

# **ASSESSMENT SCHEDULE**

**Physics Level 2**

91173 Demonstrate understanding of electricity and electromagnetism

Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

* the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging.
* the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

**Evidence Statement**

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| **Question** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| One(a) | In to the page  | * In to the page
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| (b) | The wire is moving, so all the charged particles in the wire are also moving. Charged particles moving through a magnetic field experience a force. Since some electrons are free to move in the metal wire, the magnetic force pushes the electrons along the wire, creating an electrical current.  | * A moving wire in a magnetic field produces a voltage/current
* Charged particles/electrons moving in a magnetic field feel a force.
 | * The wire is moving, so the charged particles/ electrons in the wire are also moving. Charged particles/ electrons moving through a magnetic field experience a force, which creates a voltage/ current.
 | * The wire is moving, so all the charged particles in the wire are also moving. Charged particles moving through a magnetic field experience a force. Since some electrons are free to move in the metal wire, the magnetic force pushes the electrons along the wire, creating an electrical current.
 |
| (c) | $$V\_{T}=I R\_{T}=23×1.32=30.36 V$$For each section $V=\frac{V\_{T}}{500}=\frac{30.36}{500}=0.06072 V$$V=BvL $ so$$v=\frac{V}{BL}=\frac{0.06072}{0.078×0.3}=2.594=2.6 m s^{-1} $$ | * Correct calculation of $V\_{T}$
* Calculates $v$ using any value for $V$
 | * Correct calculation of $V$ for one section
* Calculates $V\_{T}$ correctly, then uses $V\_{T}$, or another value for $V$ to correctly calculate $v$.
 | * Correct working and answer.
 |
| (d) | When the circuit is connected a current flows along the wires. A current carrying wire in a magnetic field experiences a force due to the moving electrons being pushed by the magnetic field. This force is in the opposite direction to the motion of the wire, so the coil slows down and stops.ORWhen the circuit is connected a current is flowing, therefore electrical energy is being created. This energy comes from the kinetic energy of the coil, so as the electrical energy is created, the kinetic energy decreases so the coil slows down and stops | * A current carrying wire in a magnetic field experiences a force
* Idea of conservation of energy
 | * A current carrying wire in a magnetic field experiences a force in the opposite direction to the motion
* Current is being created, so electrical energy must be being created/used. Therefore the kinetic energy is being transformed into electrical energy so the kinetic energy must decrease.
 | * When the circuit is connected a current flows along the wires. A current carrying wire in a magnetic field experiences a force due to the moving electrons being pushed by the magnetic field. This force is in the opposite direction to the motion of the wire, so the coil slows down and stops.
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| **NØ** | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No evidence | 1 A | 2 A | 3 A | 4 A | 2 M points from two different questions | 3 M points from three different questions | 1 E plus 2 M (from a different question/s to the E point) | 2 E  |

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| **Question** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| Two(a) | $$R\_{T}=R\_{1}+R\_{2}=5.0+1.2=6.2 Ω$$$$I=\frac{V}{R\_{T}}=\frac{15}{6.2}=2.419=2.4 A $$ | * Correct total resistance
* Correct method to find current using incorrect resistance
 | * Correct answer (with some working)
 |  |
| (b) | $$\frac{1}{R\_{P}}=\frac{1}{R\_{1}}+\frac{1}{R\_{2}}=\frac{1}{5}+\frac{1}{7}=0.342857 $$$$R\_{P}=\frac{1}{0.342857}=2.9167 Ω $$$$R\_{T}=R\_{P}+1.2=2.9167+1.2=4.1167 Ω$$$$I\_{T}=\frac{V}{R}=\frac{15}{4.1167}=3.6437 A$$$$P=IV=I^{2}R=3.6437^{2}×1.2=15.932=16 W$$ | * Calculates resistance of parallel section correctly
* Attempts to calculate total resistance, and correctly calculates current using this incorrect total resistance
* Uses $P=IV$+$V=IR$ or $P=I^{2}R$ with incorrect current
 | * Calculates total resistance correctly
* Calculates current correctly (using any total resistance) and then uses this to correctly calculate power.
 | * Correct answer with some working.
 |
| (c) | The water pump will have a smaller resistance than the lights. The water pump is in parallel with the lights so it will have the same voltage as the lights. Since $P=IV$, to give the water pump more power, the pump will have to have more current flowing through it. To get more current flowing through the pump than the lights, the resistance will have to be lower ($V=IR$). | * Water pump has a smaller resistance than the lights
 | * To get a larger power, the current must be larger, and therefore the resistance must be smaller.
 | * The water pump is in parallel with the lights so it has the same voltage. Since $P=IV$, the current through the pump is higher.To get more current flowing through the pump than the lights, the resistance will have to be lower
 |
| (d) | The power used by the cables will increase. Adding additional parallel branches to a circuit will always reduce the overall resistance of the circuit. Therefore, adding the water pump to the circuit will reduce the resistance of the circuit. A lower resistance in the circuit means that the current flowing through the generator will be larger as $V\_{T}=IR\_{T}$. The cables are in series with the generator, so they will also get a larger current. A larger current through the cables means a larger voltage across the cables as $V=IR$, and a much larger power too, as $P=IV$, and both current and voltage have increased.Also accept the alternative but equivalent argument involving $ P=I^{2}R$.*Note that if the answer to (c) above is incorrect then consequential marking should be applied to this question.* | * Power used increases
 | * Resistance of circuit is reduced, so current through cables increases, so power increases.
 | * Resistance of circuit is reduced, so current through cables increases. Voltage across cables also increases as $V=IR$ so power increases as $P=IV$.
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| **NØ** | **N1** | **N2** | **A3** | **A4** | **M5** | **M6** | **E7** | **E8** |
| No evidence | 1 A | 2 A | 3 A | 4 A | 2 M points from two different questions | 3 M points from three different questions | 1 E plus 2 M (from a different question/s to the E point) | 2 E plus 1 M (from a different question to the E points) |

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| **Question** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| Three(a) | - - - - - - - - - - - - | * Field lines are parallel arrows pointing downwards
 | * Field lines are parallel arrows pointing downwards, and uniformly spaced
 |  |
| (b) | $V=Ed=4200×0.005=21 V$  | * Correct working or answer
 |  |  |
| (c) | $$ΔE\_{P}=Eqd=4200×6.8×10^{-8}×0.003=8.568×10^{-7} J$$$$ΔE\_{P}=E\_{K}=\frac{1}{2}mv^{2} $$$$v=\sqrt{\frac{2E\_{K}}{m}}=\sqrt{\frac{2×8.568×10^{-7}}{7.2×10^{-9}}}=15.427=15 m s^{-1}$$Note: could also use $F=Eq$, $F=ma$ and a kinematic equation. | * Correct calculation of $ΔE\_{P}$
* Correct calculation of $v$ using any $E$
 | * Correct answer, (not all working needed)
* Correct working with one mistake e.g. did not convert units, or incorrect rearrangement
 | * Correct working (equations plus substitutions) and answer
 |
| (d) | The electric field is uniform, with the same strength and direction throughout the space between two parallel, oppositely charged plates, so the force on the piece of dust will be the same, since $F=Eq$, so therefore the acceleration will be the same. The final speed will be less if the piece of dust was released at B because the particle will be accelerating over a smaller distance (or because the change in electrical potential energy will be less). | * Final speed will be less
* Acceleration OR force will be the same
 | * Electric field is uniform between two parallel charged plates, so the force /acceleration on the piece of dust will be the same
* Final speed will be less because (force/acceleration acting over smaller distance OR change in potential energy will be less)
 | * Electric field is uniform between two parallel charged plates, so the force and therefore acceleration on the piece of dust will be the same

ANDFinal speed will be less because (force/acceleration acting over smaller distance OR change in potential energy will be less) |
| (e) | The voltage is decreasing, and since $V=Ed$, the electric field will be less, as the distance between the plates remains unchanged. Since $F=Eq$, the force on the charged pieces of dust will decrease.  | * The force on the charged pieces of dust will decrease.
* Since $V=Ed$, the electric field will be less
 | * The voltage is decreasing, and since $V=Ed$, the electric field will be less, as the distance between the plates remains unchanged. So the force will decrease.
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**Judgement Statement**

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|  | **Not Achieved** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| **Score range** | 0 – 6 | 7 – 12 | 13 – 18 | 19 – 24 |