education

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]**

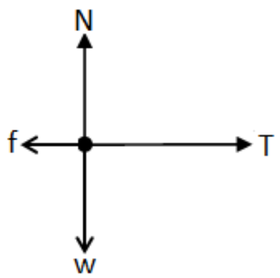
QUESTION 2

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	**Object**
$F_{net} = ma$✓	$F_{net} = ma$
$T + (-f) = ma$	$w + (-T) = ma$
$T – 6 = 9a$………..(1) ✓	$(2.5)(9,8) – T = 2.5a$………(2) ✓

Substituting (1) into (2):
$-6 + (2.5)(9.8) = 11.5a$✓
$a = 1.61 \text{ m.s}^{-2}$✓

(5)

2.4 $F = G\frac{M_1M_2}{r^2}$ ✓

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

$1{,}997\times10^{20}$ ✓ $= \frac{(6.67\times10^{-11})(7{,}35\times10^{22})(1{,}99\times10^{30})}{r^2}$ ✓

$r = 2{,}21 \times 10^{11}$ m ✓ (5)

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QUESTION 3

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

3.2 **OPTION 1**

Upward is positive

Ball Y	**Ball X**
$\Delta y_1 = v_i \Delta t + ½ a \Delta t^2$ ✓	$\Delta y_2 = v_i \Delta t + ½ a \Delta t^2$
$= 20t + ½(-9.8) \Delta t^2$	$-(50 - \Delta y_1) = (0)(\Delta t) + ½(-9.8) \Delta t^2$
$= 20t – 4.9 t^2$……….(1) ✓	$\Delta y_1 = -4.9t^2 + 50$………..(2) ✓
Now, $20t – 4.9 t^2 = -4.9t^2 + 50$ ✓	
$20t = 50$	
$t = 2.5$ s ✓	

(5)

Upward is negative

Ball Y	**Ball X**
$\Delta y_1 = v_i \Delta t + ½ a \Delta t^2$ ✓	$\Delta y_2 = v_i \Delta t + ½ a \Delta t^2$
$-\Delta y_1 = -20t + ½(9.8) \Delta t^2$	$(50 – \Delta y_1) = (0)(\Delta t) + ½(9.8) \Delta t^2$
$\Delta y_1 = 20t - 4.9 t^2$……….(1) ✓	$\Delta y_1 = -4.9t^2 + 50$………..(2) ✓
Solving (1) and (2):	
$20t = 50$ ✓	
$t = 2.5$ s ✓	

OPTION 2

The balls are approaching each other (relative velocity increases)

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

$(0✓ + 20✓) = \frac{50}{\Delta t}$ ✓

$\Delta t = 2.5$ s ✓

(5)

3.3

OPTION 1	OPTION 2
$\Delta y = v_i \Delta t + ½ a \Delta t^2$ ✓	$\Delta y = v_i \Delta t + ½ a \Delta t^2$ ✓
$= (20)(2.5)$ ✓ $+ ½(-9.8)(2.5)^2$ ✓	$= \underline{(0)(2.5) + ½(-9.8)(2.5)^2}$ ✓
$= 19.375$ m	$= -30.625$
h = 19.375 m ✓	h = 50 – ✓ 30.625
	= 19.375 m ✓

OPTION 3

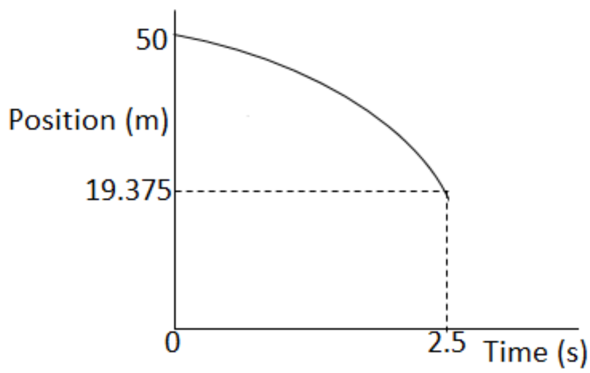
Ball X

$v_f = v_i + a\Delta t$
$= 0 + (-9.8)(2.5)$ ✓
$v_f = -24.50$ m.s^{-1}

E_m at top = E_m at meeting point
$(mgh + ½mv^2)_{at\ top} = mgh + ½mv^2)_{at\ meeting\ point}$ ✓
$m(9.8)(50) + 0 = m(9.8)\Delta y + ½m(-24.50)^2$ ✓
$\Delta y = 19.375$ m
h = 19.375 m ✓

(4)

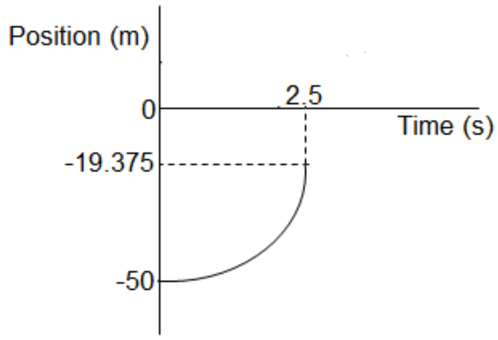
3.4 **Mark positively from 3.2 and 3.3**
OPTION 1 (downward is positive)



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)

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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✓

= (1)(10) ✓

= 10 $kg.m.s^{-1}$ to the right✓

To the right is negative

p = mv✓

= (1)(-10) ✓

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

= 10 $kg.m.s^{-1}$ (to the right)✓ (3)

4.4 **To the right is positive**

$\Sigma p_{before} = \Sigma p_{after}$ ✓

0✓ = $100v_{gb}$ ✓+ 10✓

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

v_{fi} = 0.1 $m.s^{-1}$ to the left✓

To the right is negative

$\Sigma p_{before} = \Sigma p_{after}$ ✓

0✓ = $100v_{gb}$ ✓+ (-10)✓

v_{fi} = 0.1 $m.s^{-1}$ to the left✓

(5)

[11]

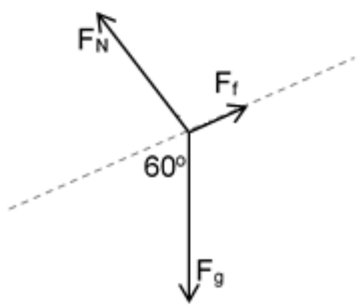
QUESTION 5

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 energyof 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**

$W_{net} = F_{net}\Delta x \cos\theta$ ✓
$= W_f + W_{Fg//}$
$= (190)(10)(\cos 180°)$ ✓ $+ (50)(9.8)(\sin 30°)(10)(\cos 0°)$ ✓
$= -1900 + 2450$
$= 550$ J ✓ (4)

OPTION 2

$F_{net} = F_{g//} - F_f$
$= \underline{(50)(9.8)(\sin 30°) - 190}$ ✓
$= 55$ N

$F_{net} = ma$
$55 = 50a$
$a = 1.10$ m.s^{-2}

$v_f^2 = v_i^2 + 2a\Delta x$
$= 2^2 + 2(1.10)(10)$ ✓
$v_f = 5.10$ m.s^{-1}

$W_{net} = ½mv_f^2 - ½mv_i^2$ ✓
$= ½(50)(5.10)^2 - ½(50)(2)^2$
$= 550$ J ✓

OPTION 3

$W_{net} = W_f + W_{Fg//}$ ✓
$= (50)(9,8)(10)\cos 60$ ✓ -1900 ✓
$= 550$ J ✓

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

$W_{net} = \Delta K$ ✓
$= ½ mv_f^2 - ½ mv_i^2$
550 ✓ $= \underline{½ (50)(v_f^2 - 2^2)}$ ✓
$v_f = 5.10$ m.s^{-1} ✓

OPTION 2

$W_{nc} = \Delta K + \Delta U$ ✓
$-1900 = ½(50)(v^2 - 2^2) + (50)(9.8)(h_Y - h_X)$
-1900 ✓ $= ½(50)(v^2 - 2^2) + (50)(9.8)(-10\sin 30°)$ ✓
$v = 5.10$ m.s^{-1} ✓ (4)
[13]

QUESTION 6

6.1 $14 \text{ x } 10^{-4}$ s ✓✓ (2)

6.2 **POSITIVE MARKING FROM QUESTION 6.1**

$f = \frac{1}{T}$ ✓

$= \frac{1}{14 \text{ x} 10^{-4}}$ ✓

$= 714{,}29 \text{ Hz}$ ✓ (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**

$f_L = \frac{v+v_L}{v-v_S} f_s$ ✓

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

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

[12]

QUESTION 7

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

$= \frac{(5\times10^{-9})✓ + (-8\times10^{-9})✓}{2}$

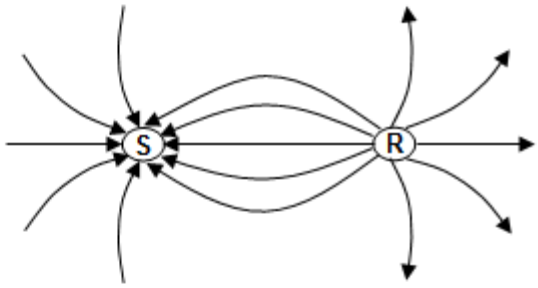
$= -1.5\times10^{-9}$ C✓ (3)

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 $T_x = (0.07)\cos60°$ ✓
$= 0.035$ N ✓ (2)

7.2.4 $F = \frac{kQ_1 Q_2}{r^2}$ ✓

0.035 ✓ $= \frac{(9\times10^9)(4.8\times10^{-8})(1.2\times10^{-8})}{r^2}$ ✓

$r = 0.012$ m

$x = 0.012$ m ✓

OR

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

$E = \frac{0.035}{4\times10^{-8}}$ ✓ $= 729166.67$ N.C^{-1} either ✓

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

$729166.67 = k\frac{1.2\times10^{-8}}{r^2}$ ✓

$r = 0.012$ m ✓ (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**

$R_{8\Omega} = \frac{V}{I}$✓

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

$V = 2.4\ V$

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

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

$I = 0.6\ A$✓

$I_{tot} = (0.3 + 0.6)$✓ $= 0.9\ A$✓

OPTION 2

$R_{8\Omega} = \frac{V}{I}$✓

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

$V = 2.4\ V$

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

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

$2.67 = \frac{2.4}{I}$ ✓

$I = 0.9\ A$✓

OPTION 3

Current through 4 Ω = 2 x 0,3 ✓
= 0,6A ✓

∴ A_1 = (0,6 + 0,3) ✓= 0,9A ✓ (4)

8.2.2 **Positive marking from Question 8.2.2**

$R_Z = \frac{V}{I}$✓

$= \frac{15.6}{0.9}$ ✓

$= 17.33\ \Omega$✓ (3)

8.2.3 **Positive marking from Question 8.2.2**

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

$R_t = (2.67 + 17.33)$ ✓

$= 20\ \Omega$✓ (3)

8.2.4 **Positive marking from Questions 8.2.1 and 8.2.3**

$emf = I(R + r)$✓

19✓ $= 0.9(20 + r)$✓

$r = 1.11\ \Omega$✓ (4)

8.3.1 Decrease✓ (1)

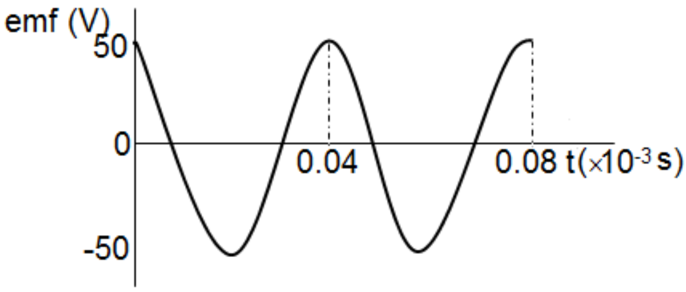
8.3.2 Total resistance of the circuit decreases, ✓ therefore current increases. ✓
More volts will be lost, ✓ and V_{ext} decreases ($V_{ext} = \varepsilon - Ir$)✓ (4)

[21]

QUESTION 9

9.1 Slip rings✓ (1)

9.2



Criteria
- Starts at 50 V✓
- Ends at 50 V✓
- Ends at 0.08×10^{-3} s✓
- 2 cycles✓

9.3 Increase the rotation speed of the coil. ✓✓ (2)

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

$I_{rms} = \frac{6.27}{\sqrt{2}}$ ✓

$I_{rms} = 4.43 A$ ✓ (3)

9.4.2 **OPTION 1**

$R = \frac{V_{max}}{I_{max}}$ ✓✓

✓ $52.6 = \frac{V_{max}}{6.27}$ ✓

$V_{max} = 329.80 V$ ✓

OPTION 2

$I_{rms} = \frac{V_{rms}}{R}$ ✓

$4.43 = \frac{V_{rms}}{52.6}$ ✓

$V_{rms} = 233.018 V$

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

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

$V_{max} = 329.54 V$ ✓

(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

$$\left.\begin{array}{l} E = W_o + E_{k(max)} \\ h\frac{c}{\lambda} = hf_o + \frac{1}{2}mv^2 \end{array}\right\} ✓$$

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

$$f_o = 6{,}67 \times 10^{14}\ \text{Hz} ✓$$ (6)

[13]

GRAND TOTAL: 150