Equation Sheet for Exam 3

MAGNETISM

Lorentz Force $\boxed{\mathbf{F} = q\,\mathbf{v} \times \mathbf{B}}$

The direction of the cross product is determined from the right-hand rule.

Circular motion for a particle in a magnetic field

$$\boxed{ma = F \quad \text{implies} \quad \frac{mv^2}{r} = qvB}$$

Magnetic force on a segment of wire

$\boxed{\mathbf{F} = L\mathbf{I} \times \mathbf{B}}$

(L = length; $\mathbf{I}$ = current)

ELECTROMAGNETISM

Ampère's Law. The magnetic field due to a long straight wire is

$$\boxed{B(r) = \frac{\mu_0 I}{2\pi r}\,\hat{\varphi} \quad \text{where } \mu_0 = 4\pi \times 10^{-7} \text{ Tm/A}}$$

The direction (φ) is determined by the right-hand rule.

The **magnetic flux** through an open surface with area A is Φ = B A cos θ. If the magnetic field is perpendicular to the surface then $\theta = 0$ and Φ = B A.

Faraday's Law. $\boxed{emf = -\frac{\Delta\Phi}{\Delta t}}$

Ideal transformer equations. Alternating current is supplied to the primary coil;

$$\boxed{\frac{V_1}{N_1} = \frac{V_2}{N_2} \quad and \quad I_1 V_1 = I_2 V_2}$$

(V = emf, I = current, N = the number of turns of wire I in the coil)

OTHER EQUATIONS

Newton's second law

$$\boxed{F = ma \quad \text{where} \quad a = \frac{\Delta v}{\Delta t}}$$

Constant acceleration

$$\boxed{v = v_0 + at \quad \text{and} \quad x = x_0 + v_0\, t + \tfrac{1}{2}at^2}$$

$$\boxed{\begin{array}{l} \text{Kinetic energy} \quad K = \tfrac{1}{2}mv^2 \\ \text{Gravitational potential energy} \quad U = mgh \\ \text{Spring potential energy} \quad U = \tfrac{1}{2}kx^2 \\ \text{Universal Gravitation} \quad F = Gm_1m_2 / r^2 \\ \text{Kepler's 3rd Law} \quad T^2 = a^3 \end{array}}$$

$$\boxed{\begin{array}{l} \text{Coulomb force} \quad F = Kq_1q_2 / r^2 \\ \text{Electric field} \quad \mathbf{E} = \mathbf{F} / q \\ \text{Electric current} \quad I = \Delta Q / \Delta t \\ \text{Ohm's law} \quad I = V / R \\ \text{Joule's law} \quad P = IV = I^2 R \end{array}}$$

CONSTANTS

$$\boxed{\begin{array}{l} g = 9.81\,\text{m/s}^2 \\ G = 6.67 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2 \\ K = 8.99 \times 10^{9}\ \text{Nm}^2/\text{C}^2 \\ e = 1.602 \times 10^{-16}\ \text{C} \\ \text{proton mass} = 1.67\ \times\ 10^{-27}\ \text{kg} \end{array}}$$