Sets (s): All students

YEAR 13

SUBJECT Physics LP2

Knowledge Focus: Magnetic fields, orbits and the wider universe, electromagnetic induction

Ysgol Uwchradd Prestatyn High School

This half term : Skills, Knowledge and Understanding to be developed:	**Key Terms to be learned this half term:**
We will cover the concept of magnetic fields and investigate the forces on current carrying conductors and moving charges in magnetic fields. We will also cover the concept of electromagnetic induction and how the invention of devices such as the a.c. generator has benefitted society. Finally, we will study Kepler's laws of planetary motion and circular orbits of satellites, the evidence for dark matter and how Hubble's constant can be used to determine the age of the universe.	Faraday's law, Magnetic flux, Hall voltage, Magnetic field (or magnetic flux density), Flux linkage, Lenz's law, Kepler's laws, elliptical orbits, dark matter, Doppler effect, Hubble's law, Higgs boson.

Dr Clayton: Nuclear decay (One bullet point per lesson) Learning Objectives etc:

- how to determine the direction of the force on a current carrying conductor in a magnetic field
- how to calculate the magnetic field, B, by considering the force on a current carrying conductor in a magnetic field i.e. understand how to use F=BIlsinθ
- how to use F=Bqvsinθ for a moving charge in a magnetic field
- the processes involved in the production of a Hall voltage and understand that $V_H \propto B$ for constant I
- the shapes of the magnetic fields due to a current in a long straight wire and a long solenoid
- the equations $B = \frac{\mu_0 I}{2\pi a}$ and $B = \mu_0 n I$ for the field strengths due to a long straight wire and in a long solenoid
- the fact that adding an iron core increases the field strength in a solenoid
- the idea that current carrying conductors exert a force on each other and to predict the directions of the forces
- quantitatively, how ion beams of charged particles, are deflected in uniform electric and magnetic fields
- the motion of charged particles in magnetic and electric fields in linear accelerators, cyclotrons and synchrotrons

Specified practical work :

Investigation of the force on a current in a magnetic field

Investigation of magnetic flux density using a Hall probe

Objective assessments:

Completion of past paper questions.

Homework:

Past exam questions.

Extension:

IsaacPhysics problems

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Dr Athanasopoulos: Orbits and the wider universe (continued) **Learning Objectives etc:** **Week 1** • how to use data on orbital motion, such as period or orbital speed, to calculate the mass of the central object • how the orbital speeds of objects in spiral galaxies implies the existence of dark matter • how the recently discovered Higgs boson may be related to dark matter **Week 2** • how to determine the position of the centre of mass of two spherically symmetric objects, given their masses and separation, and calculate their mutual orbital period in the case of circular orbits • the Doppler relationship in the form $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$ **Week 3** • how to determine a star's radial velocity (i.e. the component of its velocity along the line joining it and an observer on the Earth) from data about the Doppler shift of spectral lines • the use of data on the variation of the radial velocities of the bodies in a double system (for example, a star and orbiting exo-planet) and their orbital period to determine the masses of the bodies for the case of a circular orbit edge on as viewed from the Earth **Week 4** • how the Hubble constant (H_0) relates galactic radial velocity (v) to distance(D) and it is defined by $v=H_0D$ • why $\frac{1}{H_0}$ approximates the age of the universe • how the equation $\rho_c = \frac{3H_0^2}{8\pi G}$ for the critical density of a 'flat' universe can be derived very simply using conservation of energy **Specified practical work**: None	APP Questions on orbits	**Objective assessments:** Completion of past paper questions.	**Homework:** Past exam questions. Extension: IsaacPhysics problems
Dr Athanasopoulos: Electromagnetic induction **Learning Objectives etc:** **Week 5-6** • the definition of magnetic flux as $\varphi = AB\cos\theta$ and flux linkage = $N\varphi$ • the laws of Faraday and Lenz • how to apply the laws of Faraday and Lenz (i.e. emf = - rate of change of flux linkage) **Week 7** • the idea that an emf is induced in a linear conductor moving at right angles to a uniform magnetic field • qualitatively, how the instantaneous emf induced in a coil rotating at right angles to a magnetic field is related to the position of the coil, flux density, coil area and angular velocity	SA Test on all topics covered this term	**Objective assessments:** Completion of past paper questions.	**Homework:** Past exam questions. Extension: IsaacPhysics problems

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- the equations $B = \frac{\mu_0 I}{2\pi a}$ and $B = \mu_0 n I$ for the field

Specified practical work :

None

Terms for sections 4.4-4.5: Faraday's law, Magnetic flux, Hall voltage, Magnetic field (or magnetic flux density), Flux linkage, Lenz's law

4.4 (b)		This is a vector quantity. Its direction is that in which the North pole of a freely-pivoted magnet points. Its magnitude is defined by $B = \frac{F}{Il}$ in which F is the force on a length l of wire carrying a current I, placed perpendicular to the direction of the field. **Unit: T [= N A^{-1} m^{-1}]**
4.4 (d)		When a magnetic field, $\boldsymbol{B}$, is applied to conductor carrying a current I, at right angles to the field direction, a so-called *Hall voltage* appears across the specimen, at right angles to the B and I directions.
4.5 (a)		If a single-turn coil of wire encloses an area A, and a magnetic field B makes an angle θ with the normal to the plane of the coil, the ______ _____ through the coil is given by $\Phi = AB\cos\theta$. **Unit: Wb = T m^2**
		If the above coil consists of N turns, the ____ ________is given by $N\Phi$. **Unit: Wb** or **Wb turn.**
4.5 (b)		When the flux linking an electrical circuit is changing, an emf is induced in the circuit of magnitude equal to the rate of change of flux linkage. $E = -\frac{\Delta(N\Phi)}{\Delta t}$ [Note: the – sign is from Lenz's law, see below]
		The direction of any current resulting from an induced emf is such as to oppose the change in flux linkage that is causing the current.

Terms for section 4.3: Galactic radial velocity, Dark matter, Radial velocity of a star [in the context of Doppler shift], Kepler's law 1, Kepler's law 2, Kepler's law 3

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Section	Item	Definition
4.3 (a)		Each planet moves in an ellipse with the Sun at one focus.
		The line joining a planet to the centre of the Sun sweeps out equal areas in equal times.
		T^2, the square of the period of the planet's motion, is proportional to r^3, in which r is the semi-major axis of its ellipse. [For orbits which are nearly circular, r may be taken as the mean distance of the planet from the Sun.]
4.3 (e)		Matter which we can't see, or detect by any sort of radiation, but whose existence we infer from its gravitational effects.
4.3 (i)		This is the component of a star's velocity along the line joining it and an observer on the Earth.
4.3 (k)		This is the mean component of a galaxy's velocity along the line joining it and an observer on Earth.