



Province of the  
**EASTERN CAPE**  
EDUCATION

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**JUNE 2017**

**PHYSICAL SCIENCES P1**

**MARKS: 150**

**TIME: 3 hours**



---

This question paper consists of 12 pages, including a 2 page data sheet.

---

**INSTRUCTIONS AND INFORMATION**

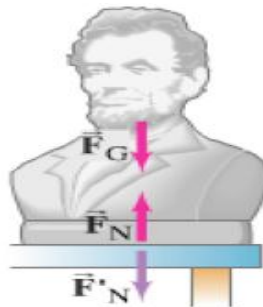
1. Write your NAME and SURNAME in the appropriate space on the ANSWER BOOK.
2. Answer ALL the questions.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
5. Number the questions correctly according to the numbering system used in this question paper.
6. You are advised to use the attached DATA SHEETS.
7. The formulae and substitutions must be shown in ALL calculations.
8. Give brief motivations, discussions, etc. where required.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Start EACH question on a NEW page.
11. All diagrams are not necessarily drawn according to scale.

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and write down **A, B, C** or **D** next to the question number (1.1 to 1.10) on your ANSWER BOOK.

- 1.1 When an object falls freely near the earth's surface, its acceleration is always ...
- A. increasing in a downward direction.  
 B. decreasing in a downward direction.  
 C.  $9,8 \text{ m}\cdot\text{s}^{-2}$  in an upward direction.  
 D.  $9,8 \text{ m}\cdot\text{s}^{-2}$  in a downward direction. (2)
- 1.2 When two cars collide head-on, the collision is inelastic if ...
- A. the change in momentum is zero.  
 B. the sum of their initial kinetic energies is not equal to sum of their final kinetic energies.  
 C. the sum of their initial kinetic energies is equal to sum of their final kinetic energies.  
 D. total linear momenta before collision is not equal total linear momenta after collision. (2)
- 1.3 A school bus suddenly comes to a stop, and all the backpacks on the floor start to slide forward. The backpacks slide forward because ...
- A. the backpacks resist a change in their state of motion.  
 B. there is a pushing force applied by the floor on the backpacks.  
 C. the backpacks experience a pulling force in a forward direction.  
 D. the weight of the backpacks decreased as the bus was stopping. (2)

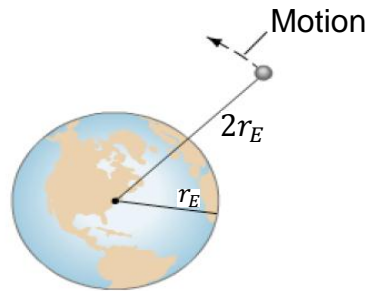
1.4



The diagram above shows a statue resting on a table.  $F_G$  is the force of gravity on the statue,  $F_N$  is the force of the table on the statue and  $F'_N$  is the force of the statue on the table. The action-reaction pair demonstrated in the above diagram is:

- A.  $(F_G + F'_N)$  and  $F_N$   
 B.  $F'_N$  and  $F_N$   
 C.  $F_G$  and  $F'_N$   
 D.  $F_G$  and  $F_N$  (2)

- 1.5 The diagram below shows a spacecraft orbiting above the earth.

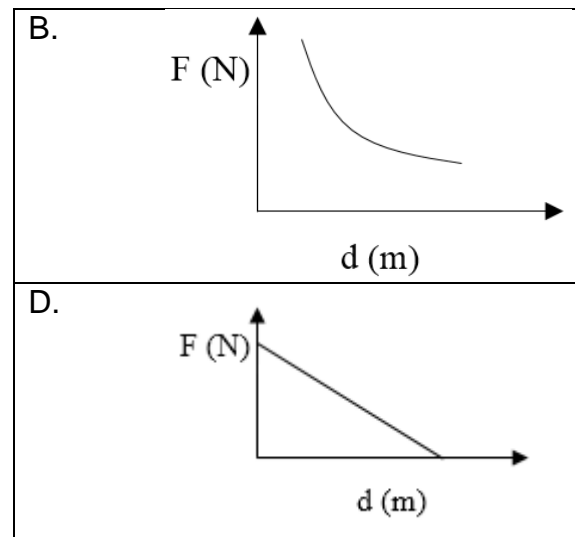
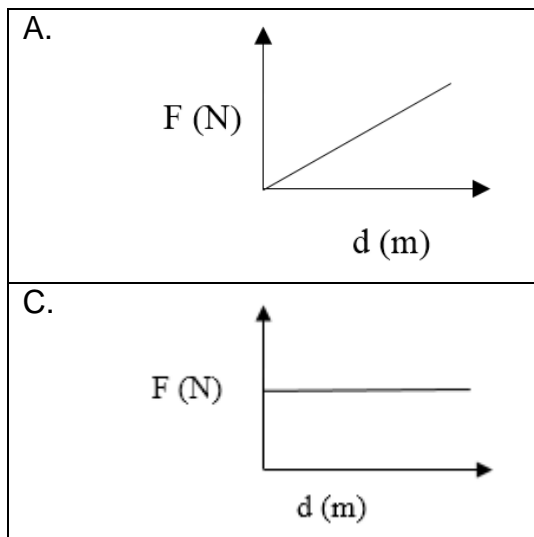


The force gravity on the spacecraft on earth is  $F_E$ . What is the force of gravity on the spacecraft when it orbits two earths' radii from the earth's center?

- A.  $\frac{1}{4} F_E$
- B.  $4 F_E$
- C.  $\frac{1}{2} F_E$
- D.  $2F_E$  (2)
- 1.6 When a police car with a siren approaches you, it emits sound waves. The sound waves that reach you have a ... wavelength and a ... frequency.

- |    |         |        |
|----|---------|--------|
| A. | shorter | higher |
| B. | longer  | higher |
| C. | shorter | lower  |
| D. | longer  | lower  |
- (2)

- 1.7 A test charge placed in an electric field around a negative point experiences an electrostatic force of attraction ( $F$ ). Which of the following graphs best represents the relationship between the force ( $F$ ) and the distance ( $d$ ) between the test charge and the point charge?



- 1.8 An observer on the earth that observes an approaching light source. He will notice that the light from the object will have a shorter wavelength because the distance between the wavefronts ( $\lambda$ ) ...
- A. increases as the source moves towards the observer.
  - B. decreases as the source moves towards the observer.
  - C. decreases as the source catches up with its emitted waves.
  - D. increases as the source moves away from its emitted waves. (2)
- 1.9 A force for which the net work done in moving an object between two points is dependant of the path taken is called ...
- A. a non-conservative force.
  - B. an electrostatic force between the surface and the object.
  - C. a conservative force.
  - D. a pulling force. (2)
- 1.10 Two identical balls, M and N, are both thrown from a cliff. Ball M is thrown directly upwards and N is thrown directly downwards. Both balls will hit the bottom of the cliff. If both balls were given the same initial speed, which ball will hit the bottom of the cliff with a greater velocity?
- A. Both balls with have the same velocity at the bottom of the cliff
  - B. Ball M
  - C. Ball N
  - D. Ball M will reach the bottom first (2)

**[20]****QUESTION 2**

- 2.1 A person throws a ball upward into the air with an initial velocity of  $15 \text{ m}\cdot\text{s}^{-1}$ . Ignore the effects of air resistance.
- 2.1.1 What is the physics name given to any object, like the ball above, where ONLY the gravitational force of the earth is acting on it? (1)
- 2.1.2 Calculate how high it goes up before coming down. (4)
- 2.1.3 Calculate how long the ball is in the air before it comes back to the hand. (3)
- 2.1.4 Calculate the time it takes the ball to pass a point of 8 m above the person's hand. (5)
- 2.1.5 Draw position vs. time graph indicating the following times: at point of projection, at 8 m above the hand, at maximum height, back at the thrower's hand. (4)
- 2.2 A stone is dropped from the roof of a building. A second stone was thrown, from the same height, straight down 2 s after the first stone had been dropped with an initial velocity of  $30 \text{ m}\cdot\text{s}^{-1}$ . After having covered the same displacement, the two stones reach the ground at the same time.
- How long did it take the second stone to reach the ground? (6)

**[23]**

**QUESTION 3**

3.1 A golf ball of mass  $0,045 \text{ kg}$  is hit off the tee at a speed of  $45 \text{ m}\cdot\text{s}^{-1}$ . The golf club was in contact with the ball for  $3,5 \times 10^{-3} \text{ s}$ .

3.1.1 Define the term *impulse*. (2)

3.1.2 Calculate the impulse imparted to the golf ball. (3)

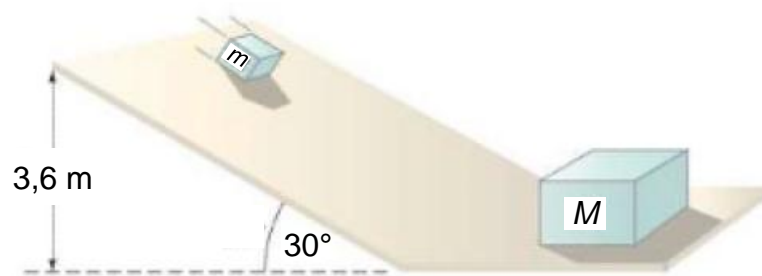
3.1.3 Calculate the average force exerted on the ball by the golf club. (2)

3.2 A tennis ball of mass  $60 \text{ g}$  strikes the wall perpendicularly at a velocity of  $12 \text{ m}\cdot\text{s}^{-1}$ . It rebounds at a velocity of  $10 \text{ m}\cdot\text{s}^{-1}$ .

3.2.1 Calculate the change in momentum of the tennis ball. (5)

3.2.2 What is the magnitude of impulse of the wall on the ball? (1)

3.3 A block of mass  $m = 2,20 \text{ kg}$  slides down slides down a  $30^\circ$  incline which is  $3,6 \text{ m}$  high. At the bottom, it strikes a stationary block of mass  $M = 7,00 \text{ kg}$  resting on a horizontal surface.



Assume that all surfaces are frictionless.

3.3.1 Define the *Principle of Conservation of Linear Momentum* in words. (2)

3.3.2 The block of mass  $m$  stops immediately after collision. Calculate the magnitude of the velocity of the block of mass  $M$  just after collision. (6)

**[21]**

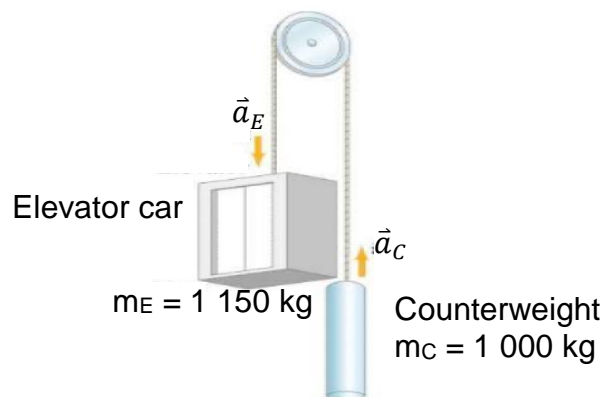
**QUESTION 4**

- 4.1 A skier in the diagram below, initially at rest, has just begun descending a  $30^\circ$  slope.



Assuming that the coefficient of kinetic friction ( $\mu_k$ ) is 0,10.

- 4.1.1 Draw a free-body diagram of all the forces acting on the skier. (3)
- 4.1.2 Calculate her acceleration down the slope (5)
- 4.1.3 Calculate the magnitude of the velocity she will reach after 4,0 s. (3)
- 4.2 A system of two objects, an elevator and a counterweight, suspended by a pulley and light cable is shown in the diagram below.



The mass of the elevator with four people inside is  $m_E = 1\,150\text{ kg}$  and its mass is  $850\text{ kg}$  when empty. The mass of the counterweight is  $m_C = 1\,000\text{ kg}$ .

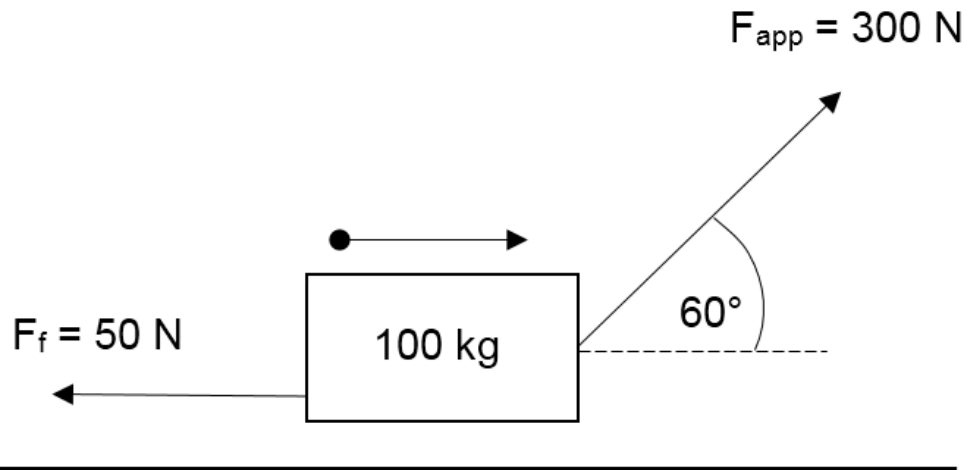
Ignore the mass of the pulley and the mass of the cable.

- 4.2.1 Define *Newton's Second Law of motion* in words. (2)
- 4.2.2 Calculate the acceleration of the elevator. (6)
- 4.2.3 Calculate the tension in the cable. (3)

**[22]**

**QUESTION 5**

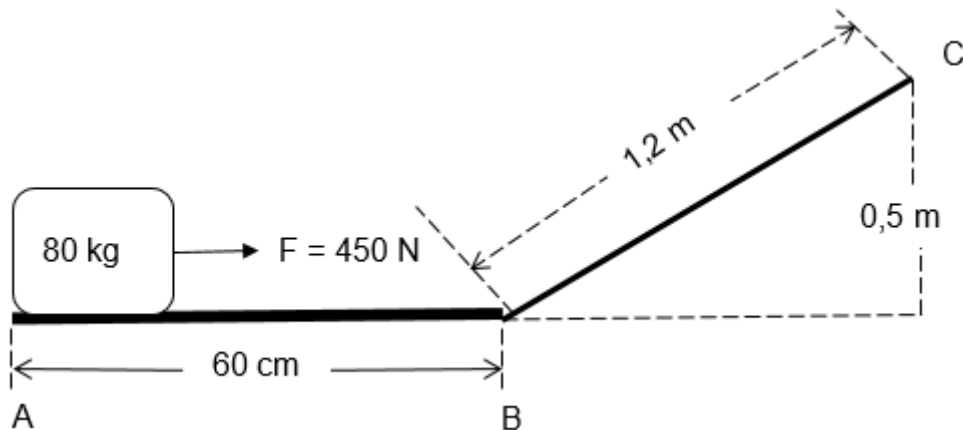
- 5.1 A car is travelling along a straight horizontal road. A force of 600 N is applied to the car in the direction that it is travelling, speeding it up. While it is speeding up it covers a distance of 30 m. Calculate the work done on the car. (3)
- 5.2 A box of mass 100 kg was resting on a flat horizontal surface when a force of 300 N was applied to pull at acting at angle of  $60^\circ$  to the horizontal. The box moved a displacement of 6 m to the east while experiencing a frictional force of 50 N.



- 5.2.1 Calculate the amount of work done by the frictional force on the box. (3)
- 5.2.2 Calculate the net work done on the box. (4)
- 5.3 The driver of a 800 kg car travelling at a speed of  $20,5 \text{ m}\cdot\text{s}^{-1}$  applies the car's brakes when a red light is observed. The car's brakes provide a frictional force of 6 000 N.
- 5.3.1 Define the *work-energy theorem* in words. (2)
- 5.3.2 Determine the stopping distance of the car. (5)



- 5.4 The diagram below shows a box that was stationary, being pushed with a constant force of 450 N across a frictionless horizontal surface which is 60 cm long.



The box then moves up an incline due to the same force of 450 N. The coefficient of kinetic friction between the box and the inclined surface is 0,34.

- 5.4.1 Calculate the net work done on the object as it moves from point A and reaches point B with a velocity of  $25 \text{ m}\cdot\text{s}^{-1}$ . (3)
- 5.4.2 What is magnitude of the kinetic friction experienced by the box as moves from point B to point C? (4)
- 5.4.3 Draw a free body diagram of all forces acting on the box when it is at point C. (4)
- 5.4.4 Calculate the net work done on the box as it reaches point C. (4)
- 5.4.5 What would be the gravitational potential energy of the box at C? (3)

**[35]**

**QUESTION 6**

6.1 The siren of a moving ambulance emits waves at a frequency of 350 Hz. The frequency of the sound as heard by the listener standing along the road is 400 Hz.

6.1.1 Define the *Doppler Effect*. (2)

6.1.2 Was the ambulance moving towards or away from the listener? Explain your answer, making special reference to *frequency*, *wavefronts* and *wavelength*. (4)

6.1.3 If the speed of sound in the air is  $340 \text{ m}\cdot\text{s}^{-1}$ , determine the velocity at which the ambulance was moving. (4)

6.2 A police car travelling down a road at constant speed emits sound waves from its siren. A lady stands on the side of the road with a detector which registers sound waves at a frequency of 450 Hz as the police car approaches her. After passing her, and moving away at the same constant speed, sound waves of frequency 390 Hz are registered. Assume that the speed of sound in air is  $343 \text{ m}\cdot\text{s}^{-1}$ .

Calculate:

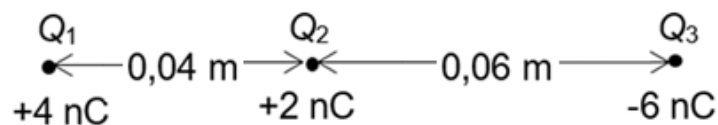
6.2.1 The speed at which the ambulance is moving. (7)

6.2.2 The frequency at which the siren emits the sound waves. (3)

**[20]**

**QUESTION 7**

7.1 Three point charges are in a straight line. Their charges are  $Q_1 = +4 \times 10^{-9} \text{ C}$ ,  $Q_2 = +2 \times 10^{-9} \text{ C}$  and  $Q_3 = -6 \times 10^{-9} \text{ C}$ . The distance between  $Q_1$  and  $Q_2$  is  $2 \times 10^{-2} \text{ m}$  and the distance between  $Q_2$  and  $Q_3$  is  $4 \times 10^{-2} \text{ m}$ .



7.1.1 Define *Coulomb's Law* in words (2)

7.1.2 What is the net electrostatic force on  $Q_2$  due to the other two charges? (7)

**[9]**

**TOTAL: 150**

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

**GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 12  
VRAESTEL 1 (FISIKA)**

**TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES**

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s <sup>-2</sup>
Universal gravitational constant <i>Universele gravitasiekonstant</i>	G	6,67 × 10 <sup>-11</sup> N·m <sup>2</sup> ·kg <sup>-2</sup>
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	3,0 × 10 <sup>8</sup> m·s <sup>-1</sup>
Planck's constant <i>Planck se konstante</i>	h	6,63 × 10 <sup>-34</sup> J·s
Coulomb's constant <i>Coulomb se konstante</i>	k	9,0 × 10 <sup>9</sup> N·m <sup>2</sup> ·C <sup>-2</sup>
Charge on electron <i>Lading op elektron</i>	-e	-1,6 × 10 <sup>-19</sup> C
Electron mass <i>Elektronmassa</i>	m <sub>e</sub>	9,11 × 10 <sup>-31</sup> kg
Mass of Earth <i>Massa van Aarde</i>	M	5,98 × 10 <sup>24</sup> kg
Radius of Earth <i>Radius van Aarde</i>	R <sub>E</sub>	6,38 × 10 <sup>6</sup> m

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

**MOTION/BEWEGING**

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

**FORCE / KRAG**

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G \frac{m_1 m_2}{d^2}$ or/of $F = G \frac{m_1 m_2}{r^2}$	$g = G \frac{M}{d^2}$ or/of $g = G \frac{M}{r^2}$



**WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING**

$F_{\text{net}} = ma$	$p = mv$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G \frac{m_1 m_2}{d^2}$ or/of $F = G \frac{m_1 m_2}{r^2}$	$g = G \frac{M}{d^2}$ or/of $g = G \frac{M}{r^2}$

**WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG**

$v = f \lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or /of $E = h \frac{c}{\lambda}$
$E = W_o + E_{k(\text{max})}$ or/of $E = W_o + K_{\text{max}}$ where/waar	
$E = hf$ and/en $W_o = hf_o$ and/en $E_{k(\text{max})} = \frac{1}{2} m v_{\text{max}}^2$ or/of $K_{\text{max}} = \frac{1}{2} m v_{\text{max}}^2$	

**ELECTROSTATICS / ELEKTROSTATIKA**

$F = \frac{kQ_1 Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/of $n = \frac{Q}{q_e}$	





