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Department:
Education
PROVINCE OF KWAZULU-NATAL

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

**PHYSICAL SCIENCES P1
MARKING GUIDELINE
PREPARATORY EXAMINATION
SEPTEMBER 2018**

This marking guideline consists of 11 pages.

QUESTION 1

- 1.1 C✓✓
 1.2 C✓✓
 1.3 A✓✓
 1.4 B✓✓
 1.5 D✓✓
 1.6 C✓✓
 1.7 A✓✓
 1.8 D✓✓
 1.9 C✓✓
 1.10 C✓✓

10x 2 = [20]

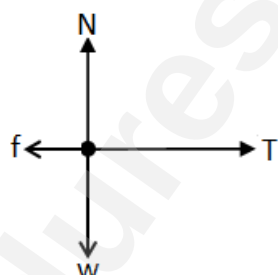
QUESTION 2

- 2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force✓ and inversely proportional to the mass of the object. ✓

OR

The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force. ✓✓ (2)

2.2



Notes : Accepted labels		Mark
w	Weight / F_g / F_G	✓
T	Tension in string	✓
f	Frictional force	✓
N	Normal force	✓

(4)

2.3

Box

$$F_{\text{net}} = ma✓$$

$$T + (-f) = ma$$

$$T - 6 = 9a \dots \dots \dots (1) ✓$$

Substituting (1) into (2):

$$-6 + (2.5)(9.8) = 11.5a✓$$

$$a = 1.61 \text{ m.s}^{-2}✓$$

Object

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

$$w + (-T) = ma$$

$$(2.5)(9.8) - T = 2.5a \dots \dots \dots (2) ✓$$

(5)

$$2.4 \quad F = G \frac{M_1 M_2}{r^2} \checkmark$$

But $F_{E\&M} = F_{S\&M} \checkmark$ (**net zero gravitational force**)

$$1,997 \times 10^{20} \checkmark = \frac{(6.67 \times 10^{-11})(7,35 \times 10^{22})(1,99 \times 10^{30})}{r^2} \checkmark$$

$$r = 2,21 \times 10^{11} \text{m} \checkmark$$

(5)

[16]**QUESTION 3**

3.1 An object upon which the only force acting is the force of gravity. $\checkmark \checkmark$

(2)

3.2 OPTION 1

Upward is positive

Ball Y

$$\begin{aligned} \Delta y_1 &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= 20t + \frac{1}{2}(-9.8) \Delta t^2 \\ &= 20t - 4.9 t^2 \dots\dots\dots(1) \checkmark \end{aligned}$$

$$\text{Now, } 20t - 4.9 t^2 = -4.9 t^2 + 50 \checkmark$$

$$20t = 50$$

$$t = 2.5 \text{ s} \checkmark$$

Ball X

$$\begin{aligned} \Delta y_2 &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ -(50 - \Delta y_1) &= (0)(\Delta t) + \frac{1}{2}(-9.8) \Delta t^2 \\ \Delta y_1 &= -4.9 t^2 + 50 \dots\dots\dots(2) \checkmark \end{aligned}$$

(5)

Upward is negative

Ball Y

$$\begin{aligned} \Delta y_1 &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ -\Delta y_1 &= -20t + \frac{1}{2}(9.8) \Delta t^2 \\ \Delta y_1 &= 20t - 4.9 t^2 \dots\dots\dots(1) \checkmark \end{aligned}$$

Solving (1) and (2):

$$20t = 50 \checkmark$$

$$t = 2.5 \text{ s} \checkmark$$

Ball X

$$\begin{aligned} \Delta y_2 &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \\ (50 - \Delta y_1) &= (0)(\Delta t) + \frac{1}{2}(9.8) \Delta t^2 \\ \Delta y_1 &= -4.9 t^2 + 50 \dots\dots\dots(2) \checkmark \end{aligned}$$

OPTION 2

**The balls are approaching each other
(relative velocity increases)**

$$(v_x + v_y) = \frac{\Delta x}{\Delta t} \checkmark$$

$$(0 \checkmark + 20 \checkmark) = \frac{50}{\Delta t} \checkmark$$

$$\Delta t = 2.5 \text{ s} \checkmark$$

(5)

3.3

OPTION 1

$$\begin{aligned}\Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= (20)(2.5) \checkmark + \frac{1}{2}(-9.8)(2.5)^2 \checkmark \\ &= 19.375 \text{ m} \\ h &= 19.375 \text{ m} \checkmark\end{aligned}$$

OPTION 2

$$\begin{aligned}\Delta y &= v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark \\ &= (0)(2.5) + \frac{1}{2}(-9.8)(2.5)^2 \checkmark \\ &= -30.625 \\ h &= 50 - \checkmark 30.625 \\ &= 19.375 \text{ m} \checkmark\end{aligned}$$

OPTION 3

Ball X

$$\begin{aligned}v_f &= v_i + a\Delta t \\ &= 0 + (-9.8)(2.5) \checkmark \\ v_f &= -24.50 \text{ m.s}^{-1}\end{aligned}$$

 E_m at top = E_m at meeting point

$$(mgh + \frac{1}{2}mv^2)_{\text{at top}} = mgh + \frac{1}{2}mv^2_{\text{at meeting point}} \checkmark$$

$$m(9.8)(50) + 0 = m(9.8)\Delta y + \frac{1}{2}m(-24.50)^2 \checkmark$$

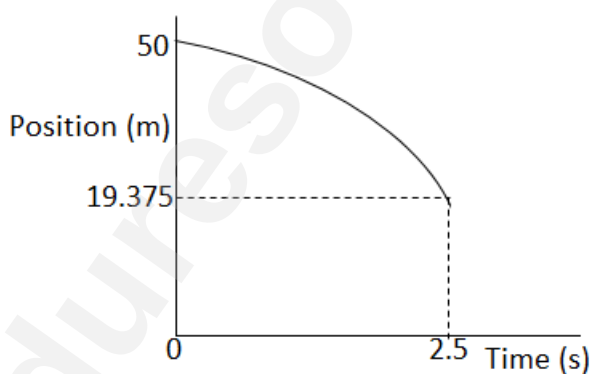
$$\Delta y = 19.375 \text{ m}$$

$$h = 19.375 \text{ m} \checkmark$$

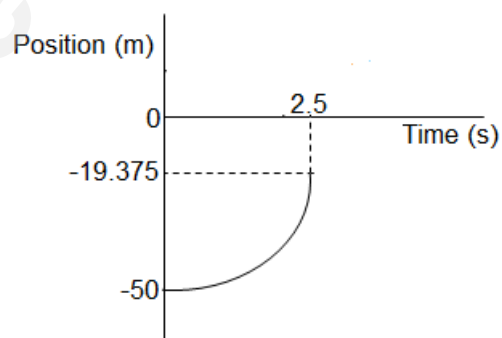
(4)

3.4

Mark positively from 3.2 and 3.3

OPTION 1 (downward is positive)**Criteria**

- Shape ✓
- Starts at 50 m ✓
- Ends at 2.5 s ✓
- Ends at 19.375m ✓

OPTION 2 (downward is negative)**Criteria**

- Shape ✓
- Starts at -50 m ✓
- Ends at 2.5 s ✓
- Ends at -19.375m ✓

(4)

OPTION 3

Can shift the lower graph to start at the origin, and the rest will remain the same. (4)

[15]**QUESTION 4**

4.1 The product of mass and velocity of the object. ✓✓ (2)

4.2 0 kg.m.s^{-1} (Accept 0 / Zero) ✓ (1)4.3 **To the right is positive**

$$p = mv \checkmark$$

$$= (1)(10) \checkmark$$

$$= 10 \text{ kg.m.s}^{-1} \text{ to the right} \checkmark$$

To the right is negative

$$p = mv \checkmark$$

$$= (1)(-10) \checkmark$$

$$= -10 \text{ kg.m.s}^{-1}$$

$$= 10 \text{ kg.m.s}^{-1} \text{ (to the right)} \checkmark \quad (3)$$

4.4 **To the right is positive**

$$\Sigma p_{\text{before}} = \Sigma p_{\text{after}} \checkmark$$

$$0 \checkmark = 100v_{\text{gb}} \checkmark + 10 \checkmark$$

$$v_{\text{fi}} = -0.1 \text{ m.s}^{-1}$$

$$v_{\text{fi}} = 0.1 \text{ m.s}^{-1} \text{ to the left} \checkmark$$

To the right is negative

$$\Sigma p_{\text{before}} = \Sigma p_{\text{after}} \checkmark$$

$$0 \checkmark = 100v_{\text{gb}} \checkmark + (-10) \checkmark$$

$$v_{\text{fi}} = 0.1 \text{ m.s}^{-1} \text{ to the left} \checkmark$$

(5)

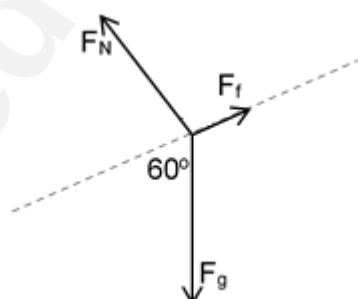
[11]**QUESTION 5**5.1 The work done by a net force on an object is equal to the change in the kinetic energy of the object. ✓✓

OR

Net work done on an object is equal to the change in the kinetic energy of the object. ✓

(2)

5.2

 F_g = gravitational force or weight ✓ F_N / N = normal force ✓ F_f / f = frictional force ✓

(3)

NB : Ignore the relative lengths the forces

5.3 **OPTION 1**

$$\begin{aligned}
 W_{\text{net}} &= F_{\text{net}} \Delta x \cos \theta \checkmark \\
 &= W_f + W_{F_{g//}} \\
 &= (190)(10)(\cos 180^\circ) \checkmark + (50)(9.8)(\sin 30^\circ)(10)(\cos 0^\circ) \checkmark \\
 &= -1900 + 2450 \\
 &= 550 \text{ J} \checkmark
 \end{aligned}
 \tag{4}$$

OPTION 2

$$\begin{aligned}
 F_{\text{net}} &= F_{g//} - F_f \\
 &= (50)(9.8)(\sin 30^\circ) - 190 \checkmark \\
 &= 55 \text{ N}
 \end{aligned}$$

$$\begin{aligned}
 F_{\text{net}} &= ma \\
 55 &= 50a \\
 a &= 1.10 \text{ m.s}^{-2}
 \end{aligned}$$

$$\begin{aligned}
 v_f^2 &= v_i^2 + 2a\Delta x \\
 &= 2^2 + 2(1.10)(10) \checkmark \\
 v_f &= 5.10 \text{ m.s}^{-1}
 \end{aligned}$$

$$\begin{aligned}
 W_{\text{net}} &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \checkmark \\
 &= \frac{1}{2}(50)(5.10)^2 - \frac{1}{2}(50)(2)^2 \\
 &= 550 \text{ J} \checkmark
 \end{aligned}$$

OPTION 3

$$\begin{aligned}
 W_{\text{net}} &= W_f + W_{F_{g//}} \checkmark \\
 &= (50)(9.8)(10)\cos 60^\circ \checkmark - 1900 \checkmark \\
 &= 550 \text{ J} \checkmark
 \end{aligned}$$

5.4 **POSITIVE MARKING FROM QUESTION 5.3****OPTION 1**

$$\begin{aligned}
 W_{\text{net}} &= \Delta K \checkmark \\
 &= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \\
 550 \checkmark &= \frac{1}{2}(50)(v_f^2 - 2^2) \checkmark \\
 v_f &= 5.10 \text{ m.s}^{-1} \checkmark
 \end{aligned}$$

OPTION 2

$$\begin{aligned}
 W_{\text{nc}} &= \Delta K + \Delta U \checkmark \\
 -1900 &= \frac{1}{2}(50)(v^2 - 2^2) + (50)(9.8)(h_Y - h_X) \\
 -1900 \checkmark &= \frac{1}{2}(50)(v^2 - 2^2) + (50)(9.8)(-10\sin 30^\circ) \checkmark \\
 v &= 5.10 \text{ m.s}^{-1} \checkmark
 \end{aligned}$$

(4)
[13]

QUESTION 6

6.1 $14 \times 10^{-4} \text{ s}$ ✓✓ (2)

6.2 **POSITIVE MARKING FROM QUESTION 6.1**

$$f = \frac{1}{T} \checkmark$$

$$= \frac{1}{14 \times 10^{-4}} \checkmark$$

$$= 714,29 \text{ Hz} \checkmark \quad (3)$$

6.3 It is 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

It is the change in the observed frequency of a sound wave when the source of sound is moving relative to the listener. ✓✓ (2)

6.4 **POSITIVE MARKING FROM QUESTION 6.1**

$$f_L = \frac{v+v_L}{v-v_S} f_s \checkmark$$

$$(714.29) \checkmark = \left(\frac{340}{340-v_S} \right) \checkmark (600) \checkmark$$

$$v_S = 54.40 \text{ m.s}^{-1} \checkmark \quad (\text{accept } 54.28 \text{ to } 54.40 \text{ m.s}^{-1}) \quad (5)$$

[12]

QUESTION 7

7.1 $Q_{\text{new}} = \frac{Q_1 + Q_2}{2}$

$$= \frac{(5 \times 10^{-9}) \checkmark + (-8 \times 10^{-9}) \checkmark}{2}$$

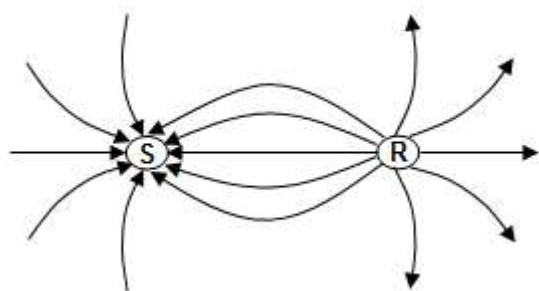
$$= -1.5 \times 10^{-9} \text{ C} \checkmark \quad (3)$$

7.2.1 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. ✓

OR

The force of attraction or repulsion between two point charges is directly proportional to the product of the charges ✓ and inversely proportional to the square of the distance between them. ✓ (2)

7.2.2



Criteria for marking the diagram	Marks
Correct shape	✓
Correct direction	✓
Field lines not touching each other or entering the spheres	✓

(3)

$$7.2.3 \quad T_x = (0.07)\cos 60^\circ \checkmark$$

$$= 0.035 \text{ N} \checkmark$$

(2)

$$7.2.4 \quad F = \frac{kQ_1 Q_2}{r^2} \checkmark$$

$$0.035 \checkmark = \frac{(9 \times 10^9)(4.8 \times 10^{-8})(1.2 \times 10^{-8})}{r^2} \checkmark$$

$$r = 0.012 \text{ m}$$

$$x = 0.012 \text{ m} \checkmark$$

OR

$$E = \frac{F_{RS}}{Q}$$

$$E = \frac{0.035}{4 \times 10^{-8}} \checkmark = 729166.67 \text{ N.C}^{-1} \text{ either} \checkmark$$

$$E = k \frac{Q}{r^2}$$

$$729166.67 = k \frac{1.2 \times 10^{-8}}{r^2} \checkmark$$

$$r = 0.012 \text{ m} \checkmark$$

(4)

[15]**QUESTION 8**

- 8.1 The potential difference across the ends of the conductor is directly proportional to the current flowing to the conductor at constant temperature. ✓✓ (2)

8.2.1 OPTION 1

$$R_{8\Omega} = \frac{V}{I} \checkmark$$

$$8 = \frac{V}{0.3}$$

$$V = 2.4 \text{ V}$$

$$R_{4\Omega} = \frac{V}{I}$$

$$4 = \frac{2.4}{I}$$

$$I = 0.6 \text{ A} \checkmark$$

$$I_{\text{tot}} = (0.3 + 0.6) \checkmark = 0.9 \text{ A} \checkmark$$

OPTION 2

$$R_{8\Omega} = \frac{V}{I} \checkmark$$

$$8 = \frac{V}{0.3}$$

$$V = 2.4 \text{ V}$$

$$R_p = \frac{8 \times 4}{8 + 4} = 2.67 \Omega \checkmark$$

$$R = \frac{V}{I}$$

$$2.67 = \frac{2.4}{I} \checkmark$$

$$I = 0.9 \text{ A} \checkmark$$

OPTION 3

$$\text{Current through } 4 \Omega = 2 \times 0.3 \checkmark$$

$$= 0.6 \text{ A} \checkmark$$

$$\therefore A_1 = (0.6 + 0.3) \checkmark = 0.9 \text{ A} \checkmark \quad (4)$$

8.2.2 Positive marking from Question 8.2.2

$$R_Z = \frac{V}{I} \checkmark$$

$$= \frac{15.6}{0.9} \checkmark$$

$$= 17.33 \Omega \checkmark \quad (3)$$

8.2.3 Positive marking from Question 8.2.2

$$R_p = \frac{8 \times 4}{8 + 4} = 2.67 \Omega \checkmark$$

$$R_t = (2.67 + 17.33) \checkmark$$

$$= 20 \Omega \checkmark \quad (3)$$

8.2.4 Positive marking from Questions 8.2.1 and 8.2.3

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

$$19 \checkmark = 0.9(20 + r) \checkmark$$

$$r = 1.11 \Omega \checkmark \quad (4)$$

$$8.3.1 \text{ Decrease} \checkmark \quad (1)$$

$$8.3.2 \text{ Total resistance of the circuit decreases, } \checkmark \text{ therefore current increases. } \checkmark$$

$$\text{More volts will be lost, } \checkmark \text{ and } V_{\text{ext}} \text{ decreases } (V_{\text{ext}} = \varepsilon - Ir) \checkmark \quad (4)$$

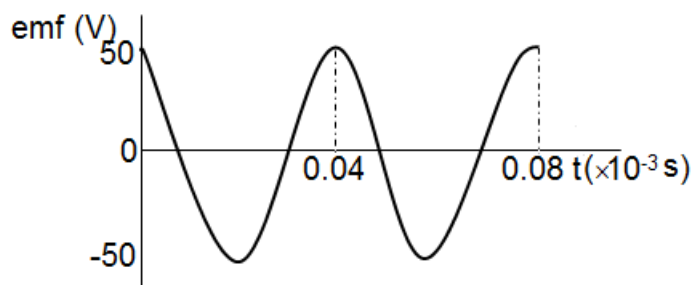
[21]

QUESTION 9

9.1 Slip rings✓

(1)

9.2

**Criteria**

- Starts at 50 V✓
- Ends at 50 V✓
- Ends at $0.08 \times 10^{-3} \text{ s}$ ✓
- 2 cycles✓

9.3 Increase the rotation speed of the coil. ✓✓

(2)

$$9.4.1 \quad I_{rms} = \frac{I_{max}}{\sqrt{2}} \checkmark$$

$$I_{rms} = \frac{6.27}{\sqrt{2}} \checkmark$$

$$I_{rms} = 4.43 \text{ A} \checkmark$$

(3)

9.4.2 **OPTION 1**

$$R = \frac{V_{max}}{I_{max}} \checkmark \checkmark$$

$$\checkmark 52.6 = \frac{V_{max}}{6.27} \checkmark$$

$$V_{max} = 329.80 \text{ V} \checkmark$$

OPTION 2

$$I_{rms} = \frac{V_{rms}}{R} \checkmark$$

$$4.43 = \frac{V_{rms}}{52.6} \checkmark$$

$$V_{rms} = 233.018 \text{ V}$$

$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \checkmark$$

$$233.018 = \frac{V_{max}}{\sqrt{2}} \checkmark$$

$$V_{max} = 329.54 \text{ V} \checkmark$$

(5)

[15]

QUESTION 10

10.1 The energy of the photons of red light is greater✓ than the work function of the metal in the photocell.✓

OR

The frequency of red light is higher✓ than the threshold/cut-off frequency of the metal in the photocell. ✓ (2)

10.2.1 Increase✓ (1)

10.2.2 Stays the same ✓
Since intensity is unchanged✓, same number of photons reach cathode. ✓
Therefore number of photo electrons emitted is unchanged. ✓ (4)

10.3 $E = W_o + E_{k(max)}$ ✓

$$h \frac{c}{\lambda} = hf_o + \frac{1}{2}mv^2$$
 ✓

$$\frac{6,63 \times 10^{-34} \times 3 \times 10^8}{4,5 \times 10^{-7}} = 6,63 \times 10^{-34}(f_o) + \frac{1}{2}(9,11 \times 10^{-31})(5,06 \times 10^5)^2$$
 ✓
 $f_o = 6,67 \times 10^{14} \text{ Hz}$ ✓ (6)

[13]

GRAND TOTAL: 150