KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

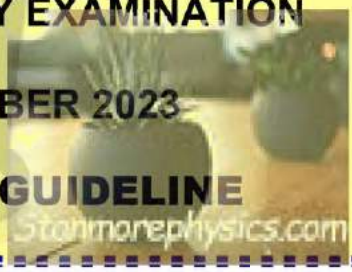
GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATION

SEPTEMBER 2023

MARKING GUIDELINE



MARKS : 150

This Marking Guideline consists of 13 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

1.1 A✓✓

1.2 A✓✓

1.3 C✓✓

1.4 D✓✓

1.5 C✓✓

1.6 D✓✓

1.7 B✓✓

1.8 D✓✓

1.9 A✓✓

1.10 B✓✓

[20]

QUESTION 2

2.1

Marking criteria
If any of the underlined key words/phrases, in the correct context is omitted, deduct 1 mark. Phrases must be in the correct context.

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. ✓ (2)

2.2

Accepted Labels	
w	F_g/ F_w/ weight/ mg/ gravitational force
T	F_T/ tension

(2)

2.3 $\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

0.98 ✓✓ $= 0(1) + \frac{1}{2} a (1)^2$ ✓

$a =$ 1.96 m·s^{-2} downwards ✓ (5)

2.4 **POSITIVE MARKING FROM QUESTION 2.3**

6 kg block

$F_{net} = ma$

$W - T = ma$ ✓

$mg - T = ma$

$6(9.8) - T = 6(1.96)$ ✓

$T = 47.07$ N

4 kg block

$F_{net} = ma$

$T - W = ma$

$47.07 - 9.8M$ ✓$= 1.96\ M$ ✓

$M = 4$ (kg) ✓ (5)

2.5 9.8 m.s^{-2} ✓

The block is in freefall. ✓

OR

The only force acting on the block is the force of gravity. (2)

[16]

QUESTION 3

3.1 Only the force of gravity acts on the object.✓ ✓ (2)

3.2

3.2.1 Downwards.✓ (1)

3.2.2 Downwards.✓ (1)

3.3

3.3.1 **OPTION 1:**

DOWNWARDS AS NEGATIVE:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0^2 = (8)^2 + 2(-9,8)(\Delta y)$ ✓
$\Delta y = 3,27$ m✓

DOWNWARDS AS POSITIVE:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0^2 = (-8)^2 + 2(+9,8)(\Delta y)$ ✓
$\Delta y = -3,27$
$\Delta y = 3,27$ m✓

OPTION 2:

DOWNWARD AS NEGATIVE:
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(-8)^2 = (0)^2 + 2(-9,8)(\Delta y)$ ✓
$\Delta y = -3,27$
$\Delta y = 3,27$ m✓

DOWNWARD AS POSITIVE:
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(8)^2 = (0)^2 + 2(+9,8)(\Delta y)$ ✓
$\Delta y = 3,27$
$\Delta y = 3,27$ m✓

(3)

3.3.2 $h = 150 - 3,27$
$= 146,73$ m✓ (1)

3.4 **POSITIVE MARKING FROM QUESTION 3.3.2**

DOWNWARDS AS NEGATIVE:

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

$-146,73$ ✓ $= (8)\Delta t + \frac{1}{2} (-9,8)\Delta t^2$ ✓

$= 6,35$ s ✓

DOWNWARDS AS POSITIVE:

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

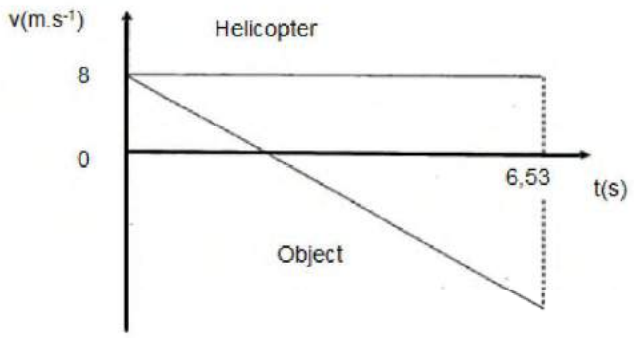
$146,73$ ✓ $= (-8)\Delta t + \frac{1}{2} (9,8)\Delta t^2$ ✓

$= 6,53$ s ✓

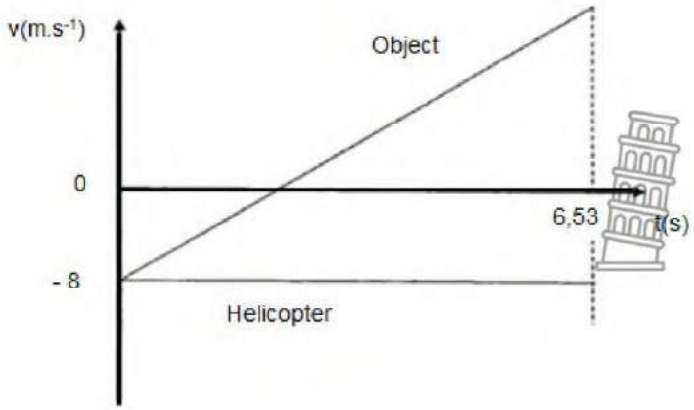
(4)

3.5 **POSITIVE MARKING FROM 3.4**

DOWNWARDS AS NEGATIVE:



DOWNWARDS AS POSITIVE:



(4)

Initial velocity for both graphs is 8 $m.s^{-1}$	✓
Both graphs stop at 6,53s	✓
For helicopter: Straight line parallel to the X-axis	✓
For object: Straight line above and below the X -axis	✓

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QUESTION 4

4.1

Marking criteria
If any of the underlined key words/phrases, in the correct context is omitted, deduct 1 mark. Phrases must be in the correct context.

Collision where the total kinetic energy ✓and total momentum are conserved✓ (2)

4.2 $\Sigma p_i = \Sigma p_f$

$m_1v_i + m_2v_i = m_1v_f + m_2v_f$ ✓

$(10)(2)+(2)(-4)=(10)(x)+(2)(y)$ ✓

$y = 6 - 5x$ .....Equation 1.

$\Sigma E_{k\,(before)} = \Sigma E_{k(after)}$

$\frac{1}{2}m_1v_i^2 + \frac{1}{2}m_2v_i^2 = \frac{1}{2}m_1v_f^2 + \frac{1}{2}m_2v_i^2$ ✓

$\frac{1}{2}(10)(2)^2 + \frac{1}{2}(2)(-4)^2$ ✓ $= \frac{1}{2}(10)(x)^2 + \frac{1}{2}(2)(y)^2$ ✓

$36 = 5x^2 + y^2$ .....Equation 2.

Sub Equation 1 into Equation 2:

$36 = 5x^2 + (6 - 5x)^2$

$0 = 30x^2 - 60x$

$x = 0$ or $x \neq 2$

$y = 6 - 5(0)$
$= 6$

∴ X = 0 $m{\cdot}s^{-1}$ ✓ y = 6 m. s^{-1} to the right✓ (7)

[9]

QUESTION 5

5.1

Marking criteria
If any of the underlined key words/phrases, in the correct context is omitted, deduct 1 mark. Phrases must be in the correct context.

The NET work done on an object is equal to the change in the object's kinetic energy. ✓✓ (2)

5. 2 **OPTION 1:**

$W_{net} = \Delta E_k$ ✓

$W_N + W_w + W_{f_k} = \frac{1}{2}m(v_f^2 - v_i^2)$

$0 + 0 + W_{f_k} = \frac{1}{2}(3)(3,5^2 - 10^2)$ ✓✓

$W_f = -131,63\ J$ ✓

OPTION 2:

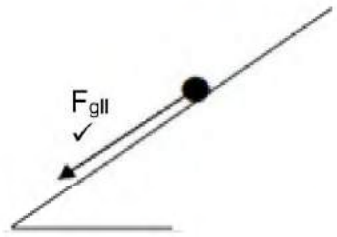
$W_{nc} = \Delta E_k + \Delta E_p$ ✓

$W_{f_k} = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$

$W_{f_k} = \frac{1}{2}(3)(3,5^2 - 10^2)$ ✓✓ $+ 0$

$W_f = -131,63\ J$ ✓ (4)

5.3



(1)

5.4 **OPTION 1**

$(E_k + E_P)_{Top} = (E_k + E_P)_{Bottom)}$ ✓

$0 + (3)(9,8)h + 0$ ✓ $= 0 + \frac{1}{2}(3)(3,5)^2$ ✓

$0 + (3)(9,8)\,d\sin 20$ ✓ $= \frac{1}{2}(3)(3,5)^2$

$d = 1,83\ m$ ✓

(5)

OPTION 2

$W_{net} = \Delta E_k$ ✓

$W_n + W_{f_a} = \frac{1}{2}m(V_f^2 - V_i^2)$

0 ✓$+ (3)(9,8)d\cos 110^0$ ✓$= (0,5)(3)(0^2 - 3,5^2)$ ✓

d = 1,83 m✓

OPTION 3

$W_{nc} = \Delta E_k + \Delta E_p$ ✓

$0 = \frac{1}{2}m(v_f^2 - v_i^2) + mg(h_f - h_i)$

0 ✓ $= \frac{1}{2}(3)(0^2 - 3,5^2)$ ✓$+ (3)(9,8)(d\sin 20^0 - 0)$ ✓

d = 1,83 m✓

5.5 Decreases (1)

[13]

QUESTION 6

6.1

Marking criteria
If any of the underlined key words/phrases, in the correct context is omitted, deduct 1 mark. Phrases must be in the correct context.

The (apparent) change in frequency (or pitch) (of sound) detected by a listener, because the 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. (2)

6.2.1 Ambulance approaching:

$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ ✓

✓

$450 = f_s \frac{340 + 0}{340 - v_s}$ ✓

$\therefore\ 450(340 - v_s) = 340 f_s$ ..... (i)

Ambulance moving away:

✓

$385 = f_s \frac{340 - 0}{340 + v_s}$ ✓ the sound waves

$\therefore\ 385(340 + v_s) = 340 f_s$ .....(ii)

$450(340 - v_s) = 385(340 + v_s)$

$v_s = 26,46\ m\cdot s^{-1}$ ✓

(6)

6.2.2 **POSITIVE MARKING FROM 6.2.1**

$450(340 - v_s) = 340f_s$ ✓ or $385(340 + v_s) = 340f_s$ ✓

$\therefore 450(340 - 26,46) = 340f_s$ or $385(340 + 26,46) = 340f_s$

$f_s = 414,98$ Hz ✓

(2)

6.3 414,98 Hz✓ (Positive Marking from Question 6.2.2) (1)

[11]

QUESTION 7

7.1 To prevent charges from leaking/escaping to the ground/spheres are not earthed.✓ (1)

7.2.1 X touches Y:

$$Q_{new} = \frac{Q_1 + Q_2}{2}$$

$$Q_{new} = \frac{20 \times 10^{-9} + (-8 \times 10^{-9})}{2}$$

$$Q_{new} = +6 \times 10^{-9}\,C$$

$Q_X = +6 \times 10^{-9}\,C$ $Q_Y = +6 \times 10^{-9}\,C$ ✓

X touches Z:

$$Q_{new} = \frac{Q_1 + Q_2}{2}$$

$$Q_{new} = \frac{6 \times 10^{-9} + 0}{2}$$

$$Q_{new} = +3 \times 10^{-9}\,C$$

$Q_x = +3 \times 10^{-9}\,C$ ✓ $Q_z = +3 \times 10^{-9}\,C$ ✓ (3)

7.2.2 X. ✓Gained electrons✓ (2)

7.3.1

Marking criteria
If any of the underlined key words/phrases, in the correct context is omitted, deduct 1 mark. Phrases must be in the correct context.

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

7.3.2

X on Y:

$$F = \frac{kQ_1Q_2}{r^2} \quad \checkmark$$

$$F = \frac{(9 \times 10^9)(20 \times 10^{-6})(45 \times 10^{-6})}{(6 \times 10^{-1})^2} \quad \checkmark$$

F = 22,5 N

Z on Y:

$$F = \frac{kQ_1Q_2}{r^2}$$

$$F = \frac{(9 \times 10^9)(30 \times 10^{-6})(45 \times 10^{-6})}{(8 \times 10^{-1})^2} \quad \checkmark$$

F = 18,98 N

$F_{net}^2 = 22,5^2 + 18,98^2$ ✓

$F_{net} = 29,44$ N ✓ (5)

7.3.3 **Marking criteria**

If any of the underlined key words/phrases, in the correct context is omitted, deduct 1 mark. Phrases must be in the correct context.

The electric field at a point is the electrostatic force experienced per unit positive charge placed at that point.✓✓ (2)

7.3.4 **POSITIVE MARKING FROM QUESTION 7.3.2**

E = F/q✓

= 29,44/(45 x 10^{-6}) ✓

= 6,54 x 10^5 N·C^{-1}✓ (3)

[18]

QUESTION 8

8.1 The maximum energy provided by a battery✓ per unit charge passing through it✓ (2)

8.2

8.2.1

OPTION 1	**OPTION 2**
$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R_P} = \frac{1}{4} + \frac{1}{2}$ ✓ R_p = 1,33 Ω V = IR ✓ = 2,48 x 1,33 ✓ = 3,3V ✓	$I_{4\Omega}$ = ⅓ (2,48) ✓ = 0,83 A V = IR ✓ = 0,83 x 4 ✓ = 3,32V ✓
	OPTION 3 $I_{2\Omega}$ = ⅔ (2,48) ✓ = 1,65 A V = IR ✓ = 1,65 x 2 ✓ = 3,3V ✓

(4)

8.2.2

OPTION 1	
W = $I^2R\Delta t$ ✓ = $(2,48)^2$ x 3 x 90 ✓ = 1660,61J ✓	
OPTION 2	**OPTION 3**
V = IR = 2,48 x 3 = 7,44V W = VIΔt ✓ = 7,44 x 2,48 x 90 ✓ = 1660,61 J ✓	V = IR = 2,48 x 3 = 7,44V $W = \frac{V^2}{R}\Delta t$ ✓ $W = \frac{7,44^2}{3} \times 90$ ✓ = 1660,61 J ✓

(3)

8.3 Decrease. ✓
The lost volts will increase ✓ (since the current increased).
An increase in lost volts (at a constant emf), will reduce the terminal potential difference. ✓ (3)

8.4 $\varepsilon = I(R + r)$ ✓
With S_2 open:
$\varepsilon = \underline{2,48(4,33 \checkmark + r)}$ ✓ …. 1
With S_2 closed
$\varepsilon = \underline{3,43(3 + r)}$ ✓ …. 2

$2,48(4,33 + r) = 3,43(3 + r)$
$r = 0,47\Omega$
$\varepsilon = 3,43(3 + r)$
$= 3,43(3 + 0,47)$
$= 11,90$ V ✓ (5)

8.5 Decreases. ✓
Current will decrease. ✓
The lost volts will increase ✓ (3)
[20]

QUESTION 9.

9.1

9.1.1 Negative.✓✓ (2)

9.1.2 Electrical energy is converted to mechanical energy.✓✓ (2)

9.1.3 Split ring. ✓ (1)

9.1.4 Motor effect. ✓ (1)

9.2

9.2.1 **Marking criteria**
If any of the underlined key words/phrases, in the correct context is omitted, deduct 1 mark. Phrases must be in the correct context.

The AC potential difference which dissipates the same amount of energy as an equivalent DC potential difference. ✓✓ (2)

9.2.2 $P_{average} = \frac{V_{rms}^2}{R}$ ✓

$200 = \frac{(220)^2}{R}$ ✓

$R = 242\ \Omega$ ✓ (3)

[11]

QUESTION 10

10.1 Minimum frequency of light needed to emit electrons from the surface a certain metal.✓ ✓ (2)

10.2 **OPTION 1:**

$c = f \times \lambda$

$3 \times 10^8 = f(200 \times 10^{-9})$ ✓

$f = 1,5 \times 10^{15}$ Hz

$E = hf = W_0 + Ek_{max}$ ✓

$(6,63 \times 10^{-34})(1,5 \times 10^{15})$ ✓ $= 7,57 \times 10^{-19}$ J ✓ $+ \frac{1}{2}(9,11 \times 10^{-31})v^2$ ✓

$v = 7,23 \times 10^5$ m·s^{-1}✓

OPTION 2:

$E = h\frac{c}{\lambda} = W_0 + Ek_{max}$ ✓

$E = h\frac{c}{\lambda} = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(200 \times 10^{-9})}$ ✓ $= 7,57 \times 10^{-19}$ J ✓ $+ \frac{1}{2}(9,11 \times 10^{-31})v^2$ ✓

✓ $v = 7,23 \times 10^5$ m·s^{-1}✓ (6)

10.3

10.3.1 REMAINS THE SAME.✓
Same number of photons will strike the cathode per unit time. ✓
Same number of electrons will be emitted per unit time✓ (3)

10.3.2 INCREASES.✓
Energy of the photon will increase✓ (2)

10.4

$E = h\frac{c}{\lambda}$

Wavelength inversely proportional to energy released.✓
Highest E therefore smallest wavelength.✓
∴ Line P ✓ (3)

[16]

TOTAL: 150