## Assessment Schedule – 2024

## Physics: Demonstrate understanding of electricity and electromagnetism (91173)

## Evidence Statement

| Q          | Evidence   | Achievement  | Merit   | Excellence                           |
|------------|--|--|---|--------------------------------------|
| ONE<br>(a) | 12 V     0.06 m     12 V       Cell A     Cell B   | • Positive terminal connected to the top plate.  |   |                                      |
| (b)        | $E = \frac{V}{d} = \frac{12}{0.06} = 200 \text{ V m}^{-1}$<br>$E_{p} = Eqd = 200 \times 1.6 \times 10^{-19} = 1.92 \times 10^{-18} \text{ J}$<br>$E_{p} = \frac{1}{2}mv^{2} \Rightarrow 1.92 \times 10^{-18} = \frac{1}{2} \times 9.1 \times 10^{-31}v^{2}$<br>$\Rightarrow v = \sqrt{4.22 \times 10^{12}} = 2.1 \times 10^{6} \text{ m s}^{-1}$ | • $E = 200 \text{ V/m}$<br>OR<br>Uses $E_p = E_k$  | • $E_p = 1.92 \times 10^{-18} \text{ J}$<br>OR<br>Finds v with error.                       | • $2.1 \times 10^6 \text{ m s}^{-1}$ |
| (c)(i)     | e  | <ul> <li>Any one of:</li> <li>curve upwards</li> <li>constant force</li> <li>uniform field</li> <li>parabolic path.</li> </ul> | Curve upwards<br>And one of<br>- parabolic path<br>- accelerates up<br>- constant force up. |                                      |
| (ii)       | The electron experiences an electric force away from the negative plate.<br>The electric force is constant as the electric field is constant. This makes<br>the electron follow a parabolic path.  |  |   |                                      |



| NØ          | N1 | N2         | A3               | A4 | M5    | M6             | E7                    | E8 |
|-------------|----|------------|------------------|----|-------|----------------|-----------------------|----|
| No evidence | NA | la<br>orlm | 2a<br>or 1 a +1m | 3a | 2m+1a | 2m+2a<br>or 3m | 1e+1m+2a<br>or 1e +2m | 2e |

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|------------|---|---|--------------------------|--------------|
| TWO<br>(a) | The voltage is the same across both branches. The branch with B and C has two lamps in series so double the resistance – half the current. Did not accept current is 1.4 A and each lamp gets half of it.   | <ul> <li>Double the resistance.<br/>OR</li> <li>Voltage is the same across<br/>both branches / parallel.</li> </ul> | Full argument.           |              |
| (b)        | Circuit Current = $1.4 + 0.7 = 2.1 \text{ A}$<br>Voltage across the resistor = $IR = 2.1 \times 3.5 = 7.35 \text{ V}$<br>Voltage across parallel branch = $12 - 7.35 = 4.65 \text{ V}$<br>Resistance lamp D = $R = \frac{4.65}{1.4} = 3.3 \Omega$<br>OR Circuit resistance: $R = \frac{V}{I} = \frac{12}{2.1} = 5.71 \Rightarrow$<br>R of parallel = $5.71 - 3.5 = 2.21 \Omega$<br>And $\left(\frac{1}{2x} + \frac{1}{x}\right)^{-1} = 2.21 \text{ so } x = 3.3 \Omega$ or equivalent | • Total current = 2.1 A   | • 2.21 Ω<br>OR<br>4.65 V | • Show 3.3 Ω |

| (c) | • Total R increases.<br>• Less current flows in circuit and through the resistor.<br>• Total V constant.<br>• Voltage across the resistor drops.<br>• Power determines brightness.<br>• Lamp D gets more V and is brighter.<br>OR Power at start in lamp D is:<br>$V = IR = 1.4 \times 3.3 = 4.6 \text{ V}, P = IV = 4.6 \times 1.4 = 6.4 \text{ W}$<br>Power of D after lamp B stops:<br>Total $R = 3.3 + 3.5 = 6.8 \Omega$<br>$I = \frac{12}{6.8} = 1.8 \text{ A}$<br>$V = IR = 1.8 \times 3.3 = 5.9 \text{ V} \Rightarrow P = IV = 5.9 \times 1.8 = 10.6$<br>= 11  W<br>Hence, lamp D is now brighter. | <ul> <li>Total R increases.<br/>OR<br/>Recognition circuit is now<br/>series.<br/>OR<br/>4.6W<br/>OR<br/>R = 6.8 Ω</li> </ul> | <ul> <li>Two correct linked statements.<br/>OR<br/>P = 6.4 W and 5.9 V.<br/>Incorrect statement about R, but linked with argument why Lamp D is dimmer.</li> </ul> | <ul> <li>6.4 W and 11 W.<br/>OR</li> <li>Full answer.</li> </ul> |
|-----|---|---|--|--|
| (d) | In Lamp D:<br>$530 / \text{minute} \Rightarrow \frac{530}{60} = 8.83 \text{ J s}^{-1} = 8.8 \text{ W} = P$<br>$P = I^2 R \Rightarrow I = \sqrt{\frac{P}{R}} = \sqrt{\frac{8.83}{3.3}} = 1.6 \text{ A}$<br>Total current = $1.5 \times 1.6 = 2.5 \text{ A}$  | • Finds 8.8 W.  | • Correct power and 1.5 times<br>any calculated current.<br>OR<br>Finds 1.6 A.   | • 2.5 A  |

| NØ          | N1 | N2      | A3               | A4 | M5    | M6             | E7                    | E8 |
|-------------|----|---------|------------------|----|-------|----------------|-----------------------|----|
| No evidence | NA | la orlm | 2a<br>or 1 a +1m | 3a | 2m+1a | 2m+2a<br>or 3m | 1e+1m+2a<br>or 1e +2m | 2e |

| Q              | Evidence   | Achievement  | Merit   | Excellence                      |
|----------------|--|--|---|---------------------------------|
| THREE<br>(a)   | Right end clearly labelled negative.   | • Right labelled negative.   |   |                                 |
| (b)            | $V = BvL = 31 \times 10^{-6} \times 4.1 \times 9.8 = 1.2(4) \times 10^{-3} V$  | • 1.2(4) × 10 <sup>-3</sup> V  |   |                                 |
| (c)            | The metal sprayer boom contains electrons which have a negative charge.<br>The electrons move with the boom cutting the magnetic field.<br>The electrons experience a force which causes charge separation, and this<br>is the induced voltage.  | • ONE correct point.   | • TWO correct linked points.  | • Full answer.                  |
| (d)(i)<br>(ii) | The direction of the force is clearly indicated with a downwards arrow.<br>$P = IV \Rightarrow 3 = 6I \Rightarrow I = 0.5 \text{ A}$ For one lamp:<br>Force on the wire<br>$= BIL = 31 \times 10^{-6} \times 0.5 \times 9.8 = 1.5 \times 10^{-4} \text{ N}$ OR<br>$P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P} \Rightarrow R = \frac{6^2}{3} = 12 \Omega$ Current in the circuit = $\frac{12}{24} = 0.5 \text{ A}$ | • Finds 0.5 A.<br>OR<br>Arrow downwards showing<br>force direction.<br>OR<br>Finds $R = 12 \Omega$ . | <ul> <li>Correct direction and finds<br/>0.5A or 12 Ω.<br/>OR<br/>Finds 1.5 × 10<sup>-4</sup> N.</li> </ul> | • Correct answer and direction. |

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## Cut Scores

| Not Achieved | Achievement | Achievement with Merit | Achievement with Excellence |  |
|--------------|-------------|------------------------|-----------------------------|--|
| 0 – 07       | 08 – 13     | 14 – 18                | 19 – 24                     |  |