THERMODYNAMICS Describe what is meant by a system	Describe what is meant by a system in thermodynamics. A system is a particular part of the universe.
THERMODYNAMICS Describe what is meant by the surroundings of a system	Describe what is meant by the surroundings of a system in thermodynamics 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.

Describe a closed system

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

Describe how adiabatic walls.

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

What type of walls does a thermally isolated system have?

A thermally isolated system has adiabatic walls.

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:

$$S(N, E) = \mathrm{k}\ln\Omega(\mathrm{N, E}, \alpha*)$$

Diffraction physics

Define the electric displacement of a dielectric.

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

Where $\mathbf{E}$ is the electric field, $\mathbf{P}$ is the polarisation

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Diffraction Physics

What are the refractive indices of MgF_2 and Al_2O_3 ?

Table 1: A table of refractive indices

Material	Symbol	n
Magnesium Fluoride	MgF_2	1.38
Aluminium Oxide	Al_2O_3	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

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

Express the force between two charges.

The force between two charges, q_1 and q_2 that a 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 ϵ_0 is the permittivity of free space.

What is the total charge contained within a volume?

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

Where ρ is the sum of the charges.

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.

What is Maxwells I?

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$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$$

ELECTROMAGNETISM	What is Maxwells II?
What is Maxwells II?	$$\nabla \cdot \mathbf{B} = 0$$

ELECTROMAGNETISM	What is Maxwells III?
What is Maxwells III?	$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

ELECTROMAGNETISM	What is Maxwells IV?
What is Maxwells IV?	$$\nabla \times \mathbf{B} = \mu_0 \left(\mathbf{J} + \epsilon_0 \frac{\partial \mathbf{E}}{\partial t} \right)$$

DIFFRACTION PHYSICS	What is the expression for intensity reflectance at normal incidence?
What is the expression for intensity reflectance	$$r = \frac{n_1 - n_2}{n_1 + n_2}$$

What is the creation operator
for a harmonic oscillator of
mass, m and frequency ω

What is the creation operator
for a harmonic oscillator of
mass, m and frequency ω

$$\hat{a} = \frac{m\omega}{2\hbar}\hat{x} + i\sqrt{\frac{1}{2m\omega\hbar}}\hat{p}$$

What is the annihilation
operator for a harmonic
oscillator of mass, m and
frequency ω

What is the creation operator
for a harmonic oscillator of
mass, m and frequency ω

$$\hat{a} = \frac{m\omega}{2\hbar}\hat{x} - i\sqrt{\frac{1}{2m\omega\hbar}}\hat{p}$$

Express the Hamiltonian

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$$i\hbar\frac{\partial\psi}{\partial t} = \hat{H}\psi$$

What is Classius statement of
the second law?

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the second law?

It is impossible to construct a device that,
operating in a cycle, produces no effect other
than the transfer of heat from a colder to a hotter
body.

THERMODYNAMICS

What is the Kelvin-Planck
statement of the second law?

What is Kelvin-Planck
statement of the second law?

It is impossible to construct a device that,
operating in a cycle, produces no effect other
than the extraction of heat from a single body at
a uniform temperature and performance of an
equivalent amount of work.

THERMODYNAMICS

What are the main consequences
of the first law of
thermodynamics?

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of the first law of
thermodynamics?

1. Heat is a form of energy

2. Energy is conserved in thermal processes