

MODULE PHY5 – THEORY REVISION

Gravitational fields

1. Define what is meant by 'gravitational field strength'
2. Calculate the gravitational field strength of on the surface of Mars if a weight of 200N on Earth only experiences a force of 50N on Mars.
3. State Newton's law of gravitation.
4. Using Newton's law of gravitation derive the relationship: $g = GM/r^2$
5. Use the above relationship to calculate the mass of the Earth. ($G = 6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}$; Earth diameter = 13 Mm; $g = 9.81 \text{ m/s}^2$)
6. In the same way calculate the mass of the Sun given that the Earth takes one year to complete an orbit of radius $150 \times 10^6 \text{ km}$.
7. Give an example of a gravitational equipotential surface.

Electric fields

8. Example how a plastic rod can become positively charged when it is rubbed using a cloth.
9. What is a coulombmeter used for?
10. How would you demonstrate that an electric current is a flow of electric charge?
11. Calculate the force exerted by an electric field of 5 kNC^{-1} on a charge of 6 nC.
12. Calculate the force exerted by a point charge of $+2.0 \mu\text{C}$ on another point charge of $-4.0 \mu\text{C}$ if the charges are 3.0 mm apart in a vacuum. (Take μ_0 to be $8.85 \times 10^{-12} \text{ F/m}$.)
13. Define what is meant by: (a) electric field strength. (b) electric potential (c) equipotentials
14. Where would you expect to find: (a) a uniform electric field (b) an inverse square law electric field.
15. Calculate the speed increase given to electrons (charge = $-1.6 \times 10^{-19} \text{ C}$; mass = $9.1 \times 10^{-31} \text{ kg}$) when they are accelerated by a potential difference of 4 kV.

Capacitance

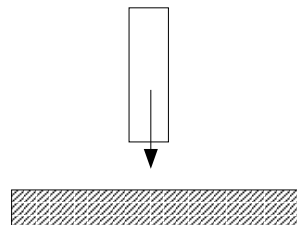
16. Define 'capacitance'
17. Calculate the charge stored by a capacitance of $70 \mu\text{F}$ when connected to a p.d. of 3 V.
18. What is the of the significance of the area under an I-t graph?
19. Derive the capacitance formula: $C = C1 + C2 + C3$.
20. Three capacitors of values $5 \mu\text{F}$; $20 \mu\text{F}$; $20 \mu\text{F}$ are connected together to give a combined value of $15 \mu\text{F}$. Draw a diagram showing how they are connected together.
21. Calculate the energy stored by the capacitor in Q 17.

Magnetic fields

22. (a) Sketch the magnetic field pattern between two facing south magnetic poles. Mark on the neutral point. (b) How would the position of the neutral point change if one of the magnets became stronger?
23. What, in terms of base S.I. units is the unit of magnetic flux density?
24. Calculate the magnetic flux density required to exert a force enough to lift a wire against gravity if the wire has a 10 cm length, mass 2 g and a current of 2.0 A. State the direction of the magnetic field and current.
25. Calculate the magnetic flux density produced by the wire in Q 23 (which has insignificant cross-sectional area) at a distance of 2 cm. ($\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$)
26. Describe how a Hall Probe can be used to investigate the field produced by a solenoid.

Electromagnetic induction

27. (a) What is meant by 'magnetic flux linkage'? (b) Calculate the magnetic flux linkage with a 60 turn circular coil of diameter 15 cm when it is inserted into a uniform magnetic field of flux density 500 mT.
28. (a) State Faraday's & Lenz's laws of electromagnetic induction. (b) Describe how you would experimentally demonstrate Lenz's law.
29. A bar magnet is dropped from about 10 cm above a flat coil of wire. The bar magnet falls through the coil as shown in the diagram below. Sketch a graph showing how the emf induced in the coil varies with time up to a point when the magnet is well below the coil



30. If at one point the emf in the coil above is 2.0 V calculate the rate of magnetic flux change if the coil has 500 turns.
31. Explain why a transformer will not work with a steady DC supply.
32. A step-down transformer consists of two coils, one of which has three times the turns of the other. Calculate the primary voltage if the secondary voltage is 50 V.