Exam 2 Equation Sheet

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1 RC Circuits

$$\tau = RC$$

Charging:

$$V = V_0 e^{-t/\tau}$$

Discharging:

$$V = V_0(1 - e^{-t/\tau})$$

2 Magnetism

2.1 Force Laws

For a charged particle:

$$F = qvB\sin\theta$$

For a current:

$$F = ILB\sin\theta$$

Force between two wires carrying current:

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

Like directed currents attract, opposite directed currents repel.

Ampere's Law:

$$B = \frac{\mu_0 I}{2\pi r}$$

2.2 Induction

Magnetic Flux:

$$\Phi_B = BA\cos\theta$$

Faraday's Law:

$$\varepsilon = -N\frac{\Delta\Phi_B}{\Delta t}$$

Motional EMF:

$$\varepsilon = v\ell B$$

Lenz's Law: The current induced in the loop will be in the direction such that *it* creates a magnetic field opposing the field that created the current.

3 Optics

3.1 Geometric

Refraction:

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

Critical angle:

$$\sin\theta_C = \frac{n_2}{n_1}, n_2 \leq n_1$$

3.2 Wave

Young's Double Slit: Constructive

$$d\sin\theta = m\lambda$$

Destructive

$$d\sin\theta = (m + \frac{1}{2})\lambda$$

$$m = 0, \pm 1, \pm 2, \ldots$$

$$\tan\theta = \frac{y}{L}$$

Thin Films: Constructive for two materials, destructive for three

$$2nt = (m + 1/2)\lambda$$

Destructive for two materials, constructive for three

$$2nt = m\lambda$$

Single slit dark spots:

$$a\sin\theta = m\lambda$$

Diffraction grating bright spots:

$$d\sin\theta = m\lambda$$

3.3 Angular Resolution

Slit opening:

$$\theta_{min} = \frac{\lambda}{a}$$

Circular opening:

$$\theta_{min} = 1.22\frac{\lambda}{a}$$

4 Constants

$$\mu_0 = 4\pi \times 10^{-7}\ Tm/A$$