\text{s}$ $\Delta t = 1,57 + 0,125 \checkmark$ $\Delta t = 1,70 \text{ s} \checkmark$	$v_f = v_i + a\Delta t \checkmark$ $15,388 = 0 + (9,8) (\Delta t) \checkmark$ $\therefore \Delta t = 1,57\text{s}$ $\Delta t = 1,57 + 0,125 \checkmark$ $\Delta t = 1,70\text{s} \checkmark$

(4)

3.2.3

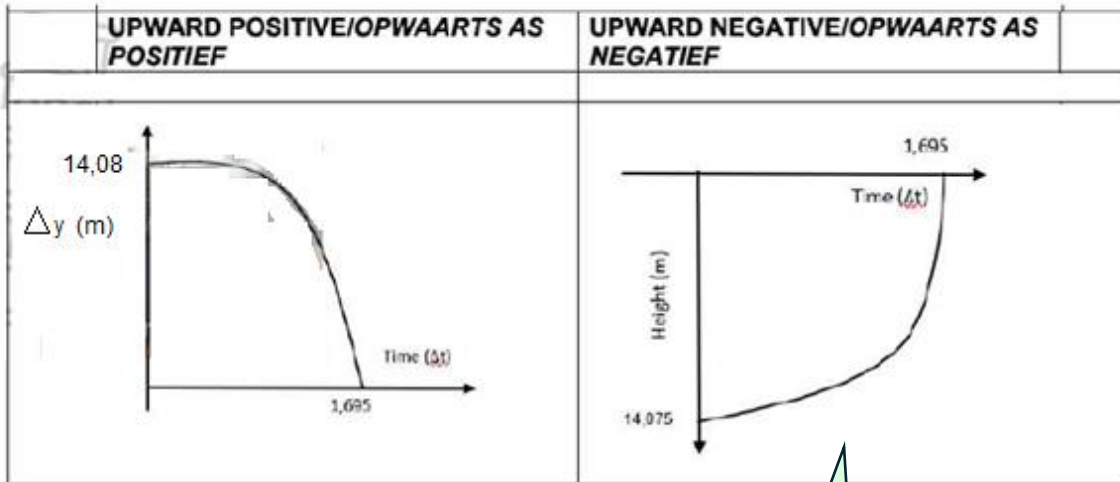
OPTION 1	
UPWARD POSITIVE	UPWARD NEGATIVE
$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $v_f^2 = -15,388^2 + 2(-9,8) (-2) \checkmark$ $\therefore v_f = 16,61 \text{ m.s}^{-1} \text{ downwards} \checkmark$	$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $v_f^2 = 15,388^2 + 2(9,8) (2) \checkmark$ $\therefore v_f = 16,61 \text{ m.s}^{-1} \text{ downwards} \checkmark$
OPTION 2	
UPWARD POSITIVE	UPWARD NEGATIVE
$v_f = v_i + a\Delta t \checkmark$ $v_f = -15,388 + (-9,8) (0,125) \checkmark$ $v_f = -16,61$ $\therefore v_f = 16,61 \text{ m.s}^{-1} \text{ downwards} \checkmark$	$v_f = v_i + a\Delta t \checkmark$ $v_f = 15,388 + (9,8) (0,125) \checkmark$ $\therefore v_f = 16,61 \text{ m.s}^{-1} \text{ downwards} \checkmark$

OPTION 3

UPWARD POSITIVE	UPWARD NEGATIVE
$\Delta x = \frac{v_f + v_i}{2} \Delta t \checkmark$ $-2 = \left(\frac{v_f + (-15,388)}{2} \right) \times 0,125 \checkmark$ $\therefore v_f = 16,61 \text{ m.s-1 downwards } \checkmark$	$\Delta x = \frac{v_f + v_i}{2} \Delta t \checkmark$ $-2 = \left(\frac{v_f + (15,388)}{2} \right) \times 0,125 \checkmark$ $\therefore v_f = 16,61 \text{ m.s-1 downwards } \checkmark$

(3)

3.3



CRITERIA FOR MARKING / NASIENKRITERIA	
Correct shape / Korrekte vorm	✓
Initial position indicated / Aarvanklike posisie aangedui	✓
Time when ball hits the ground / Tyd wanneer bal die grond tref	✓

(3)

If you choose **down as positive** then remember that you graph is inverted from how you normally would draw it.

Question 4

4.1 $\sum p_i = \sum p$ *Left as positive*

$$(m_c \cdot v_{ic}) + (m_t \cdot v_{it}) = (m_c + m_t)v_f \quad \checkmark \text{ (Any one of the formulae)}$$

$$(26000) + (2500) v_{it} \checkmark = (1300 + 2500) (-9) \checkmark \quad \text{Positive marking from Q4.1}$$

$$v_{it} = -24,08 \text{ m}\cdot\text{s}^{-1}$$

$$= 24,08 \text{ m}\cdot\text{s}^{-1} \checkmark \text{ (to the right).} \quad (4)$$

4.2 $F_{\text{net}} = \frac{m(v_f - v_i) \checkmark}{\Delta t}$

$$= \frac{1300(-9 - 20) \checkmark}{(0,2) \checkmark}$$

$$= -188500$$

$F_{\text{net}} = -188500 \text{ N} \checkmark \text{ (to the right).}$

If the graph gave the car's velocity as -9, then stay with this. Do not change it to + (4)

4.3 $\sum K_i = \frac{1}{2}m_c v_{ic}^2 + \frac{1}{2}m_t v_{it}^2 \checkmark$ *Left as positive*

$$= \frac{1}{2}(1300)(20^2) + \frac{1}{2}(2500)(-24,08^2) \checkmark \quad \text{Positive marking from Q4.2}$$

$$= 984808 \text{ J} \quad \text{Accept: } 9,85 \times 10^5 \text{ J}$$

$$\sum K_f = \frac{1}{2}(m_c + m_t) v_f^2$$

$$= \frac{1}{2}(1300 + 2500) (-9)^2 \checkmark$$

$$= 153900 \text{ J}$$

$\sum K_i \neq \sum K_f \checkmark$
 \therefore the collision is inelastic \checkmark

(5)

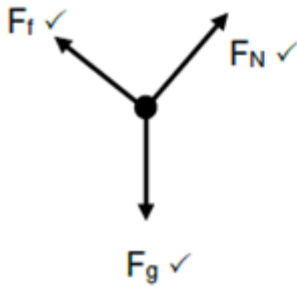
Question 5

The net work done on an object by a force 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. ✓✓

5.2



Accepted Labels:

w	F_g / F_w / weight / mg / gravitational force/ force of gravity
f_k	F_{friction} / F_f / Friction
N	F_{Normal} / Normal / F_N

Notes:

Mark awarded for label <u>and</u> arrow
Do not penalise for length of arrows since drawing is not to scale.
Any other additional force(s) → Max 2/3
If force(s) do not make contact with body → Max 2/3

(3)

5.3

OPTION 1

$$W_{\text{net}} = (W_{F_{\text{Normal}}}) + W_{\text{friction}} + W_{F_{\text{gravity}}} \checkmark$$

$$W_{\text{net}} = (0) + \mu_k N \cdot \Delta x \cdot \cos\theta + mg \cdot \Delta x \cdot \cos\theta$$

$$W_{\text{net}} = 0 + (0,42) (850) (9,8) (\cos 30^\circ) \checkmark + (200) (\cos 180^\circ) \checkmark + (850) (9,8) (200) (\cos 60^\circ) \checkmark$$

$$W_{\text{net}} = (-605\,975,2955) + 833\,000$$

$$W_{\text{net}} = 227\,024,7045 \text{ (or } 227\,024,7) \text{ J} \checkmark$$

OPTION 2

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$(W_{\text{Fnormal}}) + W_{\text{friction}} + W_{\text{Fgravity}} = \Delta E_K$$

$$(0) + \mu_k N \cdot \Delta x \cdot \cos\theta + mg \cdot \Delta x \cdot \cos\theta = \Delta E_K$$

$$0 + (0,42)(850)(9,8)(\cos 30^\circ) \checkmark + (200)(\cos 180^\circ) \checkmark + (850)(9,8)(200)(\cos 60^\circ) \checkmark = \Delta E_K$$

$$- 605\,975,2955 + 833\,000 = \Delta E_K$$

$$W_{\text{net}} = \Delta E_K = 227\,024,7045 \text{ (or } 227\,024,7) \text{ J } \checkmark$$

OPTION 3

$$W_{\text{net}} = (W_{\text{Fnormal}}) + W_{\text{friction}} + W_{\text{Fgravity}} \checkmark$$

$$W_{\text{net}} = (0) + \mu_k N \cdot \Delta x \cdot \cos\theta + mg \cdot \Delta x \cdot \cos\theta$$

$$W_{\text{net}} = (0) + (0,42)(850)(9,8)(\cos 30^\circ) \checkmark + (200)(\cos 180^\circ) \checkmark + (850)(9,8)(100)(\cos 0^\circ) \checkmark$$

$$W_{\text{net}} = (- 605\,975,2955) + 833\,000$$

$$W_{\text{net}} = 227\,024,7045 \text{ (or } 227\,024,7) \text{ J } \checkmark$$

OPTION 4

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$(W_{\text{Fnormal}}) + W_{\text{friction}} + W_{\text{Fgravity}} = \Delta E_K$$

$$(0) + \mu_k N \cdot \Delta x \cdot \cos\theta + mg \cdot \Delta x \cdot \cos\theta = \Delta E_K$$

$$0 + (0,42)(850)(9,8)(\cos 30^\circ) \checkmark + (200)(\cos 180^\circ) \checkmark + (850)(9,8)(100)(\cos 0^\circ) \checkmark = \Delta E_K$$

$$- 605\,975,2955 + 833\,000 = \Delta E_K$$

$$W_{\text{net}} = \Delta E_K = 227\,024,7045 \text{ (or } 227\,024,7) \text{ J } \checkmark$$

OPTION 5

$$F_{\text{net}} = F_{g//} - F_k$$

$$F_{\text{net}} = (850)(9,8)(\sin 30^\circ) - (0,42)(850)(9,8)(\cos 30^\circ) \checkmark$$

$$F_{\text{net}} = 1135,123522 \text{ N}$$

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

$$W_{\text{net}} = (1135,123522) \checkmark (200)(\cos 0^\circ) \checkmark$$

$$W_{\text{net}} = 227\,024,7045 \text{ (or } 227\,024,7) \text{ J } \checkmark$$

$$\Delta E_K \text{ from B to C} = E_{Kf} - E_{Ki}$$

$$- 108\,950 = E_{Kf} - 227\,024,7045 \checkmark$$

$$E_{Kf \text{ at C}} = 118\,074,7045$$

OPTION 1

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$W_{F_{\text{normal}}} + W_{F_{\text{gravity}}} + W_{\text{friction}} + W_{F_{\text{brakes}}} = \Delta E_K$$

$$0 + 0 + \mu_k N \cdot \Delta x \cdot \cos\theta + F_{\text{brakes}} \cdot \Delta x \cdot \cos\theta = E_{Kf \text{ at D}} - E_{Ki \text{ at C}}$$

$$0 + 0 + (0,42)(850)(9,8) \checkmark (50)(\cos 180^\circ) \checkmark + F_{\text{brakes}} \cdot (50)(\cos 180^\circ) \checkmark = 0 - 118\,074,7045 \checkmark$$

$$F_{\text{brakes}} = - 1137,106 \text{ N}$$

$$\therefore \text{magnitude of } F_{\text{brakes}} = 1137,106 \text{ N} \checkmark$$

$$W_{\text{nc}} = \Delta E_P + \Delta E_K \checkmark$$

$$W_{\text{friction}} + W_{F_{\text{brakes}}} = (E_P \text{ at D} - E_P \text{ at C}) + (E_{Kf \text{ at D}} - E_{Ki \text{ at C}})$$

$$\mu_k N \cdot \Delta x \cdot \cos\theta + F_{\text{brakes}} \cdot \Delta x \cdot \cos\theta = (mgh_D - mgh_C) + (E_{Kf \text{ at D}} - E_{Ki \text{ at C}})$$

$$(0,42)(850)(9,8) \checkmark (50)(\cos 180^\circ) \checkmark + F_{\text{brakes}} \cdot (50)(\cos 180^\circ) \checkmark = (0 - 0) + (0 - 118\,074,7045) \checkmark$$

$$F_{\text{brakes}} = - 1137,106 \text{ N}$$

$$\therefore \text{magnitude of } F_{\text{brakes}} = 1137,106 \text{ N} \checkmark$$

OPTION 3 and 4

$$\Delta E_K \text{ from B to C} = E_{Kf} - E_{Ki}$$
$$- 108\,950 = E_{Kf} - 227\,024,7045 \checkmark$$

$$E_{Kf \text{ at C}} = 118\,074,7054 \text{ J}$$

$$E_{K \text{ at C}} = \frac{1}{2}mv^2$$
$$118\,074,7045 = \frac{1}{2}(850) v^2$$
$$v_{\text{at C}} = 16,6680 \text{ m.s}^{-1}$$

OPTION 3

$$W_{\text{net}} = \Delta E_K \checkmark$$

$$W_{F_{\text{normal}}} + W_{F_{\text{gravity}}} + W_{F_{\text{friction}}} + W_{F_{\text{brakes}}} = \frac{1}{2}m(v^2_f - v^2_i)$$

$$0 + 0 + \mu_k N \cdot \Delta x \cdot \cos \theta + F_{\text{brakes}} \cdot \Delta x \cdot \cos \theta = \frac{1}{2}m(v^2_f - v^2_i)$$

$$(0,42)(850)(9,8) \checkmark (50)(\cos 180^\circ) \checkmark + F_{\text{brakes}} \cdot (50)(\cos 180^\circ) \checkmark = \frac{1}{2}(850)(0^2 - 16,6680^2)$$

$$F_{\text{brakes}} = - 1137,106 \text{ N}$$

OPTION 4

$$W_{nc} = \Delta E_P + \Delta E_K \checkmark$$

$$W_{\text{friction}} + W_{F_{\text{brakes}}} = (E_P \text{ at D} - E_P \text{ at C}) + \frac{1}{2}m(v_f^2 - v_i^2)$$

$$\mu_k N \cdot \Delta x \cdot \cos \theta + F_{\text{brakes}} \cdot \Delta x \cdot \cos \theta = (mgh_D - mgh_C) + \frac{1}{2}m(v_f^2 - v_i^2)$$

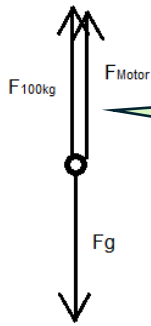
$$(0,42)(850)(9,8) \checkmark (50)(\cos 180^\circ) \checkmark + F_{\text{brakes}} \cdot (50)(\cos 180^\circ) \checkmark = (0 - 0) + \frac{1}{2}(850)(0^2 - 16,6680^2) \checkmark$$

$$F_{\text{brakes}} = - 1137,106 \text{ N}$$

$$\therefore \text{magnitude of } F_{\text{brakes}} = 1137,106 \text{ N} \checkmark$$

Question 6

6.1



The trick to this question was realising that the **motor also exerted a separate force on the box.**

(3)

6.2

OPTION 1:	OPTION 2:
$W = F\Delta y \cos\theta$ $W_w = mg\Delta y \cos\theta$ $W_w = (125)(9,8)(6,8)(\cos 180^\circ) \checkmark$ $= -8330 \text{ J}$	$W_w = -\Delta E_p$ $W_w = -mg(h_f - h_i)$ $W_w = -(125)(9,8)(6,8 - 0) \checkmark$ $= -8330 \text{ J}$

$$W = F\Delta y \cos\theta$$

$$W_{mp} = mg\Delta y \cos\theta$$

$$W_{mp} = (100)(9,8)(6,8)(\cos 0^\circ) \checkmark$$

$$= 6664 \text{ J}$$

$$W_{net} = \Delta E_k$$

$$W_{motor} + W_{mp} + W_w = \Delta E_k$$

$$W_{motor} + 6664 + (-8330) \checkmark = 0 \checkmark$$

$$W_{motor} = 1666 \text{ J}$$

$$P = \frac{W}{\Delta t} \checkmark$$

$$P = \frac{1,666}{0,01} \checkmark$$

$$= 166600 \text{ W} \checkmark$$

(7)

Question 7		
7.1	<p>The apparent change in the detected frequency (or pitch)(or wavelength) ✓ as a result of the relative motion between a source and an observer (listener). ✓</p> <p><i>Die skynbare verandering in waargenome frekwensie (of toonhoogte)(of golflengte) ✓ as gevolg van die relatiewe beweging tussen die bron en waarnemer/luisteraar. ✓</i></p>	(2)
7.2	$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \checkmark \text{ OR/OF } \quad f_L = \frac{v + v_L}{v - v_s} f_s$ $f_L = \frac{(340 + 30) 280}{340} \quad \checkmark$ $= 304,71 \text{ Hz} \quad \checkmark$	(5)
7.3	<p>SMALLER/KLEINER ✓ (negative marking, below)</p> <p>λ increases OR frequency decreases. ✓ <i>λ neem toe OF frekwensie neem af. ✓</i></p> <p style="text-align: center;">OR/OF</p> <p>$\lambda \propto \frac{1}{f}$ or/of $f \propto \frac{1}{\lambda}$ ✓</p>	(2)
7.4	<p>Determines the rate at which blood flow. ✓ Monitor and measures the heartbeat of a foetus. (Any ONE)</p> <p><i>Bepaal die tempo waarteen bloed vloei. ✓ Monitor en meet die hartklop van 'n fetus. (Enige EEN)</i></p>	(1)
7.5	<p>AWAY/WEG ✓ (negative marking, below)</p> <p>Light from a star is shifted towards a longer wavelength/towards the red end of the spectrum. ✓</p> <p><i>Die ster se lig word verskuif na 'n langer golflengte/na die rooi kant van die spektrum. ✓</i></p>	(2)

[12]