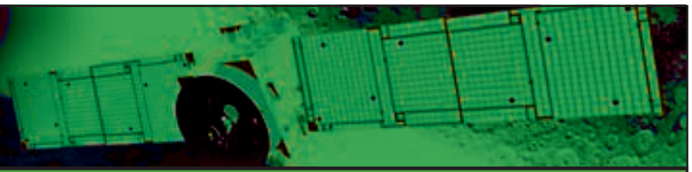
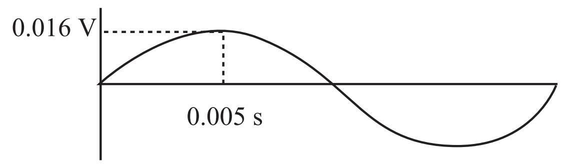


## Electricity and Magnetism: From lodestone to superconducting magnets – Comprehension

| Set | Number | Solution |
|---|---|---|
| Comp3 | 1 | It is called north seeking because it is the pole that always points to north. |
| | 2 | The Earth's magnetic field exerts a force on the magnet causing it to align with the field. |
| | 3 | The field lines around a wire are in the form of concentric circles, which do not appear to originate from a particular point. The field around a wire are a result of the magnetic field caused by moving charges, there is no beginning point for these charges so there is no pole. |
| | 4 | Field from a permanent magnet ~0.01 T, Earth's field ~$5 \times 10^{-5}$ T. $0.01/5\times10^{-5} = 200$ |
| | 5 | 30 T / $5\times10^{-5}$ = 600,000 – so strongest electromagnet produces a field 600,000 times stronger than the Earth's. |
| | 6a | For all of Q6, assume a length of 10 cm is in the field. Use F = IlB<br>$F = 1A \times 0.1\ m \times 5\times10^{-5}\ T = 5\times10^{-6}\ N$ |
| | 6b | $F = 1\ A \times 0.1\ m \times 0.01\ T = 0.001\ N$ |
| | 6c | $F = 1\ A \times 0.1\ m \times 30\ T = 3\ N$ |
| | 6d | $F = 1\ A \times 0.1\ m \times 10^{11}\ T = 1\times 10^{10}\ N$ |
| | 7a | For all of Q7 use $\phi = B\ A$, where $A = 0.1\ m \times 0.1\ m = 0.01\ m^2$<br>$\phi = 5\times10^{-5}\ T \times 0.01\ m^2 = 5 \times 10^{-7}\ Wb$ |
| | 7b | $\phi = 0.01\ T \times 0.01\ m^2 = 1 \times 10^{-4}\ Wb$ |
| | 7c | $\phi = 30\ T \times 0.01\ m^2 = 0.3\ Wb$ |
| | 7d | $\phi = 1 \times 10^{11}\ T \times 0.01\ m^2 = 1 \times 10^{9}\ Wb$ |
| | 8a | For all of Q8 use $Average\ emf = -N\frac{(B.A-0)}{t}$ where in these examples, $A = 0.01\ m^2$ and t = 0.005 s.<br>$Average\ emf = -100\frac{(5 \times 10^{-7} Wb - 0)}{0.005\ s} = -0.01\ V$ |
| | 8b | $Average\ emf = -100\frac{(1 \times 10^{-4} Wb - 0)}{0.005\ s} = -2\ V$ |
| | 8c | $Average\ emf = -100\frac{(0.3\ Wb - 0)}{0.005\ s} = -6000\ V$ |
| | 8d | $Average\ emf = -100\frac{(1 \times 10^{9} Wb - 0)}{0.005\ s} = -2 \times 10^{13}\ V$ |
| | 9 | They have been calculated using the time for ¼ of a revolution – the time required for the flux cut by the coil to change from a maximum value to zero. |
| | 10 | All graphs have similar shapes - a sine curve with an average value given by the answers to Question 8 a) - d).<br>For example, for a coil rotated in the Earth's field:<br><br>In each case, maximum voltage E= NBAW<br>Where:<br>N = 100<br>B - changes with field<br>$A = 0.01\ m^2$<br>$W = 314\ rad\ s^{-1}$ |