FINAL

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

PREPARATORY EXAMINATION

SEPTEMBER 2024

MARKING GUIDELINES

MARKS: 150

These Marking Guidelines consist of 12 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

1.1 B✓✓

1.2 B✓✓

1.3 D✓✓

1.4 D✓✓

1.5 A✓✓

1.6 C✓✓

1.7 B✓✓

1.8 C✓✓

1.9 A✓✓

1.10 C✓✓

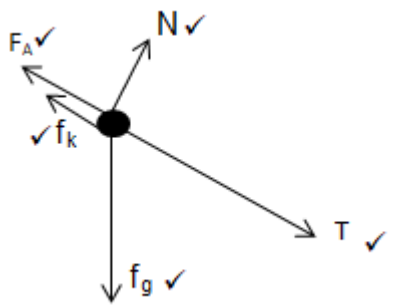
[20]

QUESTION 2

2.1

2.1.1 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 force ✓ and inversely proportional to the mass of the object. ✓ (2)

2.1.2



Accepted labels	
W	F_g/F_w/Weight/Gravitational force
f_k	f/friction/Kinetic friction
N	F_N/Normal force
F	$F_{Applied\ force}$ / 40N
T	F_T/ Tension

(5)

2.1.3 **MARKING CRITERIA**

- Mark for formula F_{net} = ma. ✓
- Mark for substitution of acceleration of 0,5 in F_{net} = ma. ✓
- Mark for calculation of the kinetic friction. ✓
- Left hand side substitution. ✓✓, one for each block.
- Mark for the answer.

***UP THE INCLINE AS POSITIVE**:*

For 3 kg block:
$F_{net} = ma$ ✓
$\mathrm{T} + \mathrm{F_{gII}} + (-\mathrm{f_k}) + (-\mathrm{F}) = \mathrm{ma}$

$\underline{[\mathrm{T} + (3)(9.8)\sin 3\,0^0 - (0{,}2)[(3)(9.8)\cos 3\,0^0 ✓] - 40\,]}✓ = 3(0.5)$ ✓

$\mathrm{T} = 31{,}89\mathrm{N}$

For block X:

F_{net} = ma

$\mathrm{F} + (-\mathrm{T}) = \mathrm{ma}$

$\mathrm{X}((9.8) - 31.89)✓ = \mathrm{X}(0.5)$

$\mathrm{X} = 3.43\mathrm{kg}$ ✓ (6)

2.2

2.2.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses✓ and inversely proportional to the square of the distance between their centres.✓ (2)

2.2.2

$F = \frac{Gm_1m_2}{r^2}$✓

1.91×10^{20}✓ $= \frac{(6.67\times10^{-11})(5.98\times10^{24})(7.35\times10^{22})}{(6.38\times10^{6}+1.2\times10^{8}+R_m)^2}$ ✓✓

$R_m = 2.65 \times 10^{8}\text{m}$ ✓ (5)

[20]

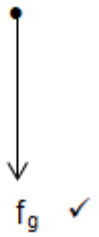
QUESTION 3

3.1

3.1.1 An object ✓which has been given an initial velocity and then it moves under the influence of the gravitational force only.✓

NB: Object will only receive a mark if used in the correct contexts of vertical motion. (2)

3.1.2



✓ (1)

3.1.3 Zero/ 0 (J)✓ (1)

3.2.1

Upwards Positive	**Upwards Negative**
$v_f = v_i + a\Delta t$ ✓ $\underline{0 = 10 + (-9{,}8)\Delta t}$ ✓ $\Delta t = 1{,}02s$ ✓	$v_f = v_i + a\Delta t$ ✓ $\underline{0 = -10 + (9{,}8)\Delta t}$ ✓ $\Delta t = 1{,}02s$ ✓

(3)

3.2.2

DOWNWARD POSITIVE:

BALL A:

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

$y_A = (-10)t + \frac{1}{2}(9.8)t^2$ ✓

$y_A = -10t + 4.9t^2$

BALL B:

$y_B = (0)(t - 0.5) + \frac{1}{2}(9.8)(t - 0.5)^2$ ✓

$8 + y_A = y_B$

$8 += -10t + 4.9t^2 = 4{,}9(t - 0.5)^2$

$-10t + 4.9t^2 = 4.9t^2 - 4{,}9t + 1{,}225 - 8$

$\therefore t = 1.33s$ ✓

DOWNWARD NEGATIVE:

BALL A:

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

$y_A = (10)t + \frac{1}{2}(-9.8)t^2$ ✓

$y_A = 10t - 4.9t^2$

BALL B:

$y_B = (0)(t - 0.5) + \frac{1}{2}(-9.8)(t - 0.5)^2$ ✓

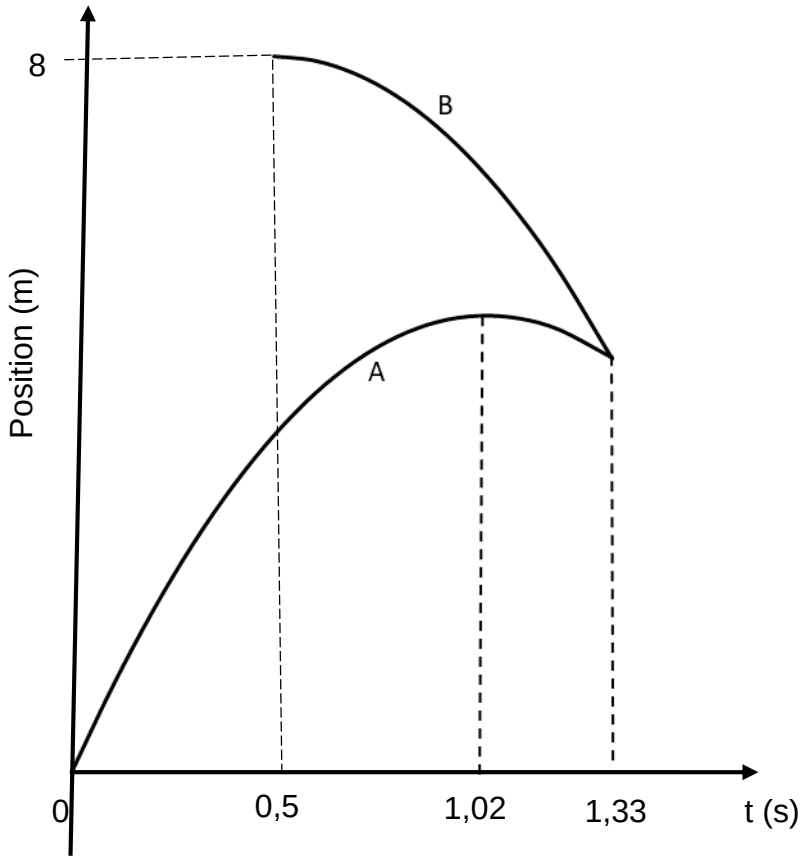
$8 + y_B = y_A$

$8 - 4.9t^2 + 4{,}9t - 1{,}225 = 10t - 4.9t^2$

$\therefore t = 1.33s$ ✓

(4)

3.3.2 **POSITIVE MARKING FROM 3.3.**



Starting times (0.5 s; 8 m) for Ball B, (0s ; 0 m) for Ball A	✓
1.33s the time at which balls meet	✓
Correct shapes for the graphs	✓

(3)
[14]

QUESTION 4

4.1 The <u>total linear momentum of an isolated system remains constant</u> (is conserved)✓✓
NB: If closed system is used award 1 mark. (2)

4.2 $E_K = \frac{1}{2}mv^2$✓
$258750 = \frac{1}{2}(2300)v^2$✓
$v = 15\text{m·s}^{-1}$✓
(3)

4.3
$\left.\begin{array}{l}\sum p_{before} = \sum p_{after} \\ m_1v_{i_1} + m_2v_{i_2} = (m_1 + m_2)v_f\end{array}\right\}$ ✓
$\underline{m_T(20) + (2300 - m_T)(-10)}$ ✓$= (2300)(15)$ ✓
$m_T = 1916{,}67\text{kg}$✓ (4)

4.4 **POSITIVE MARKING FROM 4.3**

$\Delta p = m(v_f - v_i)$ ✓
$\Delta p = 1916.67(15 - 20)$ ✓
$\Delta p = -9583.35$ kg.m·s^{-1}

∴Impulse = 9583.35 N.s✓ (3)

[12]

QUESTION 5

5.1 No.✓ Presence of kinetic frictional force/rough surface✓ (2)

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

5. 3 $W_{net} = \Delta E_k$✓

$mg\Delta y cos\theta + W_{f_k} = \frac{1}{2}m({v_f}^2 - {v_i}^2)$

$(2)(9.8)(2)cos0^0$✓$+W_{f_k}$✓$= \frac{1}{2}(2)(5^2 - 0^2)$ ✓✓

$W_{f_k} = -14.20$ J✓

Option 2:

$W_{nc} = \Delta E_k + \Delta E_p$✓

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

W_{f_k}✓$= \frac{1}{2}(2)(5^2 - 0^2)$ ✓✓$+(2)(9.8)(0 - 2)$ ✓

$W_{f_k} = -14.20$ J✓ (6)

[10]

QUESTION 6

6.1 Doppler effect 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.✓✓ (2)

6.2

$v = f \times \lambda$ ✓

$\underline{340 = f(0.24)}$ ✓

$f = 1416.67$ Hz✓ (3)

6.3 **POSITIVE MARKING FROM 6.2**

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

✓ ✓

$1466.67 = \frac{340+0}{340-v_s}(1416.67)$ ✓

∴ $v_s = 11.59$ m·s^{-1} (6)

$$v = \frac{\Delta x}{\Delta t}$$

$$11.59 = \frac{x}{15}\checkmark$$

$$x = 173.85\text{m}\checkmark$$

6.4 Doppler flowmeter. ✓
Or
Determine heartbeat of foetus. (1)

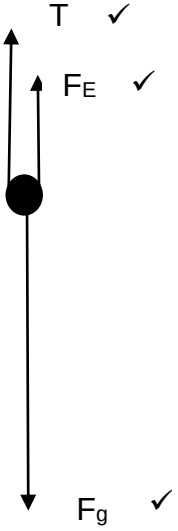
[12]

QUESTION 7

7.1

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

7.1.2



(3)

7.1.3 $F_{net} = ma$
$mg + (-T) + (-\frac{kQ_1Q_2}{r^2}) = ma$ ✓

$[m(9.8) - 8\checkmark - \frac{(9\times10^9)(50\times10^{-9})(20\times10^{-9})}{(4\times10^{-2})^2}]\ \checkmark = 0\checkmark$
$m = 0.82\text{ kg}\ \checkmark$

$m_s = 0.82 \times 2 = 1.63\text{kg}\checkmark$ (6)

7.2

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

7.2.2 **B**: The field from both charges are in the same direction.✓

C:$E\alpha\frac{1}{r^2}$, C is closer to q_2 than q1, and $q_2 > q_1$✓
Or

$$\frac{kq_2}{(5X10^{-2})^2} > \frac{kq_1}{(65X10^{-2})^2}$$ (2)

7.2.3

$$E_{net} = E_1 + (-E_2)$$
$$E_{net} = \frac{kQ_2}{r^2}✓ + (-\frac{kQ_1}{r^2})$$
$$E_{net} = \frac{(9\times10^9)(30\times10^{-6})}{(20\times10^{-2})^2}✓ - ✓\frac{(9\times10^9)(90\times10^{-6})}{(80\times10^{-2})^2}✓$$
$$\therefore E_{net} = 5484375 N.C^{-1}✓ \text{ to the left}✓$$ (6)
[21]

QUESTION 8.

8.1 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature.✓✓ (2)

8.2

8.2.1

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{R_p} = \frac{1}{18} + \frac{1}{6}✓$$
$$R_p = 4{,}5\ \Omega$$

$$R = \frac{V}{I} \quad ✓$$
$$4{,}5 = \frac{V}{0{,}4}✓$$

$$V = 1{,}8V✓$$ (4)

8.2.2 POSITIVE MARKING FROM 8.2.1

$$W = \frac{V^2\Delta t}{R} \quad ✓$$

$$W = (\frac{(1{,}8)^2(300)✓}{(18)})✓$$
$$W = 54\ J✓$$

OR

(4)

$18 = \frac{1,8}{I}$
$I = 0,1A$

W = $I^2R\triangle t$ ✓
✓
W = [$\underline{(0,1)^2\ (18)}$ (300) ✓] ✓

W = 54J✓

OR
W = VI△t✓

W = [$\underline{(1,8\ X0,1}$) x 300✓]✓

W = 54J✓

8.2.3 **POSITIVE MARKING FROM 8.2.1 AND 8.2.2**

$V_{internal} = Ir$ ✓
✓ ✓
$\underline{5-1,8}$ = 0,4r
r = 8 Ω **If learners end here award full marks**
r = 4 Ω✓

OR

ε = I(R + r) ✓
✓
5 = $\underline{(0,4)(4,5 + r)}$ ✓
r = 8 Ω
r = 4 Ω✓ (4)

8.3 Increases.✓ (1)
[15]

QUESTION 9

9.1

9.1.1 DC✓ (1)

9.1.2 Mechanical (energy) is converted to Electrical (energy).✓ (1)

9.1.3 Y. ✓ (1)

9.1.4 Maximum. ✓ (1)

9.2

9.2.1 $I_{rms} = \frac{I_{max}}{\sqrt{2}}$✓ (5)

$I_{rms} = \frac{6}{\sqrt{2}}$✓

$I_{rms} = 4.24\text{A}$
$V_{rms} = I_{rms}R$ ✓

$210 = 4.24R$✓

$R = 49.53\Omega$✓

OR
$V_{max} = V_{rms}\sqrt{2}$✓
$V_{max} = 210\sqrt{2}$✓
$V_{max} = 296{,}98\text{V}$

$R = \frac{V_{max}}{I_{max}}$✓

$R = \frac{296{,}98}{6}$✓
$R = 49.50\ \Omega$✓

9.2.2 **POSITIVE MARKING FROM 9.2.1**

$P_{ave} = V_{rms}.I$ ✓ $P_{ave} = (210)(4.24)$ ✓ $P_{ave} = 890.40\text{W}$	$P_{ave} = I_{rms}^2.R$ ✓ $P_{ave} = (4{,}24)^2(49{,}53)$ ✓ $P_{ave} = 890.43\text{W}$	$P_{ave} = \frac{V_{rms}^2}{R}$✓ $P_{ave} = \frac{(210)^2}{(49.53)}$✓ $P_{ave} = 890{,}37\text{W}$

$P = \frac{W}{\Delta t}$✓
$890.40 = \frac{W}{7200}$✓
$W = 6{,}41\ X\ 10^6\text{J}$✓ (5)

[14]

QUESTION 10

10.1 The process whereby electrons are ejected from a metal surface when light of suitable frequency is incident on that surface.✓✓ (2)

10.2

At $E_{k(max)} = 0$ J:

$f_0 = c(\frac{1}{\lambda})$ ✓
$f_0 = (3 \times 10^8)(3.6 \times 10^6)$ ✓
$f_0 = 1.08 \times 10^{15}\text{Hz}$ ✓ (3)

10.3 $\frac{hc}{\lambda} = hf_{0} + E_{k(max)}$ ✓

$(\frac{(6{,}63\times10^{-34})(3{,}0\times10^8)}{5{,}6\times10^6}$✓✓ = $\underline{(6{,}63X10^{-34})\ (1{,}08X10^{15})}$ ✓ + $E_{k(max)}$

$E_{k(max)} = 3{,}98X10^{-19}$J ✓

(5)

10.4

10.4.1 REMAIN THE SAME✓ (1)

10.4.2 INCREASES✓ (1)

[12]

TOTAL: 150