KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES: PHYSICS (P1)

NOVEMBER 2023

MARKING GUIDELINES

MARKS: 150

TIME: 3 hours

This marking guidelines consists of 16 pages.

QUESTION 1:

1.1 B✓✓
1.2 D✓✓
1.3 C✓✓
1.4 C✓✓
1.5 D✓✓
1.6 A✓✓
1.7 C✓✓ (Accept L)
1.8 C✓✓
1.9 B✓✓
1.10 A✓✓

[20]

QUESTION 2

2.1 They have both magnitude ✓and direction✓. (2)

2.2

2.2.1 $F_{Px} = F_P\cos\theta$✓
$= 300\cos20°$✓
$= 281,91$ N✓ (3)

2.2.2 $F_{Gx} = F_G\cos\theta$
$= 500\cos50°$✓
$= 321,39$ N✓ (2)

POSITIVE MARKING FROM QUESTIONS 2.2.1 AND 2.2.2

2.3 $F_x\text{net} = F_{Mx} + F_{Px} + F_{Gx}$
266,94✓ $= F_{Mx} + 281,91 + (-321,39)$ ✓
$F_{Mx} = 306,42$ N
$F_{Mx} = F_M\cos\theta$
$306,42 = F_M(\cos60°)$
$M = 612,84$ N✓ (3)

2.4 A single force✓ that has the same effect of two or more forces acting together. ✓ (2)

POSITIVE MARKING FROM QUESTION 2.4

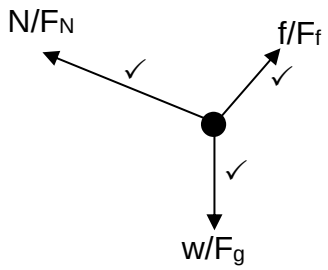
2.5 $F_y\text{net} = F_{My} + F_{Py} + F_{Gy}$
$= F_M\sin\theta + F_P\sin\theta + F_G\sin\theta$
$= (612,84)(\sin60°)$✓ + $(300)(\sin20°)$✓ - $(500)(\sin50°)$✓
$= 250,33$ N
$F^2\text{res} = 266,94^2 + 250,33^2$✓
Fres $= 387,09$ N✓ (5)

[17]

QUESTION 3 (Start on a new page.)

3.1 The force that opposes the tendency of motion of a stationary object relative to a surface. ✓✓ (2)

3.2



μ (3)

3.3.1

$F_{net} = ma$ } any one ✓
$mg\sin\theta + (-f_s) = 0$ }
$(75)(9,8)(\sin 23°) - f_s = 0$✓
$f_s = 287,19$ N✓ (3)

POSITIVE MARKING FROM QUESTION 3.3.1:

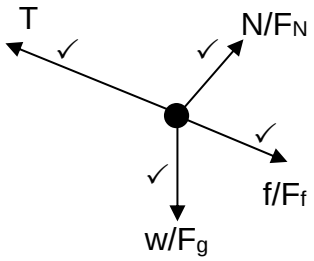
3.3.2

$f_s = \mu_s N$
$= \mu_s F_{g\perp}$ } any one✓
$= \mu_s mg\cos\theta$
$287,19$✓ $= \mu_s(75)(9,8)$ ✓ $(\cos 23°)$✓
$\mu_s = 0,42$✓ (5)

3.4 GREATER THAN✓ (1)
[14]

QUESTION 4 (Start on a new page.)

4.1



(5)

4.2 When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration that is directly proportional to the force✓ and inversely proportional to the mass of the object. ✓ (2)

4.3

$$\begin{aligned} F_{net} &= ma \\ T + (-f) + (-F_{gp}) &= ma \quad \checkmark \\ 18 - \mu_k N - mg\sin\theta &= ma \end{aligned}$$

$$18 - (0,45)(m)(9,8)\cos 30° \checkmark - (9,8)(m)\sin 30° \checkmark = (m)(5,72) \checkmark$$

$$m = 1,25 \text{ kg} \checkmark$$ (5)

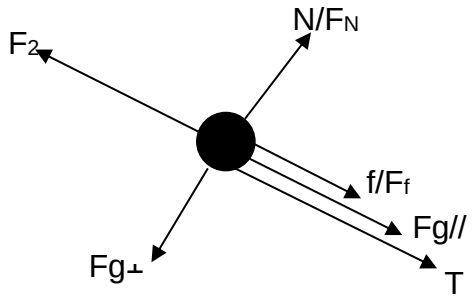
4.4 **POSITIVE MARKING FROM QUESTION 4.3:**

$$T + (-f) + (-F_{g//}) = 0$$

$$T - \mu_k N - mg\sin\theta = 0$$

$$T - (0,45)(1,25)(9,8)\cos 30° \checkmark - (1,25)(9,8)\sin 30° \checkmark = 0 \checkmark$$

$$T = 10,9 \text{ N}$$



$$\begin{aligned} F_{net} &= ma \\ F + (-f) + (-F_{g//}) + (-T) &= ma \quad \checkmark \end{aligned}$$

$$F - (0,15)(2)(9,8)\cos 30° + (2)(9,8)\sin 30° \checkmark - 10,9 = 0$$

$$F = 3,65 \text{ N} \checkmark$$ (6)

[18]

QUESTION 5 (Start on a new page.)

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

5.2 ATTRACTIVE✓ (1)

5.3 EQUAL TO✓ (1)

5.4 Newton's Third Law of Motion. ✓
When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A. ✓✓ (3)

5.5

$$F = \frac{Gm_1m_2}{r^2} \checkmark$$

$$2{,}30 \times 10^{-8} \checkmark = \frac{(6{,}67 \times 10^{-11})(16)(48)}{r^2} \checkmark$$

$$r = 1{,}49 \text{ m}$$

$$\text{radius} = 1{,}49 - 1{,}24 \checkmark - 0{,}10 \checkmark$$

$$= 0{,}15 \text{ m} \checkmark$$ (6)

5.6 $3{,}07 \times 10^{-8}$ N✓✓ (2)
[15]

QUESTION 6 (Start on a new page.)

6.1 X✓ (1)

6.2

$$n = \frac{Q}{e}$$

$$= \frac{15 \times 10^{-9}}{1{,}6 \times 10^{-19}} \checkmark$$

$$= 9{,}375 \times 10^{10}$$

$$m = nm_e$$

$$= (9{,}375 \times 10^{10})(9{,}11 \times 10^{-31}) \checkmark$$

$$= 8{,}54 \times 10^{-20} \text{ kg} \checkmark$$ (4)

6.3

$$\frac{(-15 \times 10^{-9}) + Q\ (2 \times 10^{-9})}{3} = -3 \times 10^{-9} \checkmark$$

$$Q = 4 \times 10^{-9} \text{ C} \checkmark$$ (2)

6.4 The magnitude of the electrostatic force exerted by two point charges on each other is directly proportional to the product of the magnitudes of the charges ✓and inversely proportional to the square of the distance(r) between them. ✓ (2)

6.5

MARKING CRITERIA:
- Determining distance between spheres Y and Z (r_{YZ}). ✓
- Coulomb's Law formula. ✓
- Substitution into formula for calculating force of Y on Z (F_{YZ}). ✓
- Substitution into formula for calculating force of X on Z (F_{XZ}). ✓
- Final answer (magnitude + direction). ✓

Since the charges are equal, and F_{net} on Y = 0, $r_{XY} = r_{YZ} = 0{,}15$ m. ✓

F_{net} (on Z) = F_{YZ} + F_{XZ}

$$= \frac{kQ_YQ_Z}{r_{YZ}^2} + \frac{kQ_XQ_Z}{r_{XZ}^2} \checkmark$$

$$= \frac{9 \times 10^9 \times 3 \times 10^{-9} \times 3 \times 10^{-9}}{(0{,}15)^2} \checkmark + \frac{9 \times 10^9 \times 3 \times 10^{-9} \times 3 \times 10^{-9}}{(0{,}3)^2} \checkmark$$

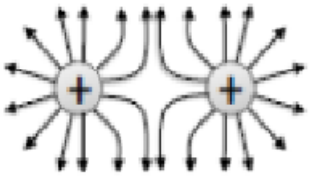
$$= \underline{4{,}5 \times 10^{-6} \text{ N to the right}} \checkmark$$ (5)

[14]

QUESTION 7 (Start on a new page.)

7.1 The electrostatic force experienced per unit positive charge placed at that point. ✓✓ (2)

7.2



Criteria for graph/*Kriteria vir grafiek:*	
Correct shape	✓
Correct direction – field lines directed away from positive charges	✓
Lines must not cross and must touch spheres.	✓
NOTE: If the net electric field pattern is drawn for two unlike charges:	$^0/_3$

(3)

7.3

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

$$= \frac{(9 \times 10^9)(5 \times 10^{-9})}{(0{,}03)^2} \checkmark$$

$$= 50\,000 \text{ N.C}^{-1} \text{ to the right}$$

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

$$= \frac{(9 \times 10^9)(5 \times 10^{-9})}{(0{,}01)^2} \checkmark$$

$$= 450\,000 \text{ N.C}^{-1} \text{ to the right}$$

$$E_{net} = 50\,000 + \checkmark\ 450\,000$$

$$= 500\,000 \text{ N.C}^{-1} \checkmark$$ (5)

7.4 **POSITIVE MARKING FROM QUESTION 7.3**

$E = \frac{F}{q}$ ✓

$500\,000 = \frac{F}{(1,6 \times 10^{-19})}$ ✓

$F = 8 \times 10^{-14}$ N ✓ (3)

[13]

QUESTION 8

8.1.1 EQUAL TO✓
The potential difference across them is equal✓ (2)

8.1.2 LESS THAN✓
The potential difference across P is less than/ half of the potential difference across R✓ (2)

8.2.1 $V = V_{2\Omega} + V_{5\Omega}$
$= IR$✓ $+ IR$
$= (1,2)(2) + (1,2)(5)$ ✓
$= 8,40$ V✓ (3)

8.2.2 $I_{A2} = I_{3\,\Omega} + I_{A1}$
$= \frac{V}{R}$ ✓ $+ 1,2$✓
$= \frac{8,4}{3}$ ✓ $+ 1,2$
$= 4$ A✓ (4)

8.2.3 **POSITIVE MARKING FROM QUESTIONS 8.2.1 AND 8.2.2**

OPTION 1	**OPTION 2**	**OPTION 3**
$P = \frac{V^2}{R}$ ✓	$P = I^2R$ ✓	$P = VI$ ✓
$= \frac{8,4^2}{3}$ ✓	$= (2,8)^2 \times 3$ ✓	$= 8,4 \times 2,8$ ✓
$= 23,52$ W✓	$= 23,52$ W ✓	$= 23,52$ W ✓

(3)

8.2.4 **POSITIVE MARKING FROM QUESTIONS 8.2.1 AND 8.2.2**

$V_{BATTERY} = V_R + V_P$ ✓
$= 4R + 8,4$ ✓ ……EQN 1

$V_{BATTERY} = 3,48R + 3,48(3)$
$= 3.48R + 10,44$ ✓ ……EQN 2

$4R + 8,4 =$✓ $3,48R + 10,44$
$R = 3,92\,\Omega$

$V = (4)(3,92) + 8,4$ ✓
$= 24,08$ V✓ (6)

8.2.5 Decreases✓
Total resistance increases✓ Total current decreases✓ (3)

8.3

OPTION 1	**OPTION 2**	**OPTION 3**
$W = VI\Delta t$ ✓ $= 220 \times 4,4 \times 90$ ✓ $= 87120$ W	$W = I^2R\Delta t$ ✓ $= (4,4)^2 \times 50 \times 90$ ✓ $= 87120$ W	$W = \frac{V^2}{R}\Delta t$ ✓ $= \frac{220^2}{50} \times 90$ ✓ $= 87120$ W
Cost = 87,12 kW x R1,83 ✓ = R159,43 ✓		

(4)
[27]

QUESTION 9 (Start on a new page.)

9.1

9.1.1 The magnitude of the induced emf across the ends of a conductor is directly proportional to the rate of change in the magnetic flux linked with the conductor. ✓✓ (2)

9.1.2 South✓ (1)

9.1.3 No deflection / zero reading ✓
No change in the magnetic flux (linkage). ✓ (2)

9.1.4 Y to X✓ (1)

9.2

9.2.1 $\phi = BA\cos\theta$ ✓
$= (0,5)(0.001)\cos 20°$ ✓
$= 4,70 \times 10^{-4}$ Wb / T·m^2 ✓ (3)

9.2.2 **POSITIVE MARKING FROM QUESTION 9.2.1:**

$$E = \frac{-N\Delta\phi}{\Delta t} \checkmark$$
$$= \frac{(-1) \checkmark (0 - 4,70 \times 10^{-4})}{(0,2)} \checkmark$$
$$= 2,35 \times 10^{-3} \text{ V} \checkmark$$

(4)

9.3

9.3.1 Remains the same. ✓ (1)
9.3.2 Increases. ✓ (1)
[15]

TOTAL: 150