KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P1 (PHYSICS)

COMMON TEST

JUNE 2023

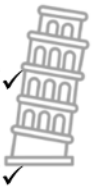
MARKING GUIDELINES

MARKS : 150

This Marking Guideline consists of 13 pages.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

1.1 C✓✓



1.2 D✓✓

1.3 D✓✓

1.4 A✓✓

1.5 D✓✓ (Accept B)

1.6 C✓✓

1.7 A✓✓

1.8 D✓✓

1.9 C✓✓

1.10 D✓✓

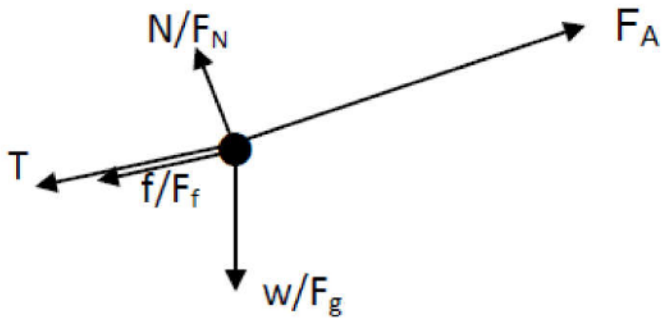
[20]

QUESTION 2

2.1

2.1.1 When a net force is applied to an object, it accelerates the object in the direction of the net force. The acceleration is directly proportional to the net force and inversely proportional to the mass of the object.✓✓ (2)

2.1.2



Notes: Accepted Labels		MARK
w	F_g/F_w/weight/9,8 N/mg/gravitational force	✓
f	F_f/f_k/friction	✓
N	FN/Normal	✓
T	FT/Tension force	✓
F_A	30 N/F	✓
Any additional force: deduct 1 mark maximum (maximum 4/5)		
Lines must touch dot/square otherwise (maximum 4/5)		
Accept if components of gravitational force provided instead of F_g		

(5)

2.1.3 For the 1 kg block:

$F_{net} = ma$
$F - (T+mg\sin\theta + f_k) = ma$
$30 - \{T+(1)(9,8)(\sin 28^0) +4\} = (1)(a)$✓
$21, 399 - T = a$……(1)

For the 2 kg block:

$F_{net} = ma$
$T-(mg\sin\theta + f_k) = ma$
$T-\{(2)(9,8)(\sin 28^0) + 8\} = (2)(a)$✓
$T - 17,201 = 2a$ ……(2)

Any one ✓

Substitute for T from equation (1)
$(21,4 - a) - 17,2 = 3a$✓
$4,198 = 3a$
$a = 1,4\ m\cdot s^{-2}$

$T = 21,399 - a$
$= 21,399 - 1,399$
$= 20\ N$ ✓

(5)

2.1.4 REMAINS THE SAME✓ (1)

2.1.5 DECREASES✓ (1)

2.2

2.2.1 Every 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 $F = G\frac{m_1 m_2}{r^2}$ ✓

$F = (6,67\times10^{-11})\times\frac{(5,98\times10^{24})[(330000)(5,98\times10^{24})]}{(1,38\times10^{9})^2}$ ✓ ✓

$F = 4,13\times10^{26}\text{N}$ ✓ (4)

2.2.3 Equal to.✓

Newton's third law is obeyed.✓ (2)

[22]

QUESTION 3

3.1 Object moving✓ under the influence of the gravitational force only✓ (2)

3.2

OPTION 1

Upward positive:

$V_f = V_i + a\Delta t$✓
$0 = V_i + (-9,8)1,5$✓
$\therefore V_i = 14,7\ m\cdot s^{-1}$ ✓

Upward negative:

$V_f = V_i + a\Delta t$✓
$0 = V_i + (9,8)1,5$✓
$\therefore V_i = -14,7\ m\cdot s^{-1}$
$\therefore V_i = 14,7\ m\cdot s^{-1}$ ✓

OPTION 2

Upward positive:

$\Delta y = v_i\Delta t + \frac{1}{2}\ a\Delta t^2$ ✓
$0 = v_i(3) + \frac{1}{2}\ (-9,8)(3)^2$ ✓
$\therefore V_i = 14,7\ m\cdot s^{-1}$ ✓

Upward negative:

$\Delta y = v_i\Delta t + \frac{1}{2}\ a\Delta t^2$ ✓
$0 = v_i(3) + \frac{1}{2}\ (9,8)(3)^2$ ✓
$\therefore V_i = -14,7\ m\cdot s^{-1}$
$\therefore V_i = 14,7\ m\cdot s^{-1}$ ✓

(3)

3.3 **POSITIVE MARKING FROM Q3.2**

Upward positive:

$v_f^2 = v_i^2 + 2a\Delta y$✓
$0 = 14,7^2 + 2(-9,8)\ \Delta y$✓
$\Delta y = 11.025m$✓

Upward negative:

$v_f^2 = v_i^2 + 2a\Delta y$✓
$0 = (-14,7)^2 + 2(9,8)\ \Delta y$✓
$\Delta y = -11.025m$
$\therefore$ max height reached = 11,025 m✓

(3)

3.4 **POSITIVE MARKING FROM Q3.3**

$\Delta y = v_i\Delta t + \frac{1}{2}\ a\Delta t^2$ ✓
2 ✓ $= v_i(0,1) + \frac{1}{2}\ (9.8)(0,1)^2$ ✓
$v_i = 19,51\ m\cdot s^{-1}$

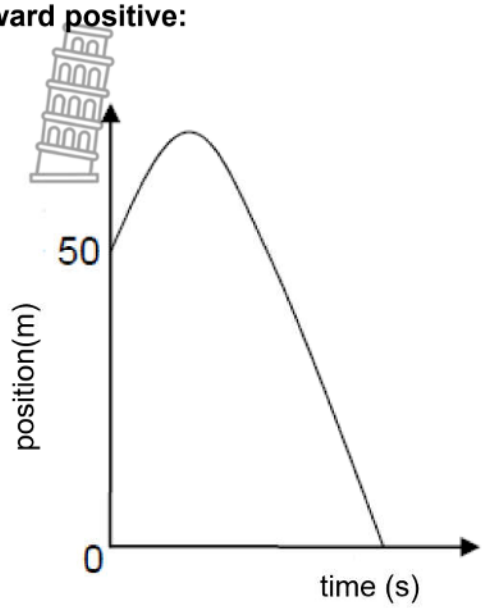
Height = 41,6 +✓ 8,4 = 50 m✓

$v_f^2 = v_i^2 + 2a\Delta y$
19,51✓ $= 14,7^2 + 2(9.8)\Delta y$✓
$\Delta y = 8,40\ m$

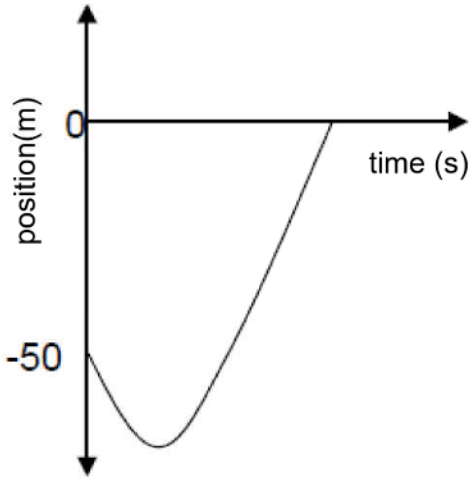
(7)

3.5 **POSITIVE MARKING FROM Q3.4**

Upward positive:



Upward negative:



Criteria for graph	**Marks**
Correct shape.	✓
Final position lower than initial position.	✓
Graph ends on x axis and starts from height of tower	✓

(3)
[18]

QUESTION 4

4.1

4.1.1 Total mechanical energy in an isolated system remains constant / is conserved ✓✓ (2)

4.1.2 **OPTION 1**

E_M total (top) = E_M total (bottom) } Any one ✓
$(Ep + Ek)_{TOP} = (Ep + Ek)_{BOTTOM}$ }
$(0,15 \times 9,8 \times 2,5) + ½ (0,15) \times 8^2$ ✓ = 0 + $½\ 0,15\ v^2$ ✓
$V = 10,63\ m \cdot s^{-1}$ ✓

OPTION 2

$W_{nc} = \Delta E_p + \Delta E_k$ ✓
$0 = [0 - (0,15 \times 9,8 \times 2,5)]$ ✓ + $[½\ 0,15\ v^2 - ½ (0,15) \times 8^2]$ ✓
$V = 10,63\ m \cdot s^{-1}$ ✓

OPTION 3

$W_{net} = \Delta E_k$ }
$W_{Fg} = ½ mv_f^2 - ½ mv_i^2$ } Any one ✓
$mg\Delta x \cos\theta = ½ mv_f^2 - ½ mv_i^2$ }
$0,15(9,8)(2,5) \cos 0°$ ✓ = $½\ 0,15\ v^2 - ½ (0,15) \times 8^2$ ✓
$V = 10,63\ m \cdot s^{-1}$ ✓ (4)

4.1.3 Product of the net force and the time ✓ for which the force acts ✓ (2)

4.1.4 $F_{ground} = F_{net} + F_{gravity}$
$25,55 = F_{net} + (0,15 \times 9,8)$ ✓
$F_{net} = 24,08\ N$

$F_{net}.\Delta t = \Delta p$
$24,08 \times 0,1$ ✓ $= 0,15v - 0,15(-10,63)$ ✓
$v = 5,42\ m \cdot s^{-1}$

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$0 = 5,42^2 + 2(-9,8)$ ✓Δy
$\Delta y = 1,5\ m$ ✓

(6)

4.2

4.2.1 $v = \frac{\Delta x}{\Delta t}$

$v = \frac{10,2 - 4,8}{5 - 2}$ ✓

$v = 1,8 \quad m \cdot s^{-1}$ ✓ (3)

4.2.2 In an isolated system the total linear momentum is conserved. ✓✓ (2)

4.2.3 (p total) before = (p total) after ✓ Any one

$m_1v_1 + m_2v_2 = (m_1 + m_2)v_f$

$(0,9)(2,4) + 0$ ✓ $= (0,9 + m)(1,8)$ ✓

$m = 0,3$ kg ✓ (4)

[23]

QUESTION 5

5.1

5.1.1 The net work done on an object is equal to the change in kinetic energy of the object. ✓✓ (2)

5.1.2 $W_{net} = \Delta E_k$ ✓

$F_{net} \Delta x \cos \theta = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$

$F_{net} \times 2,5$ ✓ $= \frac{1}{2}(2 \times 4^2) - \frac{1}{2}(2 \times 1,5^2)$ ✓

$F_{net} = 5,5$ N

$F_{net} = F - f_k$

$5,5 = F - 26$

$F = 31,5$ N ✓ (4)

5.2

5.2.1 A force for which the work done in moving an object between two points is dependent on the path taken. ✓✓ (2)

5.2.2 $P = \frac{W_{nc}}{\Delta t}$

$P = \frac{\Delta Ep + \Delta Ek}{\Delta t}$ ✓ Any one

500 ✓ $= \frac{m(9,8)(35 - 0)$ ✓ $+ \frac{1}{2} m (2,1^2 - 0)}{60}$ ✓

$m = 87$ kg ✓ (86,9 kg) (5)

[13]

QUESTION 6

6.1

6.1.1 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.✓✓

OR

Doppler effect is the change in frequency (or pitch) of the sound detected by a listener, when there is relative motion between the sound source and the listener.✓✓ (2)

6.1.2 $f = \frac{1,25}{\Delta t}$

$f = \frac{1,25}{17,36 \times 10^{-4}}$ / $f = \frac{1}{13,89 \times 10^{-4}}$ ✓

f = 720,05 Hz

fL > fs. ✓ Towards. ✓ (3)

6.1.3 **POSITIVE MARKING FROM 6.1.2**

$f_L = \frac{V \pm V_L}{V \pm V_S} f_S$ ✓

$720,05 = \frac{340+0}{340-V_S}(650)$ ✓ ✓

V_{car} = 33,06 m·s^{-1}✓ (4)

6.1.4 Determine whether arteries are clogged.✓

Determine heartbeat of foetus.✓ (2)

6.2 Frequencies of the spectral lines decrease✓✓. OR frequencies of light emitted by these stars are red shifted. (2)

[13]

QUESTION 7

7.1

7.1.1 To the left.✓ (1)

7.1.2 $$Q_{net} = \frac{Q_1 + Q_2}{2}$$

$$Q_{net} = \frac{-4\times10^{-6} + 8\times10^{-6}}{2} \quad ✓$$

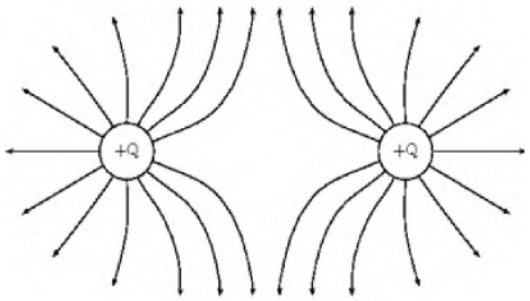
$Q_{net} = 2\times10^{-6}\,C$

$\therefore Q_P = 2\times10^{-6}\,C$ } Any one ✓

$\therefore Q_Q = 2\times10^{-6}\,C$

(2)

7.1.3



Criteria for sketch:	Marks
Correct direction of field lines.	✓
Shape of the electric field.	✓
No field line crossing each other / Field lines start from the sphere / No field lines inside the spheres.	✓

(3)

7.1.4 **POSITIVE MARKING FROM 7.1.2**

$$\Delta Q = Q_f - Q_i$$
$$= 2\times10^{-6} - (-4\times10^{-6})$$
$$= 6\times10^{-6}\ C$$

$$n = \frac{Q}{e} \quad ✓$$

$$n = \frac{6\times10^{-6}}{1{,}6\times10^{-19}} \quad ✓$$

$n = 3{,}75\times10^{13}$✓

(2)

POSITIVE MARKING FROM QUESTION 7.1.2

7.1.5

$$F = \frac{kQ_1Q_2}{r^2} \quad ✓$$

$$0,8 = \frac{(9\times10^{9})(2\times10^{-6})(2\times10^{-6})}{(d)^2} \quad ✓✓$$

$$d = 0,21\text{m} \quad ✓$$

(4)

7.2

7.2.1 Force experienced per unit positive charge placed at that point. ✓✓ (2)

7.2.2

$$E = \frac{kQ}{r^2} \quad ✓$$

$$E_4 = \frac{(9\times10^{9})(4\times10^{-6})}{(0,3)^2} \quad ✓$$

$$E_4 = 4 \times 10^{5}\ \text{N·C}^{-1}$$

$$E = \frac{kQ}{r^2}$$

$$E_3 = \frac{(9\times10^{9})(3\times10^{-6})}{(0,1)^2} \quad ✓$$

$$E_3 = 2,7 \times 10^{6}\ \text{N·C}^{-1}$$

$$E_4 + E_3 = E_P$$

$$E_P = 4 \times 10^{5} - 2,7 \times 10^{6} \quad ✓$$

$$E_P = 2,3 \times 10^{6}\ \text{N·C}^{-1}\ \text{Left} \quad ✓$$

MARKING CRITERIA:

- Electric field formula ✓
- Substitution into electric field due to 4μC charge. ✓
- Substitution into electric field due to -3μC charge. ✓
- Subtracting the two electric fields. ✓
- Final answer, including direction. ✓

(5)

7.2.3

$$F_{net} = ma \quad ✓$$

$$\therefore QE = ma$$

$$m = \frac{QE}{a}$$

$$m = \frac{(6\times10^{-6})(2,3\times10^{6})}{(5\times10^{2})} \quad ✓$$

$$m = 2,7 \times 10^{-2}\ \text{kg} \quad ✓$$

MARKING CRITERIA:

- Equating electrostatic force to net force ✓
- Substitution for Q, E and a. ✓
- Final answer. ✓

(3)

[22]

QUESTION 8

8.1

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

8.1.2 **OPTION 1**

$V_{tot} = IR_{tot}$ ✓

$12 = (0,5)R_{tot}$ ✓

$\therefore R_{tot} = 24\ \Omega$

$\therefore R_x = (24 - 8)$ ✓ $= 16\ \Omega$ ✓

OPTION 2

$V_8 = IR_{8\Omega}$ ✓

$= (0,5)(8)$ ✓

$= 4\ V$

$\therefore V_x = (12 - 4)$ ✓ $= 8\ V$

$V_x = IR_x$

$8 = (0,5)(R_x)$

$\therefore R_x = 16\ \Omega$✓

(4)

8.1.3 Keep temperature of conductor constant ✓ (1)

8.2

8.2.1 12 V✓ (1)

8.2.2 **OPTION 1**

$V_4 = I_4 R_{4\Omega}$ ✓

$12 = I_4(4)$✓

$I_{4\Omega} = 3\ A$

$V_x = I_{16\Omega} R$

$12 = I_{16\Omega} 16$

$I_{16\Omega} = 0,75\ A$

OR

$I_4 R_4 = I_{16\Omega} R_{16\Omega}$

$(3)(4) = I_{16\Omega}(16)$

$I_{16\Omega} = 0,75\ A$

$I_A = (3 +$✓ $0,75)$

$= 3,75\ A$✓

OPTION 2

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{16} + \frac{1}{4}$$ ✓

$R_p = 3,2\ \Omega$

$V = IR$✓

$12 = I(3,2)$✓

$I_{4\Omega} = 3,75\ A$✓

(4)

8.2.3 **OPTION 1**

$$W = \frac{V^2 \Delta t}{R} \checkmark$$

$$= \frac{(7,2)^2}{12} \checkmark \; 120 \checkmark$$

= 518,4 J ✓

OPTION 2

$V_{8,12} = I(R_8 + R_{12})$
$12 = I(20)$
$I = 0,6$ A

$W = I^2 R\Delta t$✓
$= (0,6)^2(12)$✓ (120) ✓
= 518,4 J✓

(4)

8.2.4 REMAINS THE SAME✓. Potential difference across the 16Ω and 4 Ω resistors in parallel remain the same✓✓ (3)

[19]

TOTAL: 150