



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

**NATIONAL
SENIOR CERTIFICATE**

**PHYSICAL SCIENCES P1
MARKING GUIDELINE
PREPARATORY EXAMINATION
SEPTEMBER 2019**

GRADE 12

MARKS: 150

N.B. This marking guideline consists of 12 pages including this page.

QUESTION 1

- 1.1 A✓✓ (2)
- 1.2 D✓✓ (2)
- 1.3 D✓✓ (2)
- 1.4 B✓✓ (2)
- 1.5 B✓✓ (2)
- 1.6 C✓✓ (2)
- 1.7 C✓✓ (2)
- 1.8 B✓✓ (2)
- 1.9 A✓✓ (2)
- 1.10 D✓✓ (2)
- [20]**

QUESTION 2

- 2.1 When one body exerts a force on a second body, the second body exerts a force of equal magnitude in the opposite direction on the first body. ✓✓ (2)

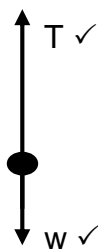
OR

If body A exerts a force on body B, then body B exerts an equal and opposite force on body A

NOTE

If any of the underlined key words in the **correct context** is omitted deduct 1 mark.

2.2



Accepted Labels:	
T	F_T / Tension / $F_{\text{cord on } m_1}$
w	weight / F_g / Gravitational force / $F_{\text{earth on } m_A}$ / mg/force of Earth on block.

Criteria

- Mark awarded for label and arrow.
- Do not penalize for length of arrow since drawing is not to scale
- Any other additional force(s): Max.: 1/2
- If force(s) do not make contact with dot: Max: 1/2

(2)

2.3

TAKE CLOCKWISE AS POSITIVE

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

$$0,5 = 0 \cdot \Delta t + \frac{1}{2} a (1,43)^2 \checkmark$$

$$a = 0,49 \text{ m} \cdot \text{s}^{-2} \checkmark$$

Consider m_A :

$$F_{\text{net}} = ma \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{Any one} \checkmark$$

$$T - m_A g = m_A a$$

$$T - (1,9)g = (1,9)(0,49) \checkmark$$

$$T - (1,9)g = 0,931 \dots \dots \dots (1)$$

Consider m_B :

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

$$m_B g - T = m_B a$$

$$(2,1)g - T = (2,1)(0,49) \checkmark$$

$$(2,1)g - T = 1,029 \dots \dots \dots (2)$$

Solving (1) and (2) :

$$(2,1)g - (1,9)g = 1,96 \text{ (simplification)}$$

$$(0,2)g = 1,96$$

$$g = 9,80 \text{ m} \cdot \text{s}^{-2} \checkmark$$

(7)

[11]

QUESTION 3

3.1 10 m ✓ (1)

3.2 1,2 (s) ✓ (1)

3.3 An object upon which the only force acting is the force of gravity. ✓✓ (2)

3.4 Take downward motion as NEGATIVE.
(Other option: take downwards as positive)

$$\begin{aligned} v_f &= v_i + a \Delta t \quad \checkmark \\ 0 &= v_i + (-9,8)(0,6) \quad \checkmark \\ v_i &= \underline{5,88 \text{ m}\cdot\text{s}^{-1}, \text{ upwards}} \quad \checkmark \end{aligned} \quad (3)$$

3.5 **Positive marking from QUESTION 3.4**

OPTION 1

$$\begin{aligned} \Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark \\ &= \underline{(5,88)(0,6) + \frac{1}{2}(-9,8)(0,6)^2} \quad \checkmark \\ &= 1,764 \text{ m} \\ \text{Maximum height} &= \underline{10 + 1,764} \quad \checkmark \\ &= 11,76 \text{ m} \quad \checkmark \end{aligned}$$

OPTION 2

$$\begin{aligned} \Delta U + \Delta K &= 0 \\ \frac{1}{2} m v_i^2 + m g h_i &= \frac{1}{2} m v_f^2 + m g h_f \quad \checkmark \\ \underline{\frac{1}{2} m (5,88)^2 + m (9,8)(10)} &= 0 + m (9,8) h \quad \checkmark \\ h &= 11,76 \text{ m} \quad \checkmark \end{aligned}$$

OPTION 3

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta y \quad \checkmark \\ (0)^2 &= \underline{(5,88)^2 + 2(-9,8)\Delta y} \quad \checkmark \\ \Delta y &= 1,764 \text{ m} \quad \checkmark \\ \text{Maximum height} &= 10 + 1,764 \\ &= 11,76 \text{ m} \quad \checkmark \end{aligned}$$

OPTION 4

$$\begin{aligned} \Delta y &= \left(\frac{v_f + v_i}{2} \right) \Delta t \quad \checkmark \\ &= \frac{1}{2} (0 + 5,88) (0,6) \quad \checkmark \\ &= 1,764 \text{ m} \quad \checkmark \\ \text{Maximum height} &= 10 + 1,764 \\ &= 11,76 \text{ m} \quad \checkmark \end{aligned}$$

3.6 **Positive marking from QUESTION 3.4 and 3.5**

From maximum height downwards

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta y \quad \checkmark \\ &= \underline{(0)^2 + 2(-9,8)(-11,76)} \quad \checkmark \\ v_f &= 15,18 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \end{aligned}$$

OR

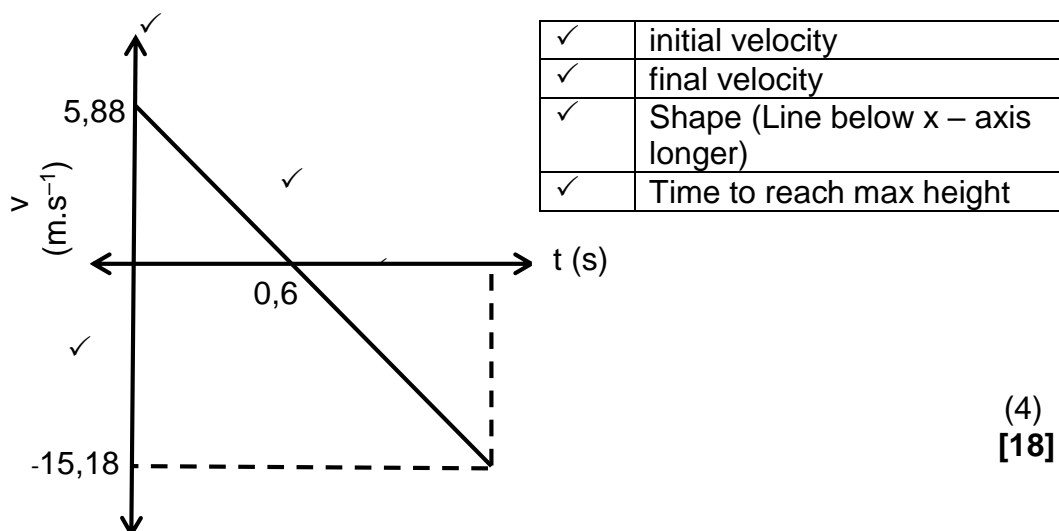
From the balcony upwards

$$\begin{aligned} v_f^2 &= v_i^2 + 2a\Delta y \quad \checkmark \\ &= \underline{(5,88)^2 + 2(-9,8)(-10)} \quad \checkmark \\ v_f &= 15,18 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \end{aligned}$$

(4)

(3)

3.7 Positive marking from QUESTION 3.4 and 3.6

(4)
[18]

QUESTION 4

- 4.1 The total linear momentum in a closed/isolated system remains constant / is conserved. ✓✓ (2)

NOTE

If any of the underlined key words in the **correct context** is omitted deduct 1 mark.

- 4.2 **Right as positive**

$$\Sigma p_i = \Sigma p_f \quad \checkmark$$

$$(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$$

$$(5500)v + (2000)(-30) \quad \checkmark = \quad (5500)(6) + (2000)(10) \quad \checkmark$$

$$v = 20,55 \text{ m}\cdot\text{s}^{-1} \quad \checkmark$$

Left as positive

$$\Sigma p_i = \Sigma p_f \quad \checkmark$$

$$(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$$

$$(5500)v + (2000)(30) \quad \checkmark = \quad (5500)(-6) + (2000)(-10) \quad \checkmark$$

$$v_i = -20,5455 \text{ m}\cdot\text{s}^{-1}$$

$$\text{magnitude of velocity} = 20,55 \text{ m}\cdot\text{s}^{-1} \quad \checkmark \quad (4)$$

- 4.3 $F_{\text{net}} \Delta t = mv_f - mv_i \quad \checkmark$
 $F_{\text{net}} (0,2) \quad \checkmark = \quad (2000)(10) - (2000)(-30) \quad \checkmark$
 $F_{\text{net}} = 400\,000 \text{ N}$
 $F_{\text{net}} = \underline{400\,000 \text{ N to the left}} \quad \checkmark$

OR

$$F_{\text{net}} \Delta t = mv_f - mv_i \quad \checkmark$$

$$F_{\text{net}} (0,2) \quad \checkmark = \quad (5500)(6) - (5500)(20,5455) \quad \checkmark$$

$$F_{\text{net}} = -400\,001,25 \text{ N}$$

$$F_{\text{net}} = \underline{400\,001,25 \text{ N to the left}} \quad \checkmark$$

(4)
[10]

QUESTION 5

- 5.1 The total mechanical energy in an isolated (closed) system ✓ remains constant (is conserved). ✓ (2)

NOTE

If any of the underlined key words in the **correct context** is omitted deduct 1 mark.

5.2

OPTION 1

$$E_{\text{mech at P}} = E_{\text{mech at Q}} \checkmark$$

$$(mgh + \frac{1}{2} mv^2)_P = (mgh + \frac{1}{2} mv^2)_Q$$

$$\underline{4[(9,8)(3) + \frac{1}{2}(0)^2]} \checkmark = \underline{4[(9,8)(1,25) + \frac{1}{2} v^2]} \checkmark$$

$$v = 5,86 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(4)

OPTION 2

$$E_{\text{mech at P}} = E_{\text{mech at Q}} \checkmark$$

$$(mgh + \frac{1}{2} mv^2)_P = (mgh + \frac{1}{2} mv^2)_Q$$

$$\underline{4[(9,8)(1,75) + \frac{1}{2}(0)^2]} \checkmark = \underline{4[(9,8)(0) + \frac{1}{2} v^2]} \checkmark$$

$$v = 5,86 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(4)

- 5.3.1 The net/total work done on an object is equal to the change in the object's kinetic energy. ✓✓

OR

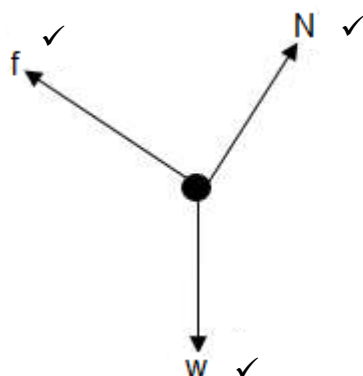
The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. ✓✓

(2)

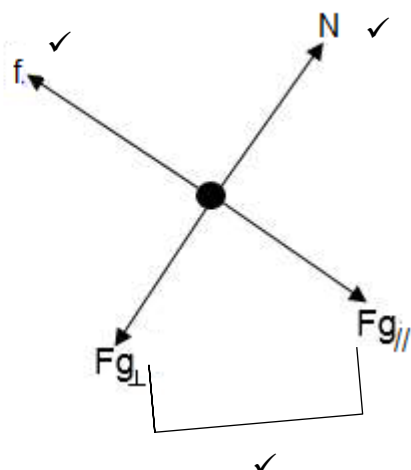
NOTE

If any of the underlined key words in the **correct context** is omitted deduct 1 mark. **If the word "work" is omitted then 0 marks.**

5.3.2



OR



(3)

5.3.3 $W_{\text{net}} = \Delta E_K$ ✓

$$W_{\text{net}} = 0$$

$$W_f + W_g = 0$$

$$f\Delta x \cos\theta + mg\Delta x \cos\theta = 0$$

$$(15)(X)\cos 180^\circ + (4)(9,8)(1,25)\cos 0^\circ = 0$$

$$X = 3,267 \text{ m}$$

(5)

5.4 REMAIN THE SAME. ✓

(1)

[17]

QUESTION 6

6.1 Doppler Effect. ✓

The change in frequency (or pitch), of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

OR

An (apparent) change in observed/detected frequency (pitch), as a result of the relative motion between a source and an observer ✓✓ (listener). (3)

NOTE

If any of the underlined key words in the **correct context** is omitted deduct 1 mark.

6.2

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad / \quad f_L = \frac{v}{v - v_s} f_s$$

$$\frac{110}{100} f_s = \left(\frac{340}{340 - v_s} \right) f_s$$

$$v_s = 30,91 \text{ m}\cdot\text{s}^{-1}$$

(5)

6.3 Increase ✓

(1)

[9]

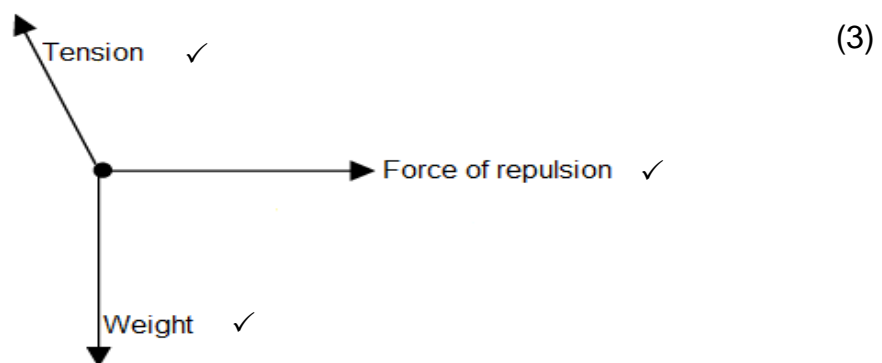
QUESTION 7

- 7.1 The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them. ✓✓ (2)

NOTE

If any of the underlined key words in the **correct context** is omitted deduct 1 mark.

7.2



7.3

$$\begin{aligned}
 F_g &= mg \checkmark \\
 &= (0,004)(9,8) \checkmark \\
 &= 0,04 \text{ N} \\
 \\
 F_{\text{repulsion}} &= F_g \times \tan 5^\circ \\
 &= 0,04 \times \tan 5^\circ \checkmark \\
 &= 3,43 \times 10^{-3} \text{ N} \checkmark
 \end{aligned}$$

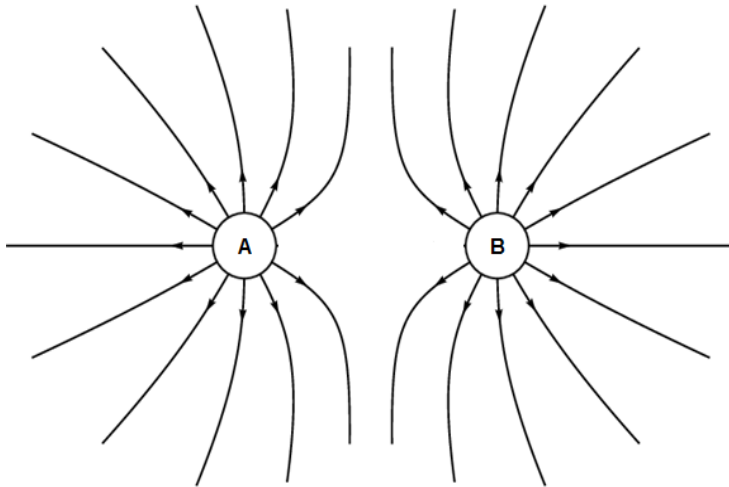
(4)

7.4 Positive Marking from 7.3

$$\begin{aligned}
 F &= \frac{kQ_1 Q_2}{r^2} \checkmark \\
 3,43 \times 10^{-3} &= \frac{(9 \times 10^9)(1 \times 10^{-6})(9 \times 10^{-6})}{r^2} \checkmark \\
 r &= 4,86 \text{ m} \checkmark
 \end{aligned}$$

(4)

7.5

**Criteria**

- Shape (pattern)✓
- Direction of field lines ✓
- Field lines not touching each other✓
- If field lines are not touching the spheres: Max 2/3

(3)

7.6

$$\begin{aligned}
 Q_{\text{new}} &= \frac{Q_1 + Q_2}{2} \\
 &= \frac{(1 \times 10^{-6}) + (9 \times 10^{-6})}{2} \checkmark \\
 &= +5 \times 10^{-6} \text{ C} \checkmark
 \end{aligned}$$

(2)

7.7 A to B ✓

(1)

7.8 Positive marking from 7.6

$$\begin{aligned}
 n &= \frac{Q_{\text{new}} - Q_1}{e} \\
 &= \frac{(5 \times 10^{-6}) - (1 \times 10^{-6})}{1,6 \times 10^{-19}} \checkmark \\
 &= 2,5 \times 10^{13} \text{ (electrons)} \checkmark
 \end{aligned}$$

(2)

[21]

QUESTION 8

8.1

OPTION 1

$$P = \frac{V^2}{R} \checkmark$$

$$13,5 = \frac{18^2}{R} \checkmark$$

$$R = 24\Omega \checkmark$$

OPTION 2

$$P = VI \checkmark$$

$$13,5 = (18)I \checkmark$$

$$I = 0,75 \text{ A}$$

$$V = IR$$

$$18 = (0,75)R$$

$$R = 24\Omega \checkmark$$

(3)

8.2 **Positive marking from 8.1****OPTION 1**

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$\frac{1}{R_p} = \frac{1}{12} + \frac{1}{24} \checkmark$$

$$R_p = 8\Omega$$

$$V = IR \checkmark$$

$$18 = I(8) \checkmark$$

$$I = 2,25 \text{ A} \checkmark$$

OPTION 2

$$V = IR \checkmark$$

$$18 = I(24) \checkmark$$

$$I = 0,75 \text{ A}$$

$$V_p = I_{12}R$$

$$18 = I_{12}(12) \checkmark$$

$$I_{12} = 1,5 \text{ A}$$

$$I_{\text{tot}} = 0,75 + 1,5 \checkmark$$

$$= 2,25 \text{ A} \checkmark$$

(5)

8.3 Internal resistance is the opposition to the flow of charge within a cell/battery. $\checkmark\checkmark$

(2)

8.4 **Positive marking from 8.2**

$$V = IR \checkmark$$

$$= (2,25)(10) \checkmark$$

$$= 22,5 \text{ V} \checkmark$$

(3)

8.5

OPTION 1

$$\varepsilon = I(R + r) \checkmark$$

$$45,9 \checkmark = 2,25 \checkmark (\underline{10+8} \checkmark + r)$$

$$r = 2,40 \Omega \checkmark$$

OPTION 2

$$V_{\text{ext}} = V_p + V_{10} \checkmark$$

$$= 18 + 22,5 \checkmark$$

$$= 40,5 \text{ V}$$

$$V_{\text{lost}} = 45,9 - 40,5 \checkmark$$

$$= 5,40 \text{ V}$$

$$V_{\text{lost}} = Ir \checkmark$$

$$5,4 = (2,25)r \checkmark$$

$$r = 2,40 \Omega \checkmark$$

(5)

(1)

[19]8.6 Increase \checkmark

QUESTION 9

9.1 Electromagnetic induction ✓ (1)

9.2 The *rms* value of the AC is the direct current which dissipates the same amount of energy as AC. ✓✓ (2)

NOTE

If any of the underlined key words in the **correct context** is omitted deduct 1 mark.

9.3 V_1 ✓ (1)

9.4 $V_1 = \frac{V_2}{\sqrt{2}}$ OR $V_2 = \sqrt{2} V_1$ ✓ (1)

9.5 $V_1 = \frac{V_2}{\sqrt{2}}$ or $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓
 $220 = \frac{V_2}{\sqrt{2}}$ ✓
 $V_2 = 311,13 \text{ V}$ ✓ (3)

9.6

OPTION 1

$$P_{ave} = \frac{1}{2} V_{max} \cdot I_{max} \quad \checkmark$$

$$1200 = \frac{1}{2} (311,13) \cdot I_{max} \quad \checkmark$$

$$I_{max} = 7,71 \text{ A} \quad \checkmark$$

OPTION 2

$$P_{ave} = \frac{1}{\sqrt{2}} V_{max} \cdot \frac{I_{max}}{\sqrt{2}} \quad \checkmark$$

$$(\sqrt{2})(1200) = (220) \cdot I_{max} \quad \checkmark$$

$$I_{max} = 7,71 \text{ A} \quad \checkmark$$

OPTION 3

$$P_{ave} = V_{rms} \cdot I_{rms}$$

$$1200 = 220 \cdot I_{rms} \quad \checkmark$$

$$I_{rms} = 5,46 \text{ A}$$

$$\text{But } I_{max} = \sqrt{2} \cdot I_{rms} \quad \checkmark$$

$$= (\sqrt{2})(5,455)$$

$$= 7,71 \text{ A} \quad \checkmark$$

OPTION 4

$$R = \frac{V_{rms}}{I_{rms}} = \frac{220}{5,455} \quad \checkmark = 40,33 \Omega$$

$$I_{max} = \frac{V_{max}}{R} \quad \checkmark = \frac{311,13}{40,33} = 7,72 \text{ A} \quad \checkmark$$

OPTION 5

$$P_{ave} = \frac{(V_{rms})^2}{R}$$

$$R = \frac{(220)^2}{1200} \quad \checkmark = 40,33 \Omega$$

$$I_{max} = \frac{V_{max}}{R} \quad \checkmark = \frac{311,13}{40,33} = 7,72 \text{ A} \quad \checkmark$$

9.7 ANYONE

- Easier to generate and transmit from place to place. ✓
 - Lesser energy loss in transmission. ✓
 - Voltage can be easily changed by stepping it up or down. ✓
- (1)
[12]

QUESTION 10

10.1 Cathode ✓ (1)

10.2 Threshold frequency ✓ (1)

10.3 The minimum energy that an electron in the metal needs to be emitted from the metal surface. ✓✓ (2)

NOTE

If any of the underlined key words in the **correct context** is omitted deduct 1 mark.

10.4 $W_0 = hf_0$ ✓
 $= (6,63 \times 10^{-34}) (5 \times 10^{14})$ ✓
 $= 3,32 \times 10^{-19} \text{ J}$ ✓ (3)

10.5 Positive marking from 10.4

$$hf = W_0 + \frac{1}{2}mv^2 \checkmark$$

$$(6,63 \times 10^{-34}) (f_1) = 3,32 \times 10^{-19} + 11 \times 10^{-19} \checkmark$$

$$f_1 = 2,15 \times 10^{15} \text{ Hz} \checkmark$$

(5)

10.6 Remain the same ✓ (1)
[13]

TOTAL MARKS: 150