



# education

Department:  
Education  
North West Provincial Government  
**REPUBLIC OF SOUTH AFRICA**

## PROVINCIAL ASSESSMENT

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)  
JUNE 2026

Stanmorephysics.com

**MARKS: 150**

**TIME: 3 hours**

**This question paper consists of 15 pages and 2 data sheets.**

## INSTRUCTIONS AND INFORMATION

1. Write your name on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer all questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave one line open between two subquestions, e.g. QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, etc. where required.
10. You are advised to use the attached DATA SHEETS.
11. Write neatly and legibly.

### QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 Which ONE of the following S.I units is equivalent to a newton (N).

A  $\text{kg}\cdot\text{m}\cdot\text{s}^{-1}$

B  $\text{kg}\cdot\text{m}\cdot\text{s}^{-2}$

C  $\text{kg}\cdot\text{m}\cdot\text{s}^2$

D  $\text{kg}\cdot\text{m}^2\cdot\text{s}^{-2}$

(2)

1.2 A car of mass  $m$  drives at a constant velocity  $v$  up a slope that makes an angle of  $\theta$  to the horizontal. There is a driving force,  $F$ , acting on the car up the slope, as shown in the diagram below.

When the car moves a distance  $s$  up the slope, what is the component of the weight acting perpendicular to the surface:



A  $mg\sin\theta$

B  $mg\cos\theta$

C  $F\cos\theta$

D  $F\sin\theta$

(2)

1.3 A 5 kg ball moving at  $4\text{ m}\cdot\text{s}^{-1}$  collides with a stationary 3 kg ball. If the collision is perfectly elastic, what is the combined velocity after the collision?

A  $4,5\text{ m}\cdot\text{s}^{-1}$

B  $1,5\text{ m}\cdot\text{s}^{-1}$

C  $2,5\text{ m}\cdot\text{s}^{-1}$

D  $2\text{ m}\cdot\text{s}^{-1}$

(2)

1.4 Ball **X** of mass **m** is projected vertically upwards from a bridge 30m high with an initial velocity of **V<sub>x</sub>**. Ball **Y** of mass **2m** is thrown vertically downwards from the same bridge with the velocity of **V<sub>y</sub>**. The two balls reach the ground at the same speed. Ignore the effect of air resistance.

Which ONE of the following is CORRECT regarding the velocities with which the balls are projected?

A  $V_x = 0,5V_y$

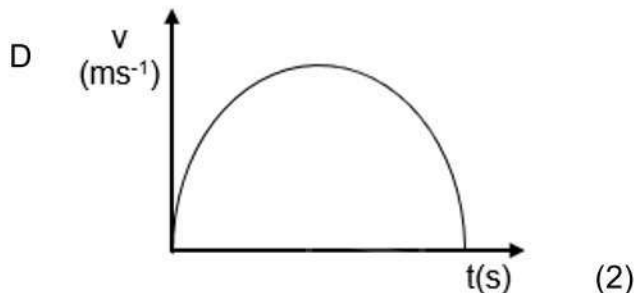
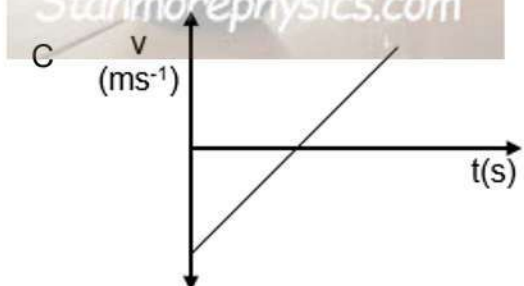
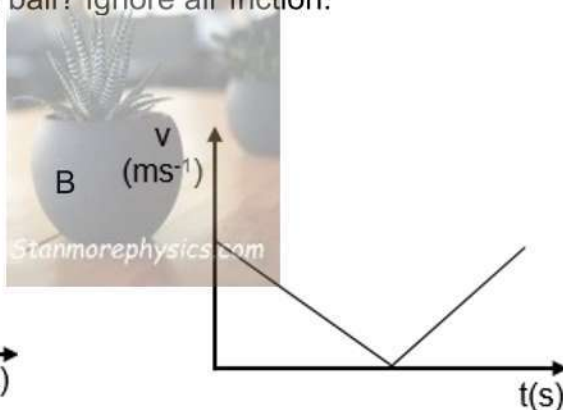
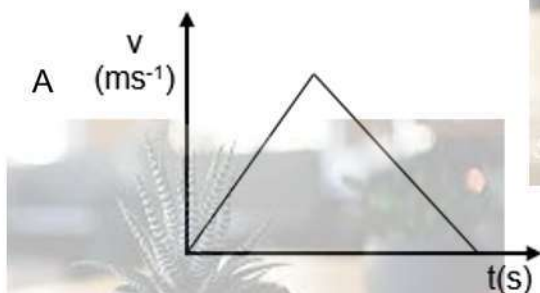
B  $V_x = V_y$

C  $V_x = 2V_y$

D  $V_x = 4V_y$

(2)

1.5 A girl throws a tennis ball vertically upwards, and after some time it returns to the girl's hands. Which ONE of the following velocity versus time graphs best represents the motion of the tennis ball? Ignore air friction.



(2)

1.6 A car moves at a speed of  $v$  and has a kinetic energy  $E_k$ . If the speed of the car increases to  $2v$ , the kinetic energy will then be ...

- A  $2 E_k$
- B  $4 E_k$
- C  $8 E_k$
- D  $16 E_k$

(2)

1.7 The power output of an engine is increased so that the same amount of work is done in one-third of the original time.

The ratio of the new power to the original power is:

- A 1 : 3
- B 3 : 1
- C 1 : 9
- D 9 : 1



(2)

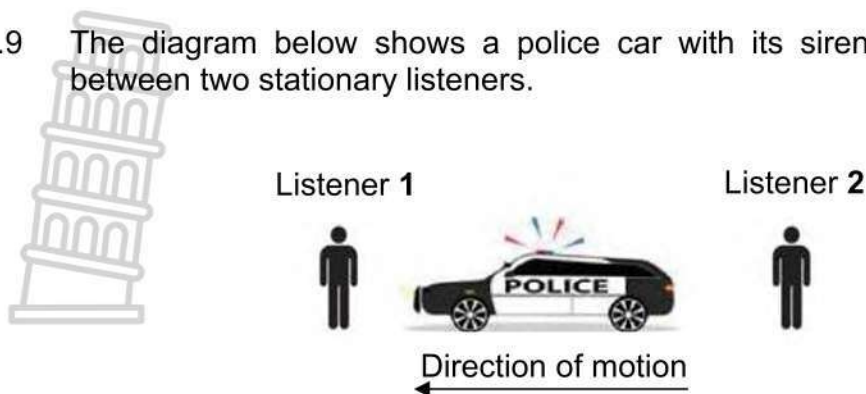
1.8 A pedestrian is waiting at a traffic light. A police car with its siren switched on is speeding towards the pedestrian.

Which ONE of the following correctly describes the relationship between frequency and wavelength detected by the pedestrian?

	Frequency	Wavelength
A	Higher	Longer
B	Higher	Shorter
C	Lower	Shorter
D	Lower	Longer

(2)

1.9 The diagram below shows a police car with its siren blaring, stationed between two stationary listeners.



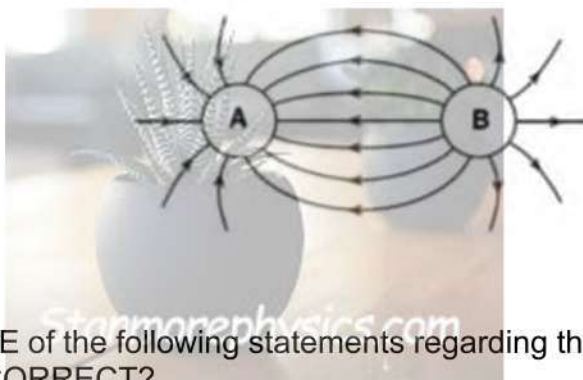
While the police car is stationary, how does the frequency detected by listener 1 compare to the frequency detected by listener 2.

- A No detection
- B Greater than
- C Less than
- D Equal to



(2)

1.10 The electric field pattern between two charged spheres, **A** and **B**, is shown below.



Which ONE of the following statements regarding the charges on spheres **A** and **B** is CORRECT?

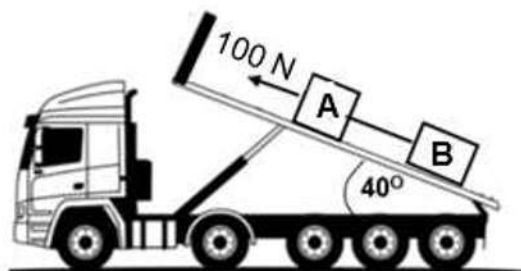
- A Spheres **A** and **B** are both positively charged.
- B Spheres **A** and **B** are both negatively charged.
- C Sphere **A** is positively charged, and sphere **B** is negatively charged.
- D Sphere **A** is negatively charged, and sphere **B** is positively charged.

(2)  
[20]

**QUESTION 2 (Start on a new page.)**

Two blocks, **B**, of mass 20 kg, and **A**, of mass 10 kg, are connected by a light inextensible string. The blocks are lowered down on a rough inclined dump bed which is at an angle of  $40^\circ$ .

The contractor applies an upwards force of 100N, parallel to the surface of the dump bed for the blocks not to break. The coefficient of kinetic friction between each block and the surface of the dump bed is 0,2.

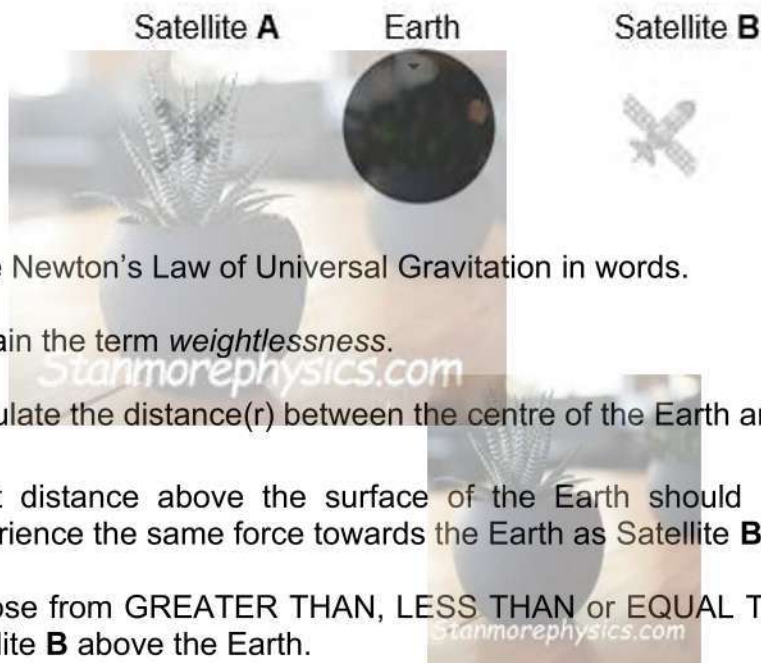


- 2.1 Define the term *kinetic frictional force*. (2)
  - 2.2 Calculate the magnitude of the frictional force acting on Block **B** as it slides down the surface of the dump bed. (3)
  - 2.3 Draw a labelled free-body diagram showing all the forces acting on Block **A** as it slides down the surface of the dump bed. (5)
  - 2.4 Calculate the magnitude of:
    - 2.4.1 Kinetic frictional force acting on block **A** as it slides down the dump bed. (2)
    - 2.4.2 Tension in the string connecting the two blocks. (8)
  - 2.5 The contractor stops applying the 100 N force to the blocks. What will happen to acceleration?  
Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)
- [21]**

**QUESTION 3 (Start on a new page.)**

Two satellites, **A** and **B**, orbiting the Earth and are situated on opposite sides of the Earth. Satellite **A** has a mass of 4 500 kg and Satellite **B** has a mass of 3 800 kg.

The force between satellite **B** and the Earth is 1 539,23 N.



3.1 State Newton's Law of Universal Gravitation in words. (2)

3.2 Explain the term *weightlessness*. (2)

3.3 Calculate the distance( $r$ ) between the centre of the Earth and Satellite **B**. (4)

3.4 What distance above the surface of the Earth should Satellite **A** be to experience the same force towards the Earth as Satellite **B**?

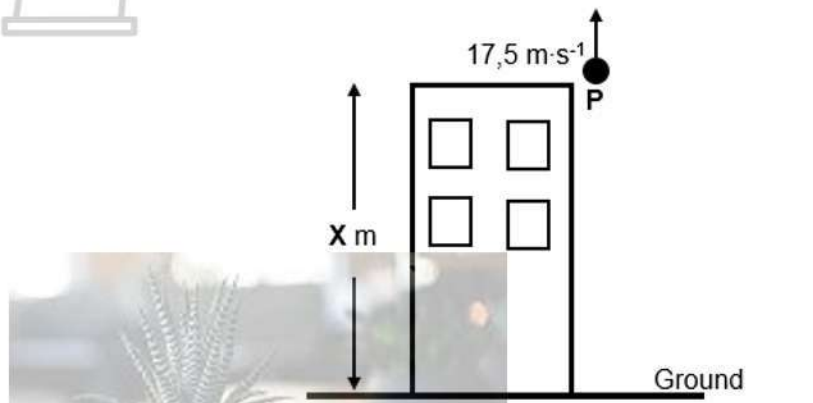
Choose from GREATER THAN, LESS THAN or EQUAL TO the distance of satellite **B** above the Earth.

Explain the answer WITHOUT the use of a calculation. (4)  
**[12]**

**QUESTION 4 (Start on a new page.)**

Ball **P** is projected vertically upwards from a height, **X** m, with a speed of  $17,5 \text{ m}\cdot\text{s}^{-1}$ . The ball strikes the ground after 5 s, with a speed of **V**.

Ignore the effects of air friction.



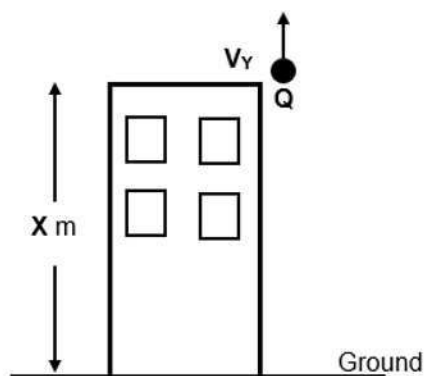
4.1 Define the term *projectile*. (2)

4.2 Calculate the: (3)

4.2.1 The value of **X** (3)

4.2.2 Speed **V** with which the ball hits the ground (3)

A second ball **Q** is thrown vertically upwards from the same height **X** m with a speed of  $\mathbf{V}_Y$ , until it strikes the ground with a speed of  $\frac{6}{7} \mathbf{V}$ .



4.3 Calculate the value of  $\mathbf{V}_Y$ . (5)

4.4 Draw a position-time graph for ball **Q** from the moment it was vertically thrown upwards until it strikes the ground.

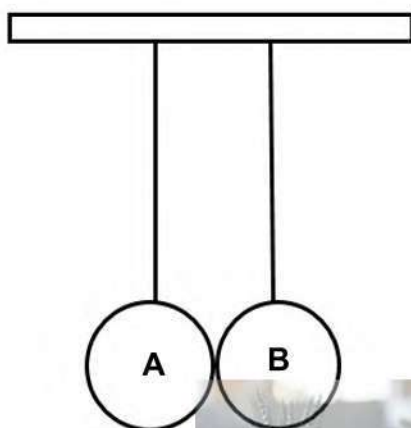
Take the ground as the zero position. (2)

**[15]**

**QUESTION 5 (Start on a new page.)**

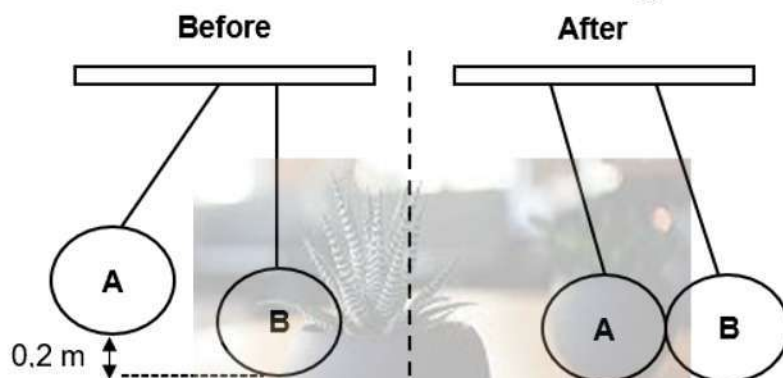
Two small plastic balls, **A** and **B** at rest, are suspended vertically from the ceiling by identical light inextensible strings.

Ball **A** has a mass of 0,4 kg and ball **B** has a mass of 0,6 kg.



Ball **A** is pulled horizontally to the left, so that its centre of mass is raised 0,2 m above its original equilibrium position. It is then released from rest. Ball **A** swings downwards and collides with ball **B**, which was initially at rest. The two balls swing together after collision.

Ignore the effects of air resistance and assume no energy is lost during collision.



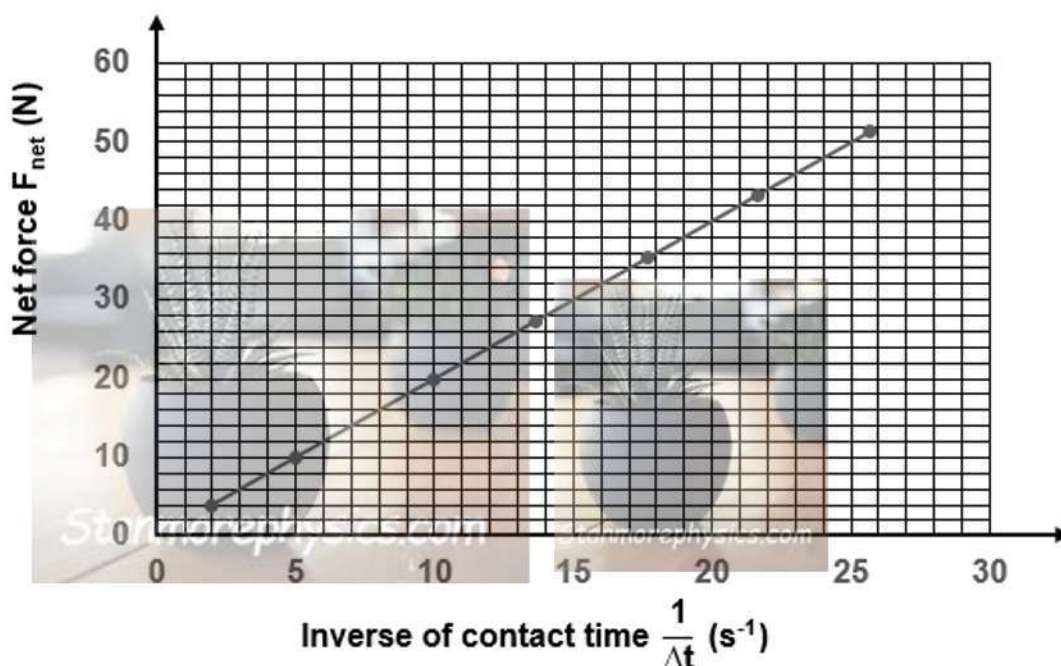
- 5.1 State the *principle of conservation of linear momentum* in words. (2)
  - 5.2 Calculate the velocity of ball **A** just before it collides with ball **B**. (4)
  - 5.3 Calculate the velocity of ball **B** immediately after the collision. (4)
  - 5.4 Is the collision between ball **A** and ball **B** ELASTIC or INELASTIC? (1)
- [11]**

**QUESTION 6 (Start on a new page.)**

The learners investigate the relationship between the net average force exerted on a tennis ball during a bounce and the inverse of the contact time.

A tennis ball of mass 0,06 kg is dropped from rest from a height of 6 m above the floor. The learners records the contact times and plots a graph of the net force versus the inverse of contact time, as shown in the graph below.

Ignore the effects of air friction.



6.1 Define the term *impulse*. (2)

6.2 Calculate the impulse of the tennis ball. (3)

The tennis ball strikes the floor at a velocity of  $10,84 \text{ m}\cdot\text{s}^{-1}$  and it remains in contact with the floor for 0,1 s.

6.3 Calculate the bouncing velocity of the tennis ball. (3)

A rubber mat is placed on the floor, and the same tennis ball is dropped from the same height.

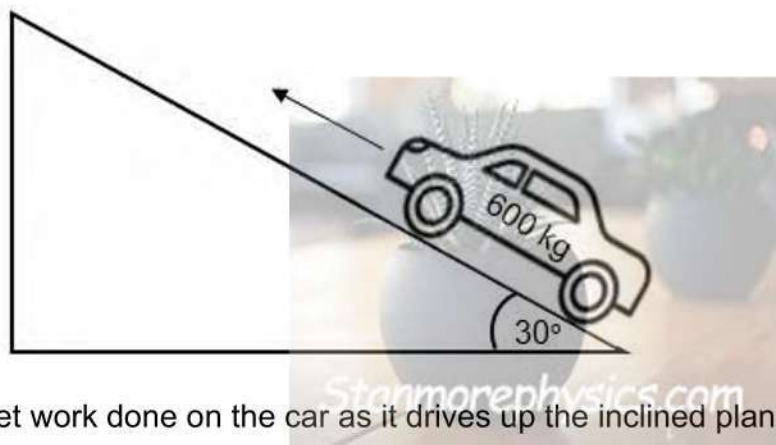
6.4 How will the net force on the tennis ball by the floor be affected? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

6.5 Explain the answer to QUESTION 6.4. (2)

**[10]**

**QUESTION 7 (Start on a new page.)**

A car of mass 600 kg drives at a **CONSTANT VELOCITY** up a rough incline plane of  $30^\circ$  as shown in the diagram below.



7.1 What is the net work done on the car as it drives up the inclined plane. (1)

7.2 Draw a labelled free-body diagram showing all the forces acting on the car as it drives up the inclined plane. (4)

7.3 The car now accelerates up the slope. The car's engine exerts a force of 600 N and the coefficient of kinetic friction between the wheels of the car and the surface is 0,23.

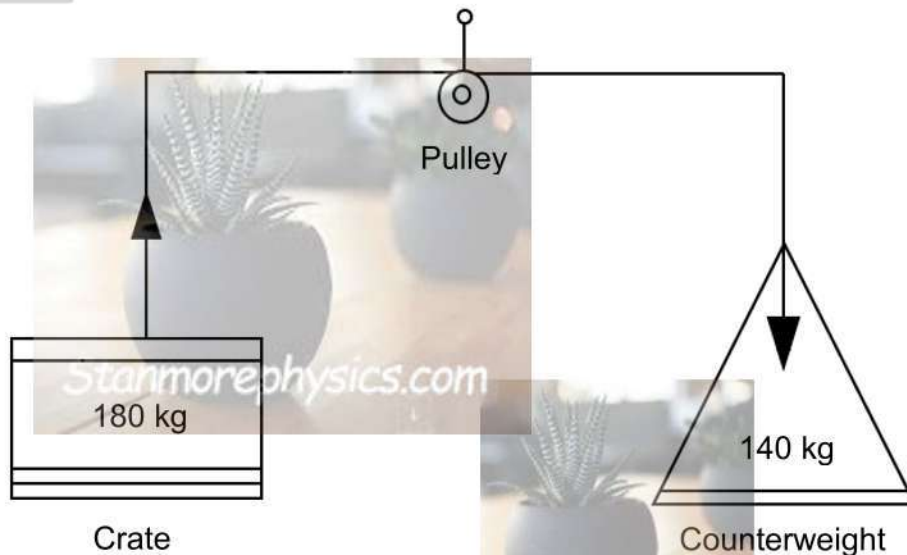
7.3.1 State the work-energy theorem in words. (2)

7.3.2 Using **ENERGY PRINCIPLE ONLY**, calculate the magnitude of the velocity of the car after moving 30 m up the incline. (7)  
**[14]**

**QUESTION 8 (Start on a new page.)**

A warehouse uses a motor-driven pulley system to lift a 180 kg crate vertically upward at a **CONSTANT VELOCITY**. A 140 kg counterweight hangs on the other side of a light pulley. Ignore the effects of friction.

The crate rises a vertical height of 4,5 m in 3 s.

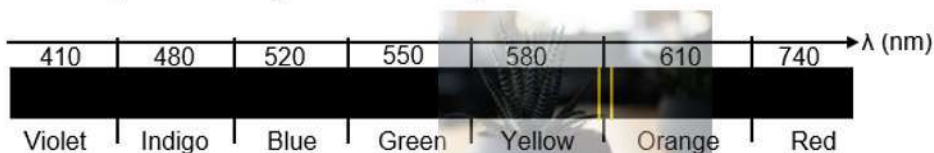


- 8.1 Define the term *power*. (2)
  - 8.2 Calculate the work done by:
    - 8.2.1 the gravitational force on the crate (3)
    - 8.2.2 the counterweight on the crate (2)
  - 8.3 Calculate the average power delivered by the motor. (6)
- [13]**

**QUESTION 9 (Start on a new page.)**

A model aeroplane with a siren that produces sound waves with a wavelength of 0,2 m flies horizontally over a group of spectators at a speed of  $10 \text{ km}\cdot\text{h}^{-1}$ . Take the speed of sound in air as  $330 \text{ m}\cdot\text{s}^{-1}$ .

- 9.1 Calculate the frequency of the sound waves that the siren of an aeroplane produces. (3)
- 9.2 Determine by what factor the emitted frequency is increased or decreased to obtain the frequency observed by the spectators when the aeroplane flies towards them (round off to 4 decimals). (4)
- 9.3 Calculate the frequency of the sound heard by the spectators when the aeroplane flies away from them. (4)
- 9.4 Consider the following spectrum of glowing sodium (Na) gas which is used in street lamps. Two bright lines, orange in colour, are observed.



Consider the following spectra **X**, **Y** and **Z** from the light of nearby stars, observed from Earth:

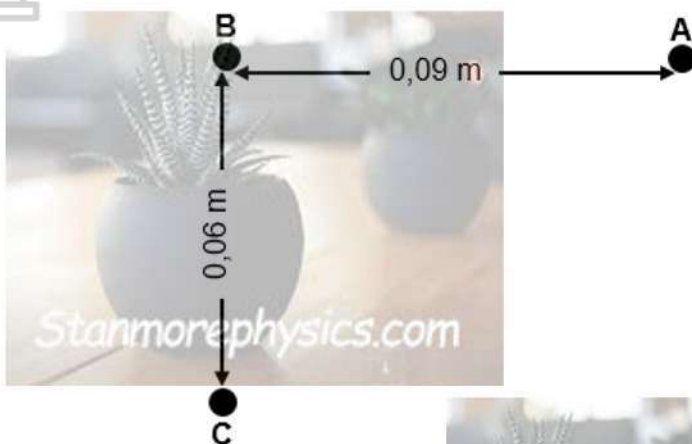
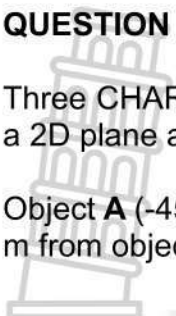


- 9.4.1 Which one of the spectra **X**, **Y**, or **Z**, shows a red shift? (1)
  - 9.4.2 In which direction relative to the Earth are stars moving? (2)
  - 9.4.3 What can be deduced from an observed red shift? (2)
- [16]**

**QUESTION 10 (Start on a new page.)**

Three CHARGED objects, **A**, **B** and **C** are placed at a right angle to each other in a 2D plane as shown in the diagram below.

Object **A** ( $-45 \mu\text{C}$ ) is  $0,09 \text{ m}$  from object **B** ( $+20 \mu\text{C}$ ), while object **C** ( $+30 \mu\text{C}$ ) is  $0,06 \text{ m}$  from object **B**.

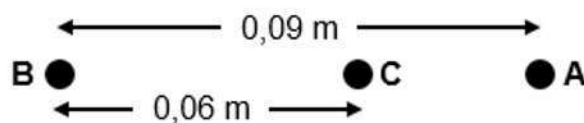


10.1 State Coulomb's law in words. (2)

10.2 Calculate the electrostatic force exerted on **B** due to the presence of object **A**. (4)

10.3 The magnitude of the electrostatic force exerted on **B** due to the presence of **C** is  $1,5 \times 10^3 \text{ N}$ . Calculate the magnitude of the net electrostatic force exerted on **B** due to the presence of **A** and **C**. (3)

10.4 Object **C** is now placed between **A** and **B** at a distance  $0,06 \text{ m}$  from **B**.



10.4.1 Define the term *electric field at a point*. (2)

10.4.2 Calculate the net electric field at **C** if the magnitude of the electric field that **C** experiences due to **B**, is equal to  $5 \times 10^7 \text{ N}\cdot\text{C}^{-1}$ . (6)

[17]

**TOTAL: 150**

**DATA FOR PHYSICAL; SCIENCES GRADE 12  
 PAPER 1 (PHYSICS)**

**TABEL 1: FISIESE KONSTANTES**

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 m·s <sup>-2</sup>
Universal gravitational constant	G	6,67 x 10 <sup>-11</sup> N·m <sup>2</sup> ·kg <sup>-2</sup>
Speed of light in a vacuum	c	3,0 x 10 <sup>8</sup> m·s <sup>-1</sup>
Planck's constant	h	6,63 x 10 <sup>-34</sup> J·s
Coulomb's constant	k	9,0 x 10 <sup>9</sup> N·m <sup>2</sup> ·C <sup>-2</sup>
Charge on electron	e	1,6 x 10 <sup>-19</sup> C
Electron mass	m <sub>e</sub>	9,11 x 10 <sup>-31</sup> kg
Radius of the Earth	R <sub>E</sub>	6,38 x 10 <sup>6</sup> m
Mass of the Earth	M <sub>E</sub>	5,98 x 10 <sup>24</sup> kg

**TABLE 2: FORMULAE**

**MOTION**

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ of $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ of $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ of $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

**FORCE**

$F_{net} = ma$	$p = mv$
$f_{smaks} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$	$w = mg$
$\Delta p = mv_f - mv_i$	
$F = G\frac{m_1m_2}{d^2}$ of $F = G\frac{m_1m_2}{r^2}$	$g = G\frac{M}{d^2}$ of $g = G\frac{M}{r^2}$

**WORK, ENERGY AND POWER**

$W = F\Delta x \cos\theta$	$U = mgh$ of $E_p = mgh$
$K = \frac{1}{2}mv^2$ of $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ of $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ of $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ of $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{gemid} = Fv_{gem}$	

**WAVES, SOUND AND LIGHT**

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ of $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(maks)}$ of $E = W_0 + K_{maks}$ waar $E = hf$ en $W_0 = hf_0$ en $E_{k(maks)} = \frac{1}{2}mv_{maks}^2$ of $K = mv_{maks}^2$	

**ELECTROSTATICS**

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ of $n = \frac{Q}{q_e}$	



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**PROVINCIAL ASSESSMENT/  
PROVINSIALE ASSESSERING**

**GRADE/GRAAD 12**

**PHYSICAL SCIENCES: PHYSICS (P1)  
FISIESE WETENSKAPPE: FISIKA (V1)**

*Stanmorephysics.com*

**JUNE/JUNIE 2026**

**CORRECTED MARKING GUIDELINES/  
GEKORRIGEERDE NASIENRIGLYNE**

**MARKS/PUNTE: 143**

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This marking guidelines consists of 14 pages.  
*Hierdie nasienriglyne bestaan uit 14 bladsye.*

**QUESTION 1/VRAAG 1**

- 1.1 B ✓✓ (2)
- 1.2 B ✓✓ (2)
- 1.3 C ✓✓ (2)
- 1.4 B ✓✓ (2)
- 1.5 C ✓✓ (2)
- 1.6 B ✓✓ (2)
- 1.7 B ✓✓ (2)
- 1.8 B ✓✓ (2)
- 1.9 D ✓✓ (2)
- 1.10 D ✓✓ (2)

**[20]**



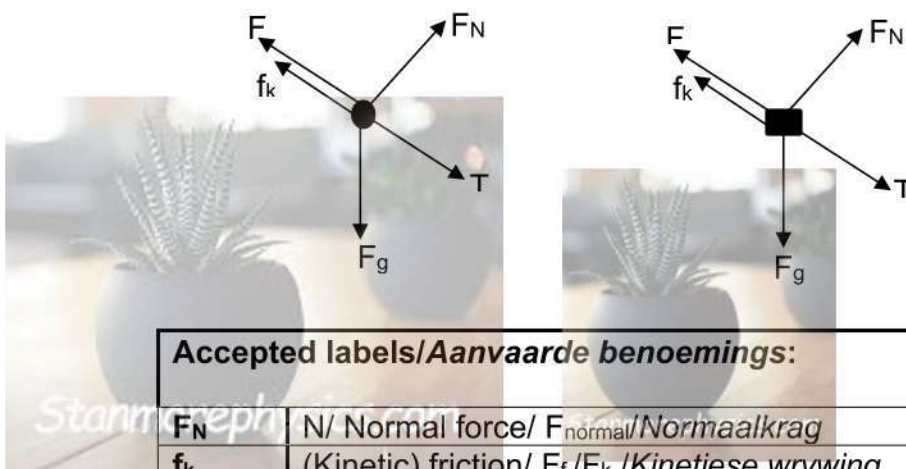
**QUESTION 2/VRAAG 2**

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

2.2  $f_k = \mu_k F_N$  } ✓ any one/enige een  
 $f_k = \mu_k mg \cos \theta$  }  
 $f_k = (0,2) (20 \times 9,8 \cos 40^\circ)$  ✓  
 $f_k = 30,03 \text{ N}$  ✓ (3)

2.3

**ACCEPT/AANVAAR**



<b>Accepted labels/Aanvaarde benoemings:</b>	
$F_N$	N/ Normal force/ $F_{\text{normal}}$ / Normaalkrag
$f_k$	(Kinetic) friction/ $F_f$ / $F_k$ /Kinetiese wrywing
$w$	$F_g$ /mg/ mg/gravitational force/gravitasiekrag
$F$	Applied force/ $F_A$ /Toegepaste krag
$T$	$F_T$ /Tension /spanning
<b>Notes/Aantekeninge</b>	
<ul style="list-style-type: none"> <li>• Mark is awarded for label <u>and</u> arrow/Punt word toegeken vir byskrif en pyltjie.</li> <li>• Do not penalise for length of arrows/Moenie vir lengte van pyltjie penaliseer nie.</li> <li>• If arrows do not touch the dot/Indien pyle nie die kolletjie raak nie: Max/Maks 4/5</li> <li>• If additional force(s)/Enige addisionele kragte:                     <ul style="list-style-type: none"> <li>• Max/Maks 4/5</li> </ul> </li> <li>• If everything is correct, but no arrows/indien alles korrek is, maar geen pyltjies: Max/Maks 4/5</li> <li>• If components are drawn/Indien komponente geteken: Max/Maks 4/5</li> </ul>	

2.4  
 2.4.1  $f_k = \mu_k F_N$   
 $f_k = \mu_k mg \cos \theta$   
 $f_k = (0,2) (10 \times 9,8 \cos 40^\circ)$  ✓  
 $f_k = 15,01 \text{ N}$  ✓ (2)

2.4.2 **OPTION 1/OPSIE 1**

**Block B/Blok B**

$$\begin{aligned}
 F_{\text{net}} &= ma && \checkmark \text{ any one/enige een} \\
 F_{\text{gll}} - f_k - T &= ma \\
 (20 \times 9,8 \sin 40) - 30,03 - T &= 20a \\
 -T &= 20a - 125,99 - 30,03 \\
 T &= -20a + 95,96 \text{ ----- (1)}
 \end{aligned}$$

**Block A/Blok A**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F_{\text{gll}} + T - f_k - F_a &= ma && \text{Both / Beide} \checkmark \\
 (10 \times 9,8 \sin 40) + T - 15,01 - 100 &= 10a \\
 T &= 10a + 52,03 \text{ ----- (2)}
 \end{aligned}$$

**Substituting/Vervanging (1) in (2)**

$$\begin{aligned}
 -20a + 95,96 &= 10a + 52,03 \checkmark \\
 30a &= 43,96 \\
 a &= 1,46 \text{ m.s}^{-2} \checkmark \\
 T &= 10a + 52,03 \\
 T &= 10(1,46) + 52,03 \checkmark \\
 T &= 66,63 \text{ N} \checkmark
 \end{aligned}$$

**Range/Gebied: 66,62 N – 66,68 N**

(8)

**OPTION 2/OPSIE 2**

**Block B/Blok B**

$$\begin{aligned}
 F_{\text{net}} &= ma && \checkmark \text{ any one/enige een} \\
 F_{\text{gll}} - f_k - T &= ma \\
 (20 \times 9,8 \sin 40) - 30,03 - T &= 20a \\
 95,9564 - T &= 20a \text{ ----- (1)} \\
 95,9564 - T &= 2 \times 10a \text{ ----- (2)}
 \end{aligned}$$

**Block A/Blok A**

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 F_{\text{gll}} + T - f_k - F_a &= ma && \text{Both / Beide} \checkmark \\
 (10 \times 9,8 \sin 40) + T - 15,01 - 100 &= 10a \\
 T - 52,0168 &= 10a \text{ ----- (3)}
 \end{aligned}$$

**Substituting/Vervanging (3) in (2)**

$$\begin{aligned}
 95,9564 - T &= 2(T - 52,0168) \checkmark \\
 95,9564 - T &= 2T - 104,0336 \\
 T &= 66,66 \text{ N} \checkmark
 \end{aligned}$$

**Range/Gebied: 66,62 N – 66,68 N**

2.5 Increase/Verhoog

(1)  
[21]

QUESTION 3/VRAAG 3

**Marking criteria/Nasienkriteria**  
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

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

3.2 The sensation experienced when all contact forces are removed. ✓✓ (2)  
*Die sensasie wat ervaar word indien alle kragte verwyder word.*

3.3  $F = G \frac{m_1 m_2}{r^2}$  ✓  
 $1\,539,23 \checkmark = 6,67 \times 10^{-11} \times \frac{(5,98 \times 10^{24}) (3800)}{r^2}$  ✓  
 $r^2 = 6,67 \times 10^{-11} \times \frac{(5,98 \times 10^{24}) (3800)}{1\,539,23}$   
 $r = 3,14 \times 10^7 \text{ m}$  ✓ (4)

3.4 Greater than/Groter as ✓  
The mass is greater / Die massa is groter ✓  
Same force, ✓ must have the same mass as planet earth ✓ / Vir dieselfde krag moet die afstand ook groter wees. (4)  
**[12]**

**QUESTION 4 / VRAAG 4**

4.1 Object which has been given an initial velocity and then it moves under the influence of the gravitational force only. ✓✓

'n Voorwerp waaraan 'n beginsnelheid gegee is en wat dan slegs onder die invloed van die gravitasiekrag beweeg.

(2 or/ of 0)

(2)

4.2

4.2.1	<b>OPTION 1/OPSIE 1</b> (Upwards as positive/Opwaarts as positief)	<b>OPTION 2/OPSIE 2</b> (Downwards as positive/Afwaarts as positief)
	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= (17,5)(5) + \frac{1}{2} (-9,8)(5)^2 \checkmark$ $= 35 \text{ m} \checkmark$	$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $= (-17,5)(5) + \frac{1}{2} (9,8)(5)^2 \checkmark$ $= -35 \text{ m}$ $= 35 \text{ m} \checkmark$

(3)

4.2.2	<b>OPTION 1/OPSIE 1</b> (Upwards as positive/Opwaarts as positief)	<b>(Downwards as positive/Afwaarts as positief)</b>
	$v_f = v_i + a \Delta t \checkmark$ $= 17,5 + (-9,8)(5) \checkmark$ $= 31,5 \text{ m} \cdot \text{s}^{-1} \checkmark$	$v_f = v_i + a \Delta t \checkmark$ $= -17,5 + (9,8)(5) \checkmark$ $= 31,5 \text{ m} \cdot \text{s}^{-1} \checkmark$

	<b>OPTION 2/OPSIE 2</b> (Upwards as positive/Opwaarts as positief)	<b>(Downwards as positive/Afwaarts as positief)</b>
	$v_f^2 = v_i^2 + 2a \Delta y \checkmark$ $= (17,5)^2 + (-9,8)(-35) \checkmark$ $v_f^2 = 992,25$ $= 31,5 \text{ m} \cdot \text{s}^{-1} \checkmark$	$v_f^2 = v_i^2 + 2a \Delta y \checkmark$ $= (-17,5)^2 + (9,8)(35) \checkmark$ $v_f^2 = 992,25$ $= 31,5 \text{ m} \cdot \text{s}^{-1} \checkmark$

(3)



4.3 Positive marking from Question 4.2.1 and 4.2.2 / Positiewe nasien vanaf VRAAG 4.2.1 en 4.2.2

OPTION 1/OPSIE 1	
(Upwards as positive/Opwaarts as positief)	(Downwards as positive/Afwaarts as positief)
$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(-\frac{6}{7} v)^2 \checkmark = (V_y)^2 + 2(-9,8)(-35) \checkmark$ $\frac{36}{49} v^2 = V_y^2 + 686$ $\frac{36}{49} (31,5)^2 \checkmark = V_y^2 + 686$ $729 = V_y^2 + 686$ $V_y^2 = 43$ $V_y = 6,56 \text{ m}\cdot\text{s}^{-1} \checkmark$	$v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(\frac{6}{7} v)^2 \checkmark = (-V_y)^2 + 2(9,8)(35) \checkmark$ $\frac{36}{49} v^2 = V_y^2 + 686$ $\frac{36}{49} (31,5)^2 = V_y^2 + 686$ $729 = V_y^2 + 686$ $V_y^2 = 43$ $V_y = 6,56 \text{ m}\cdot\text{s}^{-1} \checkmark$
(5)	
OPTION 2/OPSIE 2	
(Upwards as positive/Opwaarts as positief)	(Downwards as positive/Afwaarts as positief)
$\frac{6}{7} v \checkmark = \frac{6}{7} (31,5) \checkmark$ $\frac{6}{7} v = 27 \text{ m}\cdot\text{s}^{-1}$  $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(27)^2 = (V_y)^2 + 2(-9,8)(-35) \checkmark$ $V_y = 6,56 \text{ m}\cdot\text{s}^{-1} \checkmark$	$\frac{6}{7} v \checkmark = \frac{6}{7} (31,5) \checkmark$ $\frac{6}{7} v = 27 \text{ m}\cdot\text{s}^{-1}$  $v_f^2 = v_i^2 + 2a\Delta y \checkmark$ $(-27)^2 = (V_y)^2 + 2(9,8)(35) \checkmark$ $V_y = 6,56 \text{ m}\cdot\text{s}^{-1} \checkmark$

4.4 Upwards as positive/Opwaarts as positief      Downwards as positive/Afwaarts as positief

<p><b>Marking Criteria/Nasienkriteria:</b>                  Shape/Vorm: max/Maks 2/2</p>	

(2)  
[15]

**QUESTION 5**

5.1 The total linear momentum of an isolated system remains constant. ✓✓  
 Die totale lineêre momentum in 'n geïsoleerde sisteem bly konstant (behoue).  
 (2 or/of 0) (2)

5.2  $E_{mech/meg\ B} = E_{mech/meg\ A}$   
 $(E_p + E_k)_B = (E_p + E_k)_A$  } ✓ any one/enige een  
 $(mgh + \frac{1}{2}mv^2)_B = (mgh + \frac{1}{2}mv^2)_A$   
 $((0,4)(9,8)(0,2) + (0))_B \checkmark = (0 + \frac{1}{2}(0,4)v^2)_A \checkmark$   
 $V^2 = 3,92$   
 $V = 1,98\ m.s^{-1}\ \text{to the right} \checkmark$  (4)

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

5.3  $\Sigma p_i = \Sigma p_f$  } ✓ any one/enige een  
 $m_A v_{iA} + m_B v_{iB} = m_A v_{fA} + m_B v_{fB}$   
 $(0,4)(1,98) + (0,6)(0) \checkmark = (0,4 + 0,6) v_{fAB} \checkmark$   
 $v_{fAB} = 0,792\ m.s^{-1}\ \text{to the right} \checkmark$  (4)

5.4 Inelastic/onelasties ✓ (1)  
 [11]



**QUESTION 6/VRAAG 6**

6.1 The product of the resultant/ net force acting on an object and the time the net force acts on an object. ✓✓

Die produk van die resulterende/netto krag wat op 'n voorwerp inwerk en die tyd wat die netto krag op die voorwerp inwerk.

(2 or/of 0)

(2)

OPTION 1/OPSIE 1			
6.2	$\Delta p = m = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{20 - 10}{10 - 5} \checkmark$ $= 2 \text{ N.s} \checkmark$	$\Delta p = m = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{10 - 4}{5 - 2} \checkmark$ $= 2 \text{ N.s} \checkmark$	$\Delta p = m = \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{20 - 4}{10 - 2} \checkmark$ $= 2 \text{ N.s} \checkmark$

(3)

OPTION 2/OPSIE 2		
$F_{\text{net}} = \Delta p \cdot \frac{1}{\Delta t}$ $20 = \Delta p \cdot 10 \checkmark$ $\Delta p = 2 \text{ N.s} \checkmark$	$F_{\text{net}} = \Delta p \cdot \frac{1}{\Delta t}$ $10 = \Delta p \cdot 5 \checkmark$ $\Delta p = 2 \text{ N.s} \checkmark$	$F_{\text{net}} = \Delta p \cdot \frac{1}{\Delta t}$ $4 = \Delta p \cdot 2 \checkmark$ $\Delta p = 2 \text{ N.s} \checkmark$

6.3	OPTION 1/OPSIE 1 (DOWN POSITIVE/AFWAARTS AS POSITIEF)	OPTION 2/OPSIE 2 (UP POSITIVE/OPWAARTS AS POSITIEF)
	$\Delta p = mv_f - mv_i \checkmark$ $-2 = 0,06 \times v_f - 0,06 \times 10,84 \checkmark$ $v_f = 22,42 \text{ m} \cdot \text{s}^{-1} \text{ upwards} \checkmark$	$\Delta p = mv_f - mv_i \checkmark$ $2 = 0,06 \times v_f - 0,06 \times -10,84 \checkmark$ $v_f = 22,42 \text{ m} \cdot \text{s}^{-1} \text{ upwards} \checkmark$

OPTION 3/OPSIE 3 (DOWN POSITIVE/AFWAARTS AS POSITIEF)
$F_{\text{net}} = \frac{\Delta p}{\Delta t} \checkmark$ $20 = \frac{0,6 (v_f - (-10,8))}{0,1} \checkmark$ $v_f = 22,49 \text{ m} \cdot \text{s}^{-1} \text{ upwards}$

(3)

6.4 Decreases/Verlaag ✓

(1)

6.5 Rubber mat increases contact time/Rubber matjie verlengkontak tyd.

$$F_{\text{net}} \propto \frac{1}{\Delta t} \checkmark$$

(1)  
[10]

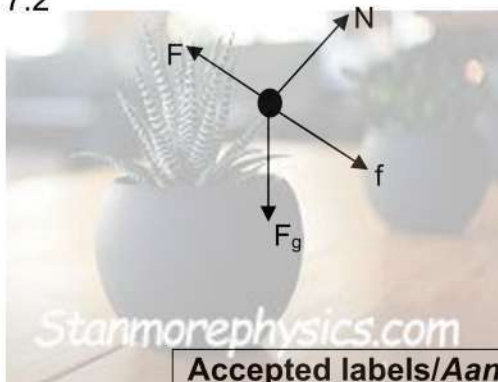
**QUESTION 7 /VRAAG 7**

7.1 There is no change in the kinetic energy of the car, therefore the net work done on the car is zero. ✓ or  $W_{\text{net}} = 0$  (J) ✓

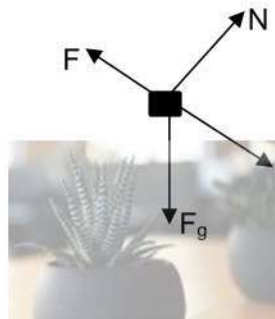
*Daar is geen verandering in die kinetiese energie van die kar nie, daarom is die netto werk verrig op die kar nul. Of  $W = 0$  (J)*

(1)

7.2



**ACCEPT/AANVAAR**



**Accepted labels/Aanvaarde benoemings:**

$F_N$	N/ Normal force/ $F_{\text{normal}}$ /Normaalkrag
$f_k$	(Kinetic) friction/ $f$ / (Kinetiese) wrywing/ $F_w$
$F_g$	w / $F_w$ / weight / mg/gravitational force/ gravitasiekrag
$F$	Applied force/Fapplied/ $F_a$ /Toegepaste krag

**Notes**

- Mark is awarded for label and arrow/Punt word toegeken vir byskrif en pyltjie.
- Do not penalise for length of arrows/Moenie vir die lengte van die pyltjies penaliseer nie.
- If arrows do not touch the dot/Indien pyle nie die kolletjie raak nie: Max/Maks 3/4
- If additional force(s)/Enige addisionele kragt(te):  
: Max/Maks 3/4
- If everything is correct, but no arrows/Indien alles korrek, maar geen pyltjies: Max/Maks 3/4
- If components are drawn/Indien komponente geteken:  
Max/Maks 3/4

(4)

7.3

7.3.1 The net work done on an object is equal to the change in object's kinetic energy. ✓✓

*Die netto arbeid verrig op 'n voorwerp is gelyk aan die verandering in kinetiese energie van die voorwerp OF die arbeid verrig op die voorwerp deur 'n netto krag is gelyk aan die verandering in kinetiese energie van die voorwerp.*

(2)

7.3.2 **REMOVED/VERWYDER**

[7]



**QUESTION 8/VRAAG 8**

8.1 The rate at which work is done or energy is expended. ✓✓ (2 or 0)  
 Die tempo waarteen arbeid verrig word. (2)

8.2.1  $W_{F_g \text{ (crate/krat)}} = F_g \Delta x \cos \theta$  ✓  
 $= (180) (9,8) (4,5) \cos 180^\circ$  ✓  
 $= -7\,938 \text{ J}$  ✓ (3)

8.2.2  $W_{F_g \text{ (counterweight/teenwig)}} = F_g \Delta x \cos \theta$   
 $= (140) (9,8) (4,5) \cos 0^\circ$  ✓  
 $= 6\,174 \text{ J}$  ✓ (2)

8.3 **Positive marking from Question 8.2.1 and 8.2.2/Positiewe nasien vanaf VRAAG 8.2.1 en 8.2.2**

**OPTION 1/ OPSIE 1**

$W_{\text{net}} = \Delta E_k$   
 $W_{\text{net}} = 0$   
 $W_{\text{motor}} + W_{\text{counterweight/teenwig}} + W_{\text{crate/krat}} = 0$   
 $W_{\text{motor}} + 6\,174 - 7\,938 = 0$  ✓  
 $W_{\text{motor}} = 1\,764 \text{ J}$  ✓

$P = \frac{W}{\Delta t}$  ✓  
 $= \frac{1\,764}{3}$  ✓  
 $= 588 \text{ W}$  ✓

**Note: If the calculation of  $W_{\text{motor}} = 1\,764 \text{ J}$  is not shown mark 3/6**

**OPTION 2/ OPSIE 2**

$F_{\text{net}} = ma$   
 $F_{\text{motor}} + F_{\text{cw}} - F_c = ma$   
 $F_{\text{motor}} + (140 \times 9,8) - (180 \times 9,8) = 0$  ✓  
 $F_{\text{motor}} + (1372) - (1764) = 0$   
 $F_{\text{motor}} - 392 = 0$   
 $F_{\text{motor}} = 392 \text{ N}$  ✓

$V = \frac{\Delta x}{\Delta t} = \frac{4,5}{3} = 1,5 \text{ m}\cdot\text{s}^{-1}$

$P_{\text{ave}} = FV_{\text{ave}}$  ✓  
 $= 392 \times 1,5$  ✓  
 $= 588 \text{ W}$  ✓

(6)  
**[13]**

**QUESTION 9/VRAAG 9**

9.1  $f = \frac{v}{\lambda}$  ✓  
 $= \frac{330}{0,2}$  ✓  
 $= 1\,650 \text{ Hz}$  ✓ (3)

9.2  $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$  ✓  
 factor/faktor =  $\frac{330 + 0}{330 - 2,78}$  ✓  
 $f_L = 1,0085 f_s$  ✓ (4)

**9.3 POSITIVE MARKING FROM 9.1/Positiewe nasien vanaf 9.1**

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$  ✓  
 $= \frac{330-0}{330+2,78} \times 1\,650$  ✓  
 $= 1\,632,22 \text{ Hz}$  ✓ (4)

9.4 9.4.1 Y ✓ (1)

9.4.2 X and Z are moving towards the earth/ X en Z beweeg na die Aarde. ✓  
 Y is moving away from the earth/Y beweeg weg van die Aarde. ✓ (2)

9.4.3 If a moving light source moves away from an observer (e.g. on earth). Light with longer wavelength ✓ (to the red side of the spectrum) is observed as a result of doppler effect. ✓ / The longer the wavelength, the higher the frequency. ✓  
 Indien die ligbron weg van die waarnemer beweeg (bv. op Aarde). Lig met langer golflengte (na die rooi kant van die spektrum) word waargeneem as gevolg van die Doppler effek. (2)

**[16]**

### QUESTION 10/VRAAG 10

#### Marking criteria/Nasienkriteria

If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.

- 10.1 The magnitude of the electrostatic forces exerted by two-point charges on each other is directly proportional to the product of their charges ✓ and inversely proportional to the square of the distance between them. ✓  
*Die grootte van die elektrostatische krag wat een puntlading ( $Q_1$ ) op 'n ander puntlading ( $Q_2$ ) uitoefen, is direk eweredig aan die produk van die groottes van die ladings en omgekeerd eweredig aan die kwadraat van die afstand ( $r$ ) tussen hulle.* (2)

10.2  $F_{AB} = \frac{k Q_A Q_B}{r^2}$  ✓  
 $= \frac{(9 \times 10^9) (45 \times 10^{-6}) (20 \times 10^{-6})}{(0,09)^2}$  ✓  
 $= 1000 \text{ N to right/na regs}$  ✓ (4)

- 10.3 **Positive marking from question 10.2./Positiewe nasien vanaf vraag 10.2.**

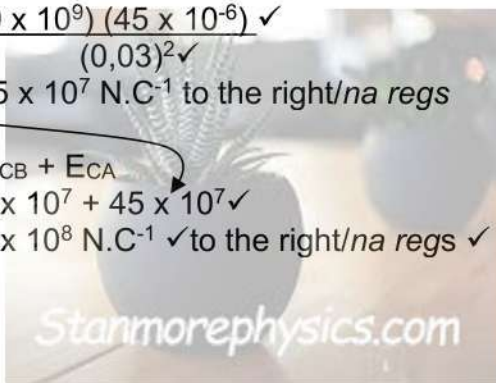
$R_x = 10000 \text{ N to the right/na regs}$   
 $R_y = 1500 \text{ N upwards/opwaarts}$

$R^2 = R_x^2 + R_y^2$  ✓  
 $= 1000^2 + 1500^2$  ✓  
 $R = 1802,78 \text{ N}$  ✓ (3)

- 10.4  
10.4.1 The electrostatic force experienced per unit positive charge placed at that point. ✓✓  
*Die elektrostatische krag wat per eenheidspositiewe-lading wat by daardie punt geplaas is, ondervind word.* (2)  
**(2 or/of 0)**

10.4.2  $E_{CA} = \frac{k Q_A}{r^2}$  ✓  
 $= \frac{(9 \times 10^9) (45 \times 10^{-6})}{(0,03)^2}$  ✓  
 $= 45 \times 10^7 \text{ N.C}^{-1}$  to the right/na regs

$E_{\text{net}} = E_{CB} + E_{CA}$   
 $= 5 \times 10^7 + 45 \times 10^7$  ✓  
 $= 5 \times 10^8 \text{ N.C}^{-1}$  ✓ to the right/na regs ✓



(6)  
[17]

**TOTAL/TOTAAL: 143**

