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

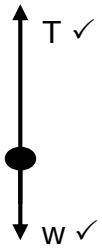
2.1 When <u>one body exerts a force on a second body</u>, the <u>second body exerts a force of equal magnitude in the opposite direction</u> on the first body. ✓✓ (2)

OR

If <u>body A exerts a force on body B</u>, then <u>body B exerts an equal and opposite force on body A</u>

**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 / $F_{cord\ on\ m1}$ |
| w | weight / $F_g$ / Gravitational force / $F_{earth\ on\ mA}$ /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: ½

(2)

2.3 **TAKE CLOCKWISE AS POSITIVE**

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$ ✓
$0,5 = 0.\Delta t + ½\ a\ (1,43)^2$ ✓
$a = 0,49\ m\cdot s^{-2}$ ✓

**Consider $m_A$:**
$F_{net} = ma$
$T - m_Ag = m_Aa$ } Any one✓
$T - (1,9)g = (1,9)(0,49)$ ✓
$T – (1,9)g = 0,931$…… (1)

**Consider $m_B$:**
$F_{net} = ma$
$m_Bg – T = m_Ba$
$(2,1)g - T = (2,1)(0,49)$ ✓
$(2,1)g - T = 1,029$……...(2)

Solving (1) and (2) :
$(2,1)g – (1,9)g = 1,96$ (simplification)
$(0, 2)g = 1,96$
$g = 9,80\ m\cdot s^{-2}$ ✓ (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))

$v_f = v_i + a\Delta t$ ✓
$0 = v_i + (-9,8)(0,6)$ ✓
$v_i$ = 5,88 m·s$^{-1}$ , upwards ✓ (3)

3.5 **Positive marking from QUESTION 3.4**

**OPTION 1**

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
= (5,88) (0,6)+ ½ (–9,8) (0,6)$^2$✓
= 1,764 m
Maximum height = 10 +✓ 1,764
= 11,76 m✓

**OPTION 2**

$\Delta U + \Delta K = 0$
$\frac{1}{2} mv_i^2 + mgh_i = \frac{1}{2} mv_f^2 + mgh_f$ ✓

½m(5,88)$^2$+m(9,8)(10)✓=0 + m(9,8)h✓
h = 11,76 m✓

**OPTION 3**

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
(0)$^2$ = (5,88)$^2$ + 2(–9,8) $\Delta y$✓
$\Delta y$ = 1,764 m✓

Maximum height = 10 + 1,764
= 11,76 m✓

**OPTION 4**

$\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$ ✓
= ½ (0+5,88) (0,6) ✓
= 1,764 m✓
Maximum height = 10 + 1,764
= 11,76 m✓

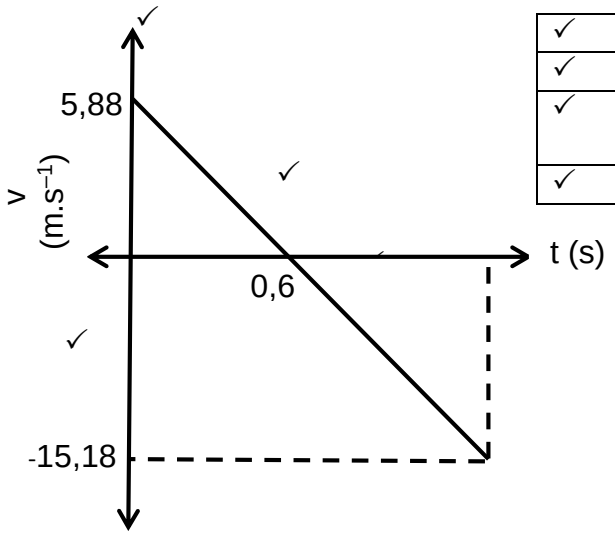
(4)

3.6 **Positive marking from QUESTION 3.4 and 3.5**
From maximum height downwards
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
= (0)$^2$ + 2 (–9,8) (–11,76)✓
$v_f$ = 15,18 m.s$^{-1}$✓

**OR**
From the balcony upwards
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
= (5,88)$^2$ + 2 (–9,8) (–10) ✓
$v_f$ = 15,18 m•s$^{-1}$✓

(3)

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




| | |
|---|---|
| ✓ | initial velocity |
| ✓ | final velocity |
| ✓ | Shape (Line below x – axis longer) |
| ✓ | Time to reach max height |

(4)
**[18]**

## QUESTION 4

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

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

4.2 **Right as positive**
$\Sigma p_i = \Sigma p_f$ ✓
$(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$
<u>(5500)v + (2000)(-30)</u> ✓= <u>(5500)(6) + (2000)(10)</u> ✓
$v = 20,55\ m\cdot s^{-1}$ ✓

**Left as positive**
$\Sigma p_i = \Sigma p_f$ ✓
$(mv_i)_1 + (mv_i)_2 = (mv_f)_1 + (mv_f)_2$
<u>(5500)v + (2000)(30)</u> ✓= <u>(5500)(-6) + (2000)(-10)</u> ✓
$v_i = -20,5455\ m\cdot s^{-1}$
magnitude of velocity = $20,55\ m\cdot s^{-1}$ ✓ (4)

4.3 $F_{net}\ \Delta t = mv_f - mv_i$ ✓
$F_{net}$ (0,2) ✓= <u>(2000)(10) – (2000)(-30)</u> ✓
$F_{net} = 400\ 000$ N
$F_{net}$ = <u>400 000 N to the left</u> ✓

**OR**
$F_{net}\ \Delta t = mv_f - mv_i$ ✓
$F_{net}$ (0,2) ✓= <u>(5500)(6) – (5500)(20,5455)</u> ✓
$F_{net} = -400\ 001,25$ N
$F_{net}$ = <u>400 001,25 N to the left</u> ✓ (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**
$E_{mech}$ at P = $E_{mech}$ at Q ✓
$(mgh + ½ mv^2)P = (mgh + ½ mv^2)Q$
$4[(9,8)(3) + ½(0)^2]$ ✓ = $4[(9,8)(1,25) + ½ v^2]$ ✓
$v = 5,86 \text{ m·s}^{-1}$ ✓
(4)

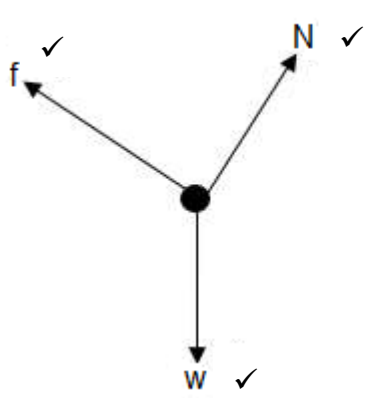
**OPTION 2**
$E_{mech}$ at P = $E_{mech}$ at Q ✓
$(mgh + ½ mv^2)P = (mgh + ½ mv^2)Q$
$4[(9,8)(1,75) + ½ (0)^2]$ ✓ = $4[(9,8)(0) + ½ v^2]$ ✓
$v = 5,86 \text{ m•s}^{-1}$ ✓ (4)

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

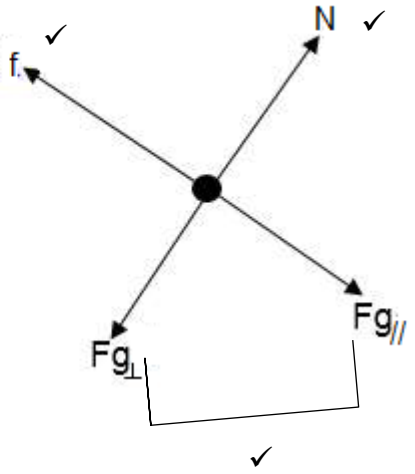
**OR**
The work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. ✓✓ (2)

**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 $W_{net} = \Delta E_K$ ✓
$W_{net} = 0$
$W_f + W_g = 0$
$f\Delta x \cos\Theta + mg\Delta x\cos\Theta = 0$
$(15)(X)\cos 180°$✓ $+ (4)(9,8)(1,25)\cos 0°$✓ $= 0$✓
$X = 3,267$ 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 $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓ / $f_L = \frac{v}{v - v_s} f_s$

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

$v_s = 30,91\ m{\cdot}s^{-1}$ ✓

(5)

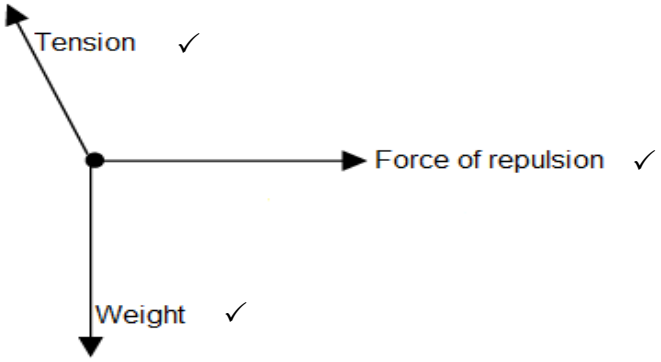
6.3 Increase ✓ (1)
**[9]**

## 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




(3)

7.3

$F_g = mg$ ✓
$= (0,004)(9,8)$ ✓
$= 0,04$ N

$F_{repulsion} = F_g \times \tan 5^o$
$= 0,04 \times \tan 5^o$ ✓
$= 3,43 \times 10^{-3}$ N ✓

(4)

7.4 **Positive Marking from 7.3**

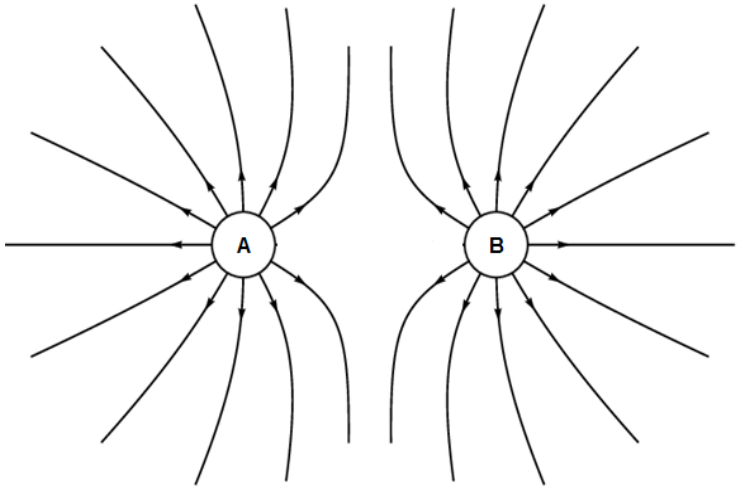
$F = \frac{kQ_1Q_2}{r^2}$ ✓

$3,43 \times 10^{-3} = \frac{(9 \times 10^9)(1 \times 10^{-6})(9 \times 10^{-6})}{r^2}$ ✓✓

$r = 4,86$ m ✓

(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

$$Q_{new} = \frac{Q_1 + Q_2}{2}$$
$$= \frac{(1\times10^{-6})+(9\times10^{-6})}{2} \checkmark$$
$$= +5\times 10^{-6}\ C \checkmark$$

(2)

7.7 A to B ✓ (1)

7.8 **Positive marking from 7.6**

$$n = \frac{Q_{new} - Q_1}{e}$$
$$= \frac{(5\times10^{-6})-(1\times10^{-6})}{1,6\times10^{-19}} \checkmark$$
$$= 2,5\times 10^{13} \text{ (electrons)} \checkmark$$

(2)
**[21]**

## QUESTION 8

8.1

**OPTION 1**

$P = \frac{V^2}{R}$ ✓

$13,5 = \frac{18^2}{R}$ ✓

$R = 24\Omega$ ✓

**OPTION 2**

P = VI ✓

13,5 = (18)I ✓

I = 0,75 A

V = IR

18 = (0,75)R

R = 24Ω ✓

(3)

8.2 **Positive marking from 8.1**

**OPTION 1**

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

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

$R_p = 8\Omega$

$V = IR$ ✓

$18 = I(8)$ ✓

$I = 2,25A$ ✓

**OPTION 2**

V = IR ✓

18 = I(24) ✓

I = 0,75A

$V_p = I_{12}R$

$18 = I_{12}(12)$ ✓

$I_{12} = 1,5$ A

$I_{tot} = 0,75 + ✓1,5$

= 2,25 A ✓

(5)

8.3 Internal resistance is the opposition to the flow of charge within a cell/battery. ✓✓ (2)

8.4 **Positive marking from 8.2**

V = IR ✓

= (2,25)(10) ✓

= 22,5 V ✓ (3)

8.5

**OPTION 1**

ε = I(R + r) ✓

45,9✓ = 2,25✓ (10+8✓ + r)

r = 2,40 Ω✓

**OPTION 2**

$V_{ext} = V_p + V_{10}$

= 18 + 22,5✓

= 40,5 V

$V_{lost}$ = 45,9 – 40,5✓

= 5,40 V

$V_{lost} = Ir$ ✓

5,4 = (2,25)r ✓

r = 2,40 Ω✓

(5)

8.6 Increase ✓ (1)

**[19]**

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

9.6

**OPTION 1**
$P_{ave} = \frac{1}{2}V_{max} \cdot I_{max}$ ✓
$1200 = \frac{1}{2}(311{,}13) \cdot I_{max}$ ✓
$I_{max} = 7{,}71$ A ✓

**OPTION 2**
$P_{ave} = \frac{1}{\sqrt{2}}V_{max} \cdot \frac{I_{max}}{\sqrt{2}}$ ✓
$(\sqrt{2})(1200) = (220) \cdot I_{max}$ ✓
$I_{max} = 7{,}71$ A ✓

(3)

**OPTION 3**
$P_{ave} = V_{rms} \cdot I_{rms}$
$1200 = 220 \cdot I_{rms}$ ✓
$I_{rms} = 5{,}46$ A

But $I_{max} = \sqrt{2} \cdot I_{rms}$ ✓
$= (\sqrt{2})(5{,}455)$
$= 7{,}71$ A ✓

**OPTION 4**
$R = \frac{V_{rms}}{I_{rms}} = \frac{220}{5{,}455}$ ✓ $= 40{,}33\ \Omega$
$I_{max} = \frac{V_{max}}{R}$ ✓$= \frac{311{,}13}{40{,}33} = 7{,}72$ A ✓

(3)

**OPTION 5**
$P_{ave} = \frac{(V_{rms})^2}{R}$
$R = \frac{(220)^2}{1200}$ ✓ $= 40{,}33\ \Omega$

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

(3)

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

10.5 Positive marking from 10.4

$hf = W_0 + \frac{1}{2}mv^2$ ✓

$(6{,}63 \times 10^{-34})(f_1)$ ✓ $= 3{,}32 \times 10^{-19}$ ✓ $+ 11 \times 10^{-19}$ ✓
$f_1 = 2{,}15 \times 10^{15}$ Hz ✓

(5)

10.6 Remain the same ✓ (1)

**[13]**

**TOTAL MARKS: 150**