

THERMODYNAMICS

Describe what is meant by a system

A system is a particular part of the universe.

THERMODYNAMICS

Describe what is meant by the surroundings of a system

The part of the universe which is outside (i.e. surrounding) a system.

THERMODYNAMICS

Describe the boundary of a system

The boundary (or wall) of a system is the thing which separates it from its surroundings.

ELECTROMAGNETISM

Explain Gauss' law for an electric field in words.

The total electric flux through any closed surface is proportional to its enclosed charge.

THERMODYNAMICS

Describe a closed system

A closed system is a system where no matter is exchanged, only energy.

THERMODYNAMICS

Describe how adiabatic walls.

Adiabatic walls prevent thermal interaction (i.e. heat exchange)

THERMODYNAMICS

What type of walls does a thermally isolated system have?

A thermally isolated system has adiabatic walls.

ELECTROMAGNETISM

What is Maxwell's II and what does it express?

$$\nabla \cdot \mathbf{B} = 0$$

There are no magnetic monopoles.

STATISTICAL MECHANICS

What is the equilibrium entropy of an isolated system of N constituents with energy E?

Equilibrium entropy of an isolated system is expressed as follows:

$$S(N, E) = k \ln \Omega(N, E, \alpha^*)$$

DIFFRACTION PHYSICS

Define the electric displacement of a dielectric.

$$\underline{D} = \epsilon_0 \underline{E} + \underline{P}$$

Where **E** is the electric field, **P** is the polarisation

DIFFRACTION PHYSICS

What are the refractive indices of MgF<sub>2</sub> and Al<sub>2</sub>O<sub>3</sub> ?

Table 1: A table of refractive indices

Material	Symbol	n
Magnesium Fluoride	MgF <sub>2</sub>	1.38
Aluminium Oxide	Al <sub>2</sub> O <sub>3</sub>	1.62

QUANTUM MECHANICS

What is the wave function for a free particle?

The quantum mechanical interpretation of a free particle is expressed as follows

$$\psi(\mathbf{r}, t) = C e^{\frac{i}{\hbar}(\mathbf{p} \cdot \mathbf{r} - \epsilon t)}$$

## ELECTROMAGNETISM

Express the force between two charges.

The force between two charges,  $q_1$  and  $q_2$  that are separated by a distance  $r$  should be expressed as follows:

$$\mathbf{F} = \frac{q_1 q_2}{4\pi\epsilon_0 r^2} \mathbf{r}$$

Where  $\epsilon_0$  is the permittivity of free space.

## ELECTROMAGNETISM

What is the total charge contained within a volume?

$$Q_v = \int_V \rho(\underline{r}) dV$$

Where  $\rho$  is the sum of the charges.

## DIFFRACTION PHYSICS

What happens when we apply a field to an electrically insulating material such as glass?

The charges will separate causing a polarisation in the material.