

APOLLO

# Induction

# HL

Physics

First assessment 2025

10 questions | mark schemes

## Mark-scheme answers

Physics HL | Paper 1A | May 2025 TZ1 | Q31 | 1 marks

31.          D  

Physics HL | Paper 1A | May 2025 TZ2 | Q28 | 1 marks

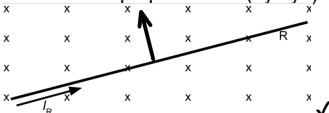
28.          B  

Physics HL | Paper 1A | May 2025 TZ2 | Q29 | 1 marks

29.          A  

Physics HL | Paper 1A | May 2025 TZ2 | Q30 | 1 marks

30.          D

|    |   |    |                                                                                                                                      |                                                                                                                                  |   |
|----|---|----|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---|
| 8. | a | i  | Use of $F = BIL$ <b>OR</b> $F/L = BI$ ✓<br>$= 1.0 \text{ «N m}^{-1}\text{»}$ ✓                                                       |                                                                                                                                  | 2 |
| 8. | a | ii | Arrow drawn perpendicular (by eye) as shown.<br>    | Arrow can be drawn anywhere along the wire.                                                                                      | 1 |
| 8. | b | i  | $\frac{F}{L} = \frac{\mu_0 I_R I_Z}{2\pi r}$<br><b>AND</b><br>$\frac{F}{L} = B_R I_Z$ ✓<br>Combine to give the result ✓              | <b>Must</b> see subscripts on both $I$ and $B$ for full marks. Award [1 max] for correct derivations with incomplete subscripts. | 2 |
| 8. | b | ii | $\text{kg m s}^{-2} \text{ A}^{-2}$ ✓                                                                                                | Allow fractional answers such as:<br>$\frac{\text{kg m}}{\text{s}^2 \text{ A}^2}$                                                | 1 |
| 8. | c | i  | the magnetic field produced by the wire/ $I_R$ is constant. ✓<br>therefore the «magnetic» flux/field through the coil is constant. ✓ |                                                                                                                                  | 2 |

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|    |   |     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |   |
|----|---|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 8. | c | ii  | $\Delta B = \frac{\mu_0}{2\pi} \left( \frac{10-2}{0.1} \right)$ <b>OR</b> $2 \times 10^{-5} - 4 \times 10^{-6} = 1.6 \times 10^{-5} \text{ «T»}$ ✓<br><br>$\Delta \phi = A \Delta B = (\pi)(0.02^2)((2 \times 10^{-5}) - (4 \times 10^{-6})) = 2.5 \times 10^{-8} - 5.03 \times 10^{-9}$<br>$= 2.01 \times 10^{-8} \text{ «Wb»}$ ✓<br><br>$\varepsilon = \frac{n \Delta \phi}{\Delta t} = \frac{(20)(2.01 \times 10^{-8})}{0.5} = 8.0 \times 10^{-7} \text{ «V»}$ ✓ |  | 3 |
| 8. | c | iii | Anticlockwise/counterclockwise/CCW ✓<br><br>magnetic field from the wire is «increasing» into the page <b>OR</b> induced field must be out of the page ✓                                                                                                                                                                                                                                                                                                            |  | 2 |
| 8. | d |     | sine graph with half the period, i.e. one large square/5 small squares (by eye) ✓<br>and twice the amplitude, i.e. four small squares (by eye) ✓                                                                                                                                                                                                                                                                                                                    |  | 2 |

|    |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                        |  |   |
|----|---|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 8. | e | i  | <p>use of <math>qvB = mv^2/r</math></p> <p><b>OR</b></p> $r = \frac{mv}{qB} \quad \checkmark$ $1.6 \times 10^{-19} \times 4.0 \times 10^{-6} = \frac{9.1 \times 10^{-31} \times 9 \times 10^5}{r}$ <p><b>OR</b></p> $r = \frac{(9.1 \times 10^{-31})(9 \times 10^5)}{[(1.6 \times 10^{-19})(4 \times 10^{-6})]} \quad \checkmark$ <p><math>r = 1.28</math> <b>OR</b> <math>1.3 \text{ «m»} \quad \checkmark</math></p> |  | 3 |
| 8. | e | ii | <p>Force/Field decreases as electron moves away from the wire <math>\checkmark</math></p> <p>Hence radius increases. <math>\checkmark</math></p>                                                                                                                                                                                                                                                                       |  | 2 |

## Mark-scheme answers

Physics HL | Paper 1A | Nov 2025 TZ1 | Q30 | 1 marks

30.        A

Physics HL | Paper 1A | Nov 2025 TZ1 | Q31 | 1 marks

31.        C

|    |   |    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |     |
|----|---|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----|
| 8. | a |    | <p>The flux is increasing / there is an induced emf/current ✓</p> <p>The induced current will be counter-clockwise / current is induced in a direction that creates a force that opposes the change ✓</p> <p>A magnetic force to the left / opposing will act on the rod ✓ (bringing it to rest)</p>                                                                                                                                                                     |  | [3] |
| 8. | b | i  | <p>«The current in the circuit will be clockwise so there will be a magnetic force accelerating the rod that then» moves to the right ✓</p>                                                                                                                                                                                                                                                                                                                              |  | [1] |
| 8. | b | ii | <p><b>ALTERNATIVE 1</b></p> <p>Since the induced emf <math>BLv</math> opposing the cell's emf is proportional to speed ✓</p> <p>It will eventually equal the emf of the cell resulting in zero current and hence zero net force on the rod ✓</p> <p><b>ALTERNATIVE 2</b></p> <p>«As in 8a, » there is a counter-clockwise induced current / a force to the left ✓</p> <p>This current / force increases with <math>v</math> until resultant current/ force is zero ✓</p> |  | [2] |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|

## Mark-scheme answers

Physics HL | Paper 1A | Specimen 2025 | Q29 | 1 marks

29.          B

|    |   |                                                                                                                                                                                                                                                                                         |  |   |
|----|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---|
| 5. | a | ring B cuts an increasing number of magnetic field lines<br><br><b>OR</b><br>magnetic field from current in A increases at the position of B ✓                                                                                                                                          |  | 1 |
| 5. | b | counterclockwise ✓                                                                                                                                                                                                                                                                      |  | 1 |
| 5. | c | the rate of change of «magnetic» flux in B increases<br><br><b>OR</b><br>The gradient of the graph is increasing with time ✓<br>Faraday's law states that the induced emf in B will «therefore» increase ✓<br>so induced current will increase because resistance of ring is constant ✓ |  | 3 |
| 5. | d | the current induced in B gives rise to a magnetic field opposing that of A<br><br><b>OR</b><br>there will be a magnetic force opposing the motion ✓<br>work must be done to move B in the opposite direction to this force✓                                                             |  | 2 |

| Question | Answers | Notes | Total |
|----------|---------|-------|-------|
|----------|---------|-------|-------|