KWAZULU-NATAL PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATION

SEPTEMBER 2023

MARKING GUIDELINE

Stanmorephysics.com

MARKS : 150

This Marking Guideline consists of 13 pages.

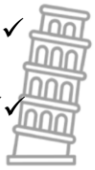
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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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]



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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]

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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)

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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:

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

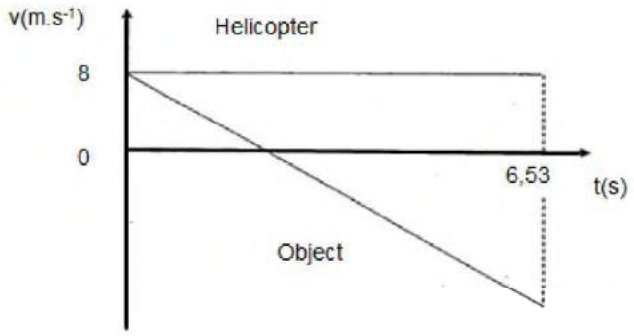
$146{,}73$ ✓ $= (-8)\Delta t + \frac{1}{2}(9{,}8)\Delta t^2$ ✓

$= 6{,}53$ s ✓

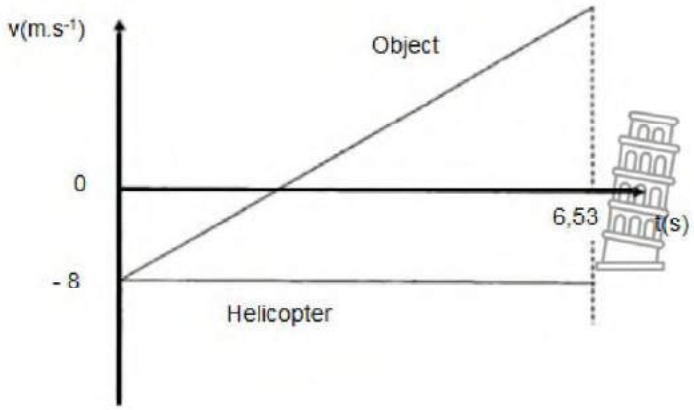
(4)

3.5 **POSITIVE MARKING FROM 3.4**

DOWNWARDS AS NEGATIVE:



DOWNWARDS AS POSITIVE:



(4)

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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·s^{-1}✓ y = 6 m. s^{-1} to the right✓ (7)

[9]

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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:

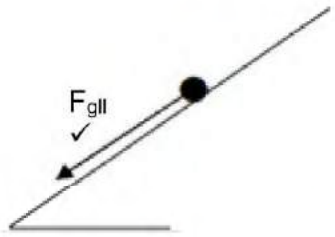
$W_{nc} = \Delta E_k + \Delta E_p$ ✓

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

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

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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)

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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)

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QUESTION 7

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

7.2.1 X touches Y:

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

$$Q_{new} = \frac{20\times10^{-9} + (-8\times10^{-9})}{2}$$

$$Q_{new} = +6\times10^{-9}\,C$$

$Q_X = +6\times10^{-9}\,C$ $Q_Y = +6\times10^{-9}\,C$ ✓

X touches Z:

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

$$Q_{new} = \frac{6\times10^{-9} + 0}{2}$$

$$Q_{new} = +3\times10^{-9}\,C$$

$Q_x = +3\times10^{-9}\,C$ ✓ $Q_z = +3\times10^{-9}\,C$ ✓ (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 <u>electrostatic force</u> exerted by one point charge on another point charge is <u>directly proportional to the product</u> <u>of the charges</u> and <u>inversely proportional to the square of the distance between them</u>.✓✓ (2)

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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]



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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)

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8.4 $\varepsilon = I(R + r)$ ✓

With S_2 open:

$\varepsilon = \underline{2,48(4,33 \checkmark + r)} \checkmark$ …. 1

With S_2 closed

$\varepsilon = \underline{3,43(3 + r)} \checkmark$ …. 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]

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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 ✓ $+ ½ (9,11 \times 10^{-31})v^2$ ✓

$v = 7,23 \times 10^5$ 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 ✓ $+ ½ (9,11 \times 10^{-31})v^2$ ✓

✓ $v = 7,23 \times 10^5$ 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

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