LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION
VHEMBE EAST DISTRICT

# VHEMBE EAST DISTRICT

## NATIONAL
## SENIOR CERTIFICATE

## GRADE 12

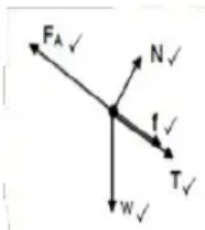
## PHYSICAL SCIENCES P1
## PRE-JUNE MEMO
## 19 MAY 2025

**MARKS: 150**

**This Marking Guideline consists of 18 pages including the cover page.**

| | | |
|---|---|---|
| 1.1 | A ✓✓ | (2) |
| 1.2 | B ✓✓ | (2) |
| 1.3 | B ✓✓ | (2) |
| 1.4 | B ✓✓ | (2) |
| 1.5 | A ✓✓ | (2) |
| 1.6 | C ✓✓ | (2) |
| 1.7 | C ✓✓ | (2) |
| 1.8 | B ✓✓ | (2) |
| 1.9 | B ✓✓ | (2) |
| 1.10 | C ✓✓ | (2) |
| | | **[20]** |

## QUESTION 2

| | | |
|---|---|---|
| 2.1 | When object A exerts a force on object B, object B SIMULTANEOUSLY exerts an oppositely directed force of equal magnitude on object A ✓✓ | (2) |
| 2.2 |  | (5) |

| Accepted labels | |
|---|---|
| w | $F_g$ / $F_w$ /force of earth on block / weight / mg / gravitational force |
| N | Normal force/$F_N$ |
| T | Tension / $F_T$ |
| $F_A$ | F / $F_{applied}$/40 N |
| f | Frictional force / $F_f$ |

| | | |
|---|---|---|
| 2.3.1 | **OPTION 1/*OPSIE 1***<br>For the 1 kg block/*Vir die 1 kg blok*;<br>$f_k = \mu_k N$<br>$= \mu_k\ mg\cos\theta$ ✓<br>$= 0{,}29\ (1 \times 9{,}8 \cos 30°)$ ✓<br>$= 2{,}46$ N ✓<br><br>**OPTION 2/*OPSIE 2***<br>BY PROPORTION:/*DEUR EWEREDIGHEID*<br>The smaller mass = ¼ of the larger mass ✓<br>*Die kleiner massa = ¼ die groter massa*<br>∴frictional force/*wrywingskrag* = ¼ (10) ✓<br>= 2,5 N ✓ | (3) |
| 2.3.2 | $F_{net} = ma$ ✓<br><br>For 1 kg block/*Vir 1 kg blok*<br>$F_A - \{(T + f_k) + mg\sin\theta\} = ma$<br>$40 - \{T + 2{,}46 + 1(9{,}8)(\sin 30°)\}$ ✓ $= (1\ x)\ a$ ✓<br>$40 - T - 7{,}36 = a$<br>$32{,}64 - T = a$.....(1)<br>For 4 kg block/*Vir 4 kg blok*<br>$T - (mg\sin\theta + f_k) = 4a$<br>$T - (4 \times 9{,}8 \sin 30° + 10) = 4a$ ✓<br>$T - 29{,}6 = 4a$.....(2)<br>From (1) and (2)/*Vanaf (1) en (2)*<br>$a = 0{,}61\ m{\cdot}s^{-2}$<br>$T = 29{,}6 + (4(0{,}61)$ ✓<br>$T = 32{,}04$ N ✓ | (6) |
| 2.4 | $F = \frac{Gm1m2}{r2}$ ✓<br>On the mountain<br><br>$F = \frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})(65)}{(6.38 \times 10^{6} + 6 \times 10^{6})^2}$ ✓✓<br>= 627.2 N<br><br>On the ground<br><br>Fg = mg<br>= (65×9,8) ✓<br>= 637 N<br><br>Difference = (637 – 627,2) ✓<br>= 9,8 N ✓ | (6) |

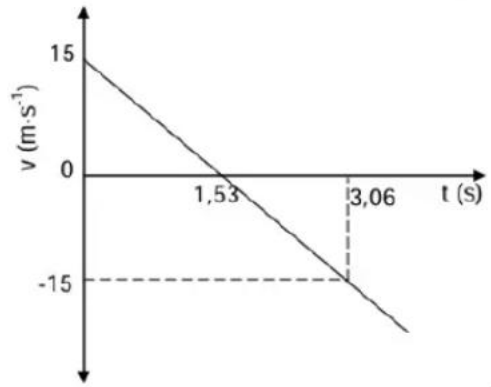
## QUESTION 3

| | | |
|---|---|---|
| 3.1 | *Free fall* is motion during which the only force acting on an object is the gravitational force ✓✓ | (2) |
| 3.2 | **OPTION 1/*OPSIE 1***<br>**Upwards positive/*Opwaarts positief*:**<br>$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓<br>0 ✓= $\underline{15\ \Delta t + \frac{1}{2}(-9,8)\ \Delta t^2}$✓<br>$\Delta t$ = 3,06 s<br>It takes/*Dit neem* 3,06 s✓<br>**Downwards positive/*Afwaarts positief*:**<br>$\Delta y = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓<br>0✓ = $\underline{-15\ \Delta t + \frac{1}{2}(9,8)\ \Delta t^2}$✓<br>$\Delta t$ = 3,06 s<br>It takes/*Dit neem* 3,06 s✓<br><br>**OPTION 2/*OPSIE 2***<br>**Upwards positive/*Opwaarts positief*:**<br>$v_f = v_i + a\Delta t$✓<br>0✓ = $\underline{15 + (-9,8)\Delta t}$✓<br>$\Delta t$ = 1,53 s<br>It takes (2)(1,53) = 3,06 s✓<br>**Downwards positive/*Afwaarts positief*:**<br>$v_f = v_i + a\Delta t$✓<br>0✓ = $\underline{-15 + (9,8)\Delta t}$✓<br>$\Delta t$ = 1,53 s<br>It takes/*Dit neem* 3,06 s✓<br><br>**OPTION 3 / *OPSIE 3***<br>**Upwards positive/*Opwaarts positief*:**<br>$v_f = v_i + a\Delta t$✓<br>-15 ✓= $\underline{15 + (-9,8)\Delta t}$✓<br>$\Delta t$ = 3,06 s✓<br>**Downwards positive/*Afwaarts positief*:**<br>$v_f = v_i + a\Delta t$✓<br>15 ✓= $\underline{-15 + (9,8)\Delta t}$✓<br>$\Delta t$ = 3,06 s✓ | (4) |

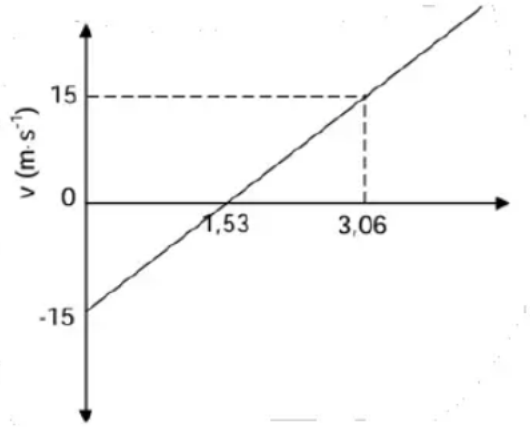
**OPTION 3/*OPSIE 3***

| **Upwards positive/*Opwaarts positief:*** | **Downwards positive/*Afwaarts positief:*** |
|---|---|
| Ball A/*Bal A*<br>$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓<br>$\Delta y_A$ = 15(1,53) ✓+ ½ (-9,8) $(1,53)^2$✓<br>= 11,48 m | Ball A/*Bal A*<br>$y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓<br>$\Delta y_A$ = -15 (1,53) ✓ + ½ (9,8) $(1,53)^2$✓<br>= -11,48 (m)<br>= 11,48 m upward/*opwaarts* |
| For ball B/*Vir bal B*<br>$v_f = v_i + a\Delta t$<br>$v_f = 0 + (-9,8)(1,53)$<br>$v_f = 14,99\ m{\cdot}s^{-1}$ | For ball B/*Vir bal B*<br>$v_f = v_i + a\Delta t$<br>$v_f = 0 + (9,8)(1,53)$<br>$v_f = 14,99\ m{\cdot}s^{-1}$ |
| $v_f^2 = v_i^2 + 2a\Delta x$<br>$14,99^2$✓ = 0 + 2(-9,8) $\Delta y_B$✓<br>$\Delta y_B$ = -11,47 (m)<br>= 11,47 m downward/*afwaarts* | $v_f^2 = v_i^2 + 2a\Delta x$<br>$14,99^2$ ✓= 0 + 2(9,8) $\Delta y_B$✓<br>$\Delta y_B$ = 11,47 (m) |
| Distance/*Afstand* = $(y_A + y_B)$<br>= 11,48 + 11,47✓<br>= 22,95 m✓ | Distance/*Afstand* = $(y_A + y_B)$<br>= 11,48 + 11,47✓<br>= 22,95 m✓ |

3.4 **CONSIDER DOWNWARD AS NEGATIVE**



**CONSIDER MOTION DOWNWARD AS POSITIVE**




| Criteria | Marks |
|---|---|
| Graphs starts at correct initial velocity shown. | ✓ |
| Time for maximum height shown (1,53 s ) | ✓ |
| Time for return shown (3,06 ) | ✓ |
| Shape / Straight line extending beyond 3,06 | ✓ |

**(**4)

**[17]**

**QUESTION 4**

| | | |
|---|---|---|
| 4.1 | Momentum is the product of mass and velocity of the object. ✓✓ | (2) |
| 4.2 | $\Delta p = 0$ ✓<br>$F_{net} = \frac{\Delta p}{\Delta t} = 0$ ✓<br>**OR/*OF***<br>$\Delta p = 0$ ✓<br>$\Delta v = 0 \therefore a = 0 \therefore F_{net} = ma$ ✓<br>**OR**<br>Gradient of graph $= \frac{\Delta p}{\Delta t} = F_{net}$ ✓<br>Gradient of the graph between t = 10 s and 20 s ✓ | (2) |
| 4.3 | **OPTION 1**<br>$F_{net}\Delta t = \Delta p$ ✓<br>$= -120 - 50$ ✓<br>$= -170$<br>$\therefore F_{net}\Delta t = 170$ N·s / kg·m·s$^{-1}$ ✓<br>**OPTION 2**<br>$F_{net} = \frac{\Delta p}{\Delta t}$ ✓<br>$= \frac{-120 - 50}{50 - 20}$<br>$\therefore F_{net} = -5,67$<br>$F_{net}\Delta t = (-5,67)(30)$ ✓<br>$= -170$<br>$\therefore F_{net}\Delta t = 170$ N·s / kg·m·s$^{-1}$ ✓ | (3) |
| 4.4 | **OPTION 1/ *OPSIE 1***<br>$\Sigma p_i = \Sigma p_f$ ✓<br>$-120 + 70$ ✓ $= 50 + p_{Bf}$ ✓<br>$\therefore p_{Bf} = -100$<br>$\therefore p_{Bf} = 100$ kg·m·s$^{-1}$ ✓ west / *wes* ✓<br>**OPTION 2/*OPSIE 2***<br>$\Delta p_A = -\Delta p_B$ ✓<br>$50 - (-120)$ ✓ $= -(p_{Bf} - 70)$ ✓<br>$\therefore p_{Bf} = -100$<br>$\therefore p_{Bf} = 100$ kg·m·s$^{-1}$ ✓ west / *wes* ✓<br>**Other formulae/*Ander formules*:**<br>$m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$<br>or<br>$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$<br>or<br>$m_Av_{iA} + m_Bv_{iB} = m_Av_{fA} + m_Bv_{fB}$<br>$p_{total\ before} = p_{total\ after}$<br>Accept /*Aanvaar*: $p_{before} = p_{after}$<br>$p_i = p_f$<br>**Notes/*Aantekeninge*:**<br>• If no formula/principle – Max. $\frac{4}{5}$<br>*Indien geen formule/beginsel – Maks.* $\frac{4}{5}$<br>• Mark direction independently.<br>*Sien rigting onafhanklik na.* | (5) |
| 4.5 | $P_i = mv_i$ ✓<br>Let mass of B $M$ ✓ | |

| | | |
|---|---|---|
| | $100 = MV_i$<br>$V_i = \frac{100}{M}$ ✓ | (3) |
| | | **[15]** |

| **QUESTION 5** | | |
|---|---|---|
| 5.1.1 | The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant / is conserved. ✓✓ | (2) |
| 5.1.2 | NO✓ | (1) |
| 5.1.3 | Due to the presence of a non-conservative force between points B and C, energy is converted to other forms. ✓✓ | (2) |
| 5.1.4 | **OPTION 1/*OPSIE 1*** | |

| Along **AB**/*Langs* **AB** | Along **AB**/*Langs* **AB** |
|---|---|
| $E_{mechanical\ at\ A} = E_{mechanical\ at\ B}$<br>$(E_p + E_k)_A = (E_p + E_k)_B$<br>$(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$ } ✓<br>$(10)(9,8)(4) + 0 = 0 + \frac{1}{2}(10)v_f^2$ ✓<br>$v_f = 8,85\ m{\cdot}s^{-1}$ | $W_{net} = \Delta E_k$ ✓<br>$F_g \Delta h \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$<br>$(10)(9,8)(4)\cos 0^\circ = \frac{1}{2}(10)(v_f^2 - 0)$ ✓<br>$v_f = 8,85\ m{\cdot}s^{-1}$ |

| **OPTION 1/*OPSIE 1*** | |
|---|---|
| Along **AB**/*Langs* **AB** | Along **AB**/*Langs* **AB** |
| $E_{mechanical\ at\ A} = E_{mechanical\ at\ B}$<br>$(E_p + E_k)_A = (E_p + E_k)_B$<br>$(mgh + \frac{1}{2}mv^2)_A = (mgh + \frac{1}{2}mv^2)_B$ } ✓<br>$(10)(9,8)(4) + 0 = 0 + \frac{1}{2}(10)v_f^2$ ✓<br>$v_f = 8,85\ m{\cdot}s^{-1}$ | $W_{net} = \Delta E_k$ ✓<br>$F_g \Delta h \cos\theta = \frac{1}{2}m(v_f^2 - v_i^2)$<br>$(10)(9,8)(4)\cos 0^\circ = \frac{1}{2}(10)(v_f^2 - 0)$ ✓<br>$v_f = 8,85\ m{\cdot}s^{-1}$ |

3.3

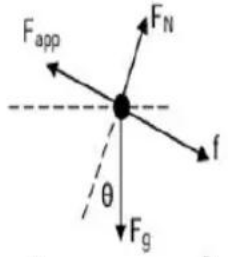
**OPTION 1/*OPSIE 1***

| **Upwards positive/*Opwaarts positief:*** | **Downwards positive/*Afwaarts positief:*** |
|---|---|
| $v_f^2 = v_i^2 + 2a\Delta y$ ✓<br>For ball A/*Vir bal A*<br>$0 = (15)^2$✓ + 2 (-9,8)$\Delta$y✓<br>$\Delta y_A$ = 11,48 m<br><br>When A is at highest point<br>*Wanneer A op hoogste punt is*<br><br>$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$<br>$= 0 + \frac{1}{2}(-9,8)(1,53)^2$✓✓<br>$\Delta y_B$ = -11,47 m<br>$\Delta y_B$ = 11,47 m downward/*afwaarts*<br><br>Distance/*Afstand* = $y_A + y_B$<br>= 11,47 + 11,48 ✓<br>= 22,95 m✓ | $v_f^2 = v_i^2 + 2a\Delta y$ ✓<br>For ball A/*Vir bal A*<br>$0 = (-15)^2$✓ + 2 (9,8)$\Delta$y✓<br>$\Delta y_A$ = -11,48 m<br><br>When A is at highest point<br>*Wanneer A op hoogste punt is*<br><br>$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$<br>$= 0 + \frac{1}{2}(9,8)(1,53)^2$✓✓<br>$\Delta y_B$ = 11,47 m<br>$\Delta y_B$ = 11,47 m downward/*afwaarts*<br><br>Distance/*Afstand* = $y_A + y_B$<br>= 11,48 + 11,47 ✓<br>= 22,95 m✓ |

**OPTION 2/*OPSIE 2***

| **Upwards positive/*Opwaarts positief:*** | **Downwards positive/*Afwaarts positief:*** |
|---|---|
| At maximum height $v_f$ = 0:<br>*By maksimum hoogte $v_f$ = 0:*<br><br>Ball/*Bal* A<br>$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓<br>= 15 (1,53) ✓ + ½ (-9,8) $(1,53)^2$✓<br>= 11,48 m | At maximum height $v_f$ = 0:<br>*By maksimum hoogte $v_f$ = 0:*<br><br>Ball/*Bal* A<br>$\Delta y_A = v_i\Delta t + \frac{1}{2} a\Delta t^2$✓<br>= (-15) (1,53) ✓+ ½ (9,8) $(1,53)^2$✓<br>= -11,48 m |
| When A is at highest/point<br>*Wanneer A op hoogste punt is*<br><br>$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$<br>$= 0 + \frac{1}{2}(-9,8)(1,53)^2$✓✓<br>$\Delta y_B$ = -11,47 m<br>$\Delta y_B$ = 11,47 m downward/*afwaarts*<br><br>Distance/*Afstand* = $y_A + y_B$<br>= 11,48 + 11,47✓<br>= 22,95 m✓ | When A is at highest point<br>*Wanneer A by hoogste punt is*<br><br>$\Delta y_B = v_i\Delta t + \frac{1}{2} a\Delta t^2$<br>$= 0 + \frac{1}{2}(-9,8)(1,53)^2$✓✓<br>$\Delta y_B$ = -11,47 m<br>$\Delta y_B$ = 11,47 m downward/*afwaarts*<br><br>Distance/*Afstand* = ($y_A + y_B$)<br>= 11,48 + 11,47 ✓<br>= 22,95 m✓ |

(7)

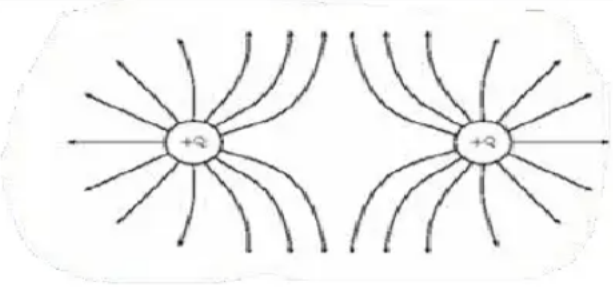
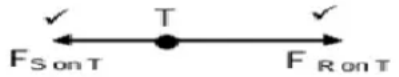
| | | |
|---|---|---|
| | **OPTION 2/*OPSIE 2***<br>Along **AC**/*Langs* **AC**<br><br>$W_{nc} = \Delta K + \Delta U$✓<br>$f\Delta x\cos\theta = \Delta K + \Delta U$<br>$(f)(8)$✓$(\cos 180^{o})$✓ $= (0 - 0)$ ✓ $+ 10\ (9,8)(0 - 4)$ ✓<br>$f = 49$ N ✓ | (6) |
| 5.2.1 | $f_k = \mu_k N$✓<br>$= \mu_k mg\cos\theta$<br>$= \underline{(0,19)(300)(9,8)\cos 25^{o}}$✓<br>$= 506,26$ N✓ | (3) |
| 5.2.2 | **OPTION 1/*OPSIE 1***<br><br><br>$F_{net} = 0$<br>$F_{app} + (-F_g\sin\theta) + (-f) = 0$ ✓<br>$F_{app} - (300)(9,8)\sin 25^{o}$✓ $- 506,26$✓ $= 0$<br>$F_{app} = 1\ 748,76$ N<br><br>$P_{ave} = Fv_{ave}$ ✓<br>$= 1748,76 \times 0,5$✓<br>$= 874,38$ W ✓ | |

| | | |
|---|---|---|
| | **OPTION 2/*OPSIE 2***<br>$W_f + W_{app} + W_N + W_g = 0$ ✓<br>$F\Delta x\cos\theta + F_{app}\Delta x\cos\theta + 0 + F_g\Delta x\cos\theta = 0$<br>$(506,26\Delta x\cos 180^0)$✓ + $(F_{app}\Delta x\cos 0) + 300(9,8)\Delta x\cos 115^0$✓ = 0<br>$F_{app} = 1748,76$ N<br>$P_{ave} = Fv_{ave}$✓<br>$= (1748,76)(0,5)$✓<br>$= 874,38$ W✓<br><br>**OPTION 3/*OPSIE 3***<br>$W_f + W_{app} + W_N + W_g = 0$✓<br>$F\Delta x\cos\theta + F_{app}\Delta x\cos\theta + 0 + F_g\sin\theta\Delta x\cos\theta = 0$<br>$(506,26\Delta x\cos 0)$ ✓ + $(F_{ap}\Delta x\cos 0) + 300(9,8)\sin 25^0\ \Delta x\cos 180)$ ✓ = 0<br>$F_{app} = 1\,748,76$ N<br><br>$P_{ave} = Fv_{ave}$✓<br>$= (1\,748,76)(0,5)$✓<br>$= 874,38$ W✓ | (6) |
| | | **[20]** |

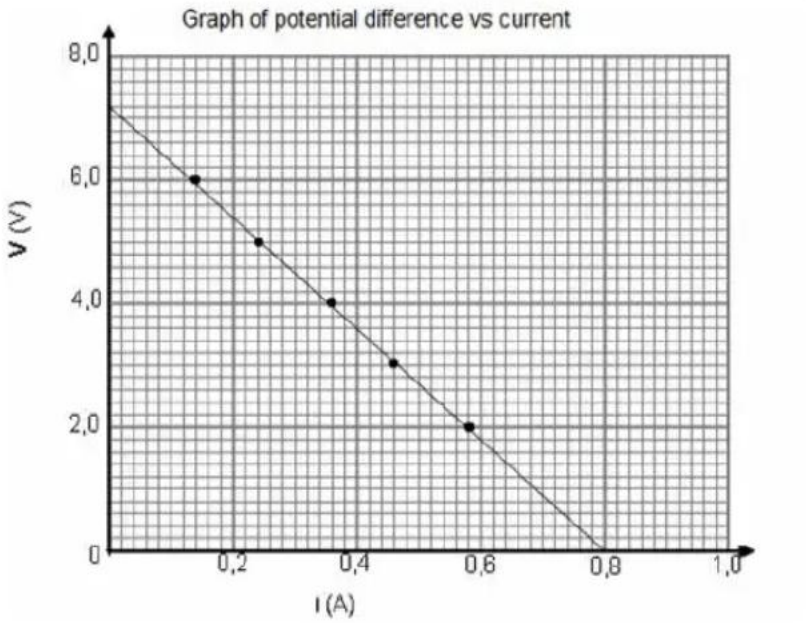
**QUESTION 6**

| | | |
|---|---|---|
| 6.1 | Red shift is a shift in the spectra of distant stars towards the longer wavelength / red end of the spectrum. ✓✓ | (2) |
| 6.2 | Moving away from the earth. ✓<br>The wavelength of the light coming from the distant star has increased / shift towads longer wavelength. ✓ | (2) |
| 6.3.1 | The difference between the speed of the car and the speed of light is very large. ✓ The frequency shift / increase is too small to observe. ✓ | (2) |
| 6.3.2 | $f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ OR $f_L = \frac{v}{v - v_S} f_S$ ✓<br><br>$\therefore f_L = \frac{340}{340 - 77,78}(1200)$<br>¿ $1555,95\ Hz$ | (4) |
| | | **[10]** |

## QUESTION 7

| | | |
|---|---|---|
| 7.1 | To ensure that charge does not leak to the ground. / In order to retain the charge / to insulate the charges. ✓✓ | (2) |
| 7.2 | $Net\ charge = \frac{Q_R + Q_s}{2} = \frac{+8+(-4)}{2} = 2\mu C$ | (3) |
| 7.3 |  <br> **Criteria for sketch** / **Marks** <br> Correct direction of field lines <br> Shape of the electric field <br> No lines crossing each other / No field lines inside the spheres | (3) |
| 7.4 |   | (2) |
| 7.5 | **OPTION 1** <br> $F = k\frac{Q_1 Q_2}{r^2}$ ✓ <br> $F_{ST} = (9\times10^{9})\frac{(1\times10^{-6})(2\times10^{-6})}{(0,2)^2}$ <br> ¿ $0,45\ N / 4,5\times10^{-1}\ N$ left <br> **OR** <br> $F = k\frac{Q_1 Q_2}{r^2}$ | |

| | | |
|---|---|---|
| | $F_{TS}=\frac{1}{4}F_{RT}=\frac{1}{4}(1,8)=0,45\,N$ right ✓<br>$\therefore 0,45\,N/4,5\times10^{-1}\,N$<br>$F_{RT}=(9\times10^{9})\frac{(2\times10^{-6})(1\times10^{-6})}{(0,1)^2}=1,8N$ right<br><br>OR<br><br>$F_{RT}=4F_{ST}=4(0,45)=1,8\,N$ right<br>$F_{net}=F_{ST}+F_{RT}=1,8+(-0,45)$ ✓<br>$\therefore 1,35\,N$ or towards sphere S or right of S ✓<br><br>**OPTION 2**<br>$E_R=\frac{kQ}{r^2}=\frac{(9\times10^{9})(2\times10^{-6})}{(0,1)^2}=1,8\times10^{6}N.C^{-1}$right<br>$E_S=\frac{kQ}{r^2}=\frac{(9\times10^{9})(2\times10^{-6})}{(0,2)^2}=4,5\times10^{5}N.C^{-1}$left<br>$E_{net}=1,8\times10^{6}-4,5\times10^{5}=1,35\times10^{6}N.C^{-1}$right<br>$F=EQ=(1,35\times10^{6})(1\times10^{-6})$<br>$\therefore 1,35\,N$ towards sphere S ✓ | (7) |
| 7.6 | Force experienced per unit positive charge placed at that point. | (2) |
| 7.7 | **OPTION 1**<br>$E=\frac{F}{q}=\frac{1,35}{1\times10^{-6}}=1,35\times10^{6}N.C^{-1}$<br><br>**OPTION 2**<br>$E_R=\frac{kQ}{r^2}=\frac{(9\times10^{9})(2\times10^{-6})}{(0,1)^2}=1,8\times10^{6}N.C^{-1}$right<br>$E_S=\frac{kQ}{r^2}=\frac{(9\times10^{9})(2\times10^{-6})}{(0,2)^2}=4,5\times10^{5}N.C^{-1}$left<br>$E_{net}=1,8\times10^{6}-4,5\times10^{5}=1,35\times10^{6}N.C^{-1}$<br><br>**OPTION 3**<br>$E=\frac{F}{q}=\frac{1,8}{1\times10^{-6}}=1,8\times10^{6}N.C^{-1}$<br>$E=\frac{F}{q}=\frac{0,45}{1\times10^{-6}}=4,5\times10^{5}N.C^{-1}$<br>$E_{net}=1,8\times10^{6}-4,5\times10^{5}=1,35\times10^{6}N.C^{-1}$ | (4) |
| | | **[23]** |

| **QUESTION 8** | | |
|---|---|---|
| 8.1.1 | The temperature of the battery must be kept constant ✓ | (1) |
| | | |
| 8.1.2 . | <br>Criteria for drawing line of best fit:<br>ALL points correctly plotted (at least 4 points) ✓ ✓<br>Correct line of best fit if all plotted points are used (at least 3 points)✓ | (3) |
| | | |
| 8.1.3 | 7,2 V (accept any answer between 7,0 -7,4 V) ✓ ✓ | (2) |
| | | |
| 8.1.4 | Slope$= \frac{\Delta V}{\Delta I}$<br>$= \frac{0-7,2}{0,8-0} = -9$<br>$r = 9\Omega$ | (3) |
| | | |
| 8.2.1 | **OPTION 1**<br>$P = VI$ ✓<br>$100 = 20(I)$ ✓ | |

| | | |
|---|---|---|
| | $I=5\,A$ ✓<br><br>**OPTION 2**<br>$P=\frac{V^2}{R}$<br>$100=\frac{(20)^2}{R}$<br>$R=4\,\Omega$<br>$V=IR$<br>$20=I(4)$<br>$I=5\,A$<br><br>**OPTION 3**<br>$P=\frac{V^2}{R}$<br>$100=\frac{(20)^2}{R}$<br>$R=4\,\Omega$<br>$P=I^2R$<br>$100=I^2(4)$ ✓<br>$I=5\,A$ ✓ | (3) |
| | | |
| 8.2.2<br>. | | |

**OPTION 1/*OPSIE 1***

$P = \frac{V^2}{R}$ ✓

$R = \frac{(20)^2}{150}$ ✓

$= 2,67\ \Omega$ ✓

**OPTION 2/OPSIE 2**

$P = VI$ ✓

$150 = (20)I$

$I = 7,5\ A$

$V = IR$

$20 = (7,5)R$ ✓

$R = 2,67\ \Omega$ ✓

**OR/*OF***

$P = I^2R$

$150 = (7,5)^2R$ ✓

$R = 2,67\ \Omega$ ✓

**OPTION 3/*OPSIE 3***

$I_X : I_Y$

$5 : 7,5$

$1 : 1,5$

$R_X : R_Y$

$1,5 : 1$ ✓

4 ✓: 2,67 Ω ✓

(3)

8.2.3

**OPTION 1/*OPSIE 1***

$P = VI$ **OR/*OF*** $P = I^2R$

$I_{150W} = \frac{150}{20}$ ✓ $= 7,5\ A$ $I_{150W} = \sqrt{\frac{150}{2,67}}$ ✓ $= 7,5\ A$

$I_{tot} = (5 + 7,5)$ ✓

$\varepsilon = I(R + r)$ ✓

$24 = 12,5(R + r)$

$24 = V_{ext} + V_{ir}$

$24 = 20 + 12,5(r)$ ✓

$r = 0,32\ \Omega$ ✓

| | | |
|---|---|---|
| | **OPTION 2/*OPSIE 2***<br>$V = Ir$ ✓<br>$I_{tot} = (5 + 7,5)$ ✓<br>$(24 - 20)$ ✓ $= 12,5\,r$ ✓<br>$\therefore r = \frac{4}{12,5}$<br>$r = 0,32\ \Omega$ ✓<br><br>**OPTION 3/*OPSIE 3***<br>$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$<br>$\frac{1}{R_{//}} = \frac{1}{4} + \frac{1}{2,67}$ ✓ OR/*OF* $R_{//} = \frac{(4)(2,67)}{4 + 2,67}$<br>$\therefore R_{//} = 1,6\ \Omega$<br>$I_{tot} = \frac{20}{1,6} = 12,5\ A$ ✓<br>$\varepsilon = I(R + r)$ ✓<br>$24 = 12,5(R + r)$<br>$24 = V_{ext} + V_{ir}$<br>$24 = 20 + 12,5(r)$ ✓<br>$r = 0,32\ \Omega$ ✓ | (5) |
| 8.2.4 | **D**evice Z is a voltmeter ✓✓ | (2) |
| 8.2.5 | Device Z should be a voltmeter (or a device with very high resistance) because it has a very high resistance and will draw very little current. ✓ The current through X and Y will remain the same hence the device can operate as rated. ✓ | (2) |
| | | **[24]** |