+2 PHYSICS

IMPORTANT LAWS & RULES

(Expect any two for public exam)

1. Coulomb's law

Coulomb's law states that the electrostatic force is directly proportional to the product of the magnitude of the two point charges and is inversely proportional to the square of the distance between the two point charges.

2. Gauss's law

Gauss's law states that if a charge Q is enclosed by an arbitrary closed surface, then the total electric flux ϕ_E through the closed surface is

$$\Phi_E = \oint \vec{E} \cdot d\vec{A} = \frac{Q_{encl}}{\epsilon_0}$$

3. Ohm'S law:

When a potential difference V is applied across the wire, a net electric field is created in the wire which constitutes the current in the wire. Therefore, the macroscopic form of ohm's law can be stated as **V=IR.**

4. Kirchhoff's first rule (Current rule or Junction rule)

It states that the algebraic sum of the currents at any junction of a circuit is zero.

5. Kirchhoff's Second rule (Voltage rule or Loop rule)

It states that in a closed circuit the algebraic sum of the products of the current and resistance of each part of the circuit is equal to the total emf included in the circuit.

6. Joule's law

If a current I flows through a conductor kept across a potential difference V for a time t, the work done or the electric potential energy spent is

W=VIt

In the absence of any other external effect, this energy is spent in heating the conductor. The amount of heat (H) produced is

$H = VIt$

7. Joule's law of heating

$H = I^2 Rt$

It states that the heat developed in an electrical circuit due to the flow of current varies directly as

(i) the square of the current

(ii) the resistance of the circuit and

(iii) the time of flow.

8. Seebeck effect

Seebeck discovered that in a closed circuit consisting of two dissimilar metals, when the junctions are maintained at different temperatures an emf (potential difference) is developed. The current that flows due to the emf developed is called thermoelectric current. The two dissimilar metals connected to form two junctions is known as thermocouple.

9. Peltier effect

Peltier discovered that when an electric current is passed through a circuit of a thermocouple, heat is evolved at one junction and absorbed at the other junction. This is known as Peltier effect.

10. Thomson effect

Thomson showed that if two points in a conductor are at different temperatures, the density of electrons at these points will differ and as a result the potential difference is created between these points. Thomson effect is also reversible.

11. Curie's law

When temperature is increased, thermal vibration will upset the alignment of magnetic dipole moments. Therefore, the magnetic susceptibility decreases with increase in temperature. In many cases, the susceptibility of the materials is

$$\chi_m \propto \frac{1}{T} \text{ or } \chi_m = \frac{C}{T}$$

12. Curie-Weiss law

As temperature increases, the ferromagnetism decreases due to the increased thermal agitation of the atomic dipoles. At a particular temperature, ferromagnetic material becomes paramagnetic. This temperature is known as Curie temperature TC. The susceptibility of the material above the Curie temperature is given by

$$\chi_m = \frac{C}{T - T_C}$$

13. Right hand thumb rule

Assume that we hold the current carrying conductor in our right hand such that the thumb points in the direction of current flow, then the fingers encircling the conductor point in the direction of the magnetic field lines produced.

14. Maxwell's right hand cork screw rule

This rule can also be used to find the direction of the magnetic field around the current-carrying conductor. If we rotate a right-handed screw using a screw driver, then the direction of current is same as the direction in which screw advances and the direction of rotation of the screw gives the direction of the magnetic field.

15. Biot- Savart law

Biot and Savart experimentally observed that the magnitude of magnetic field $d\vec{B}$ at a point P (Figure 3.30) at a distance r from the small elemental length taken on a conductor carrying current varies

(i) directly as the strength of the current I

(ii) directly as the magnitude of the length element $d\vec{l}$

(iii) directly as the sine of the angle θ between $d\vec{l}$ and $\hat{r}$.

(iv) inversely as the square of the distance r between the point P and length element $d\vec{l}$.

This is expressed as

$$dB \propto \frac{Idl}{r^2}\sin\theta$$

$$dB = k\frac{I\,dl}{r^2}\sin\theta$$

16. Tangent law

When a magnetic needle or magnet is freely suspended in two mutually perpendicular uniform magnetic fields, it will come to rest in the direction of the resultant of the two fields.

17. Ampère's circuital law

The line integral of magnetic field over a closed loop is μ_0 times net current enclosed by the loop.

$$\oint_C \vec{B}.\vec{dl} = \mu_\circ I_{enclosed}$$

18. Definition of tesla

The strength of the magnetic field is one tesla if a unit charge moving normal to the magnetic field with unit velocity experiences unit force.

19. Fleming's left hand rule

Stretch out forefinger, the middle finger and the thumb of the left hand such that they are in three mutually perpendicular directions. If the forefinger points in the direction of magnetic field, the middle finger in the direction of the electric current, then thumb will point in the direction of the force experienced by the conductor

20. Definition of ampere

One ampere is defined asthat constant current which when passed through each of the two infinitely long parallel straight conductors kept side by side parallelly at a distance of one metre apart in air or vacuum causes each conductor to experience a force of 2×10^{-7} newton per metre length of conductor.

21. Faraday's Law of Electromagnetic Induction

Whenever the magnetic flux linked with a closed coil changes, an emf (electromotive force) is induced and hence an electric current flows in the circuit. This current is called an induced current and the emf giving rise to such current is called an induced emf. This phenomenon is known as electromagnetic induction.

22. Faraday's first law and second law :

First law

Whenever magnetic flux linked with a closed circuit changes, an emf is induced in the circuit which lasts in the circuit as long as the magnetic flux is changing.

Second law

The magnitude of induced emf in a closed circuit is equal to the time rate of change of magnetic flux linked with the circuit.

23. Lenz's law

Lenz's law states that the direction of the induced current is such that it always opposes the cause responsible for its production.

24. Fleming's right hand rule or generator rule.

The thumb, index finger and middle finger of right hand are stretched out in mutually perpendicular directions (as shown in Figure 4.8). If the index finger points the direction of the magnetic field and the thumb indicates the direction of motion of the conductor, then the middle finger will indicate the direction of the induced current. Fleming's right hand rule is also known as generator rule.

25. Maxwell's law of induction

Maxwell's law of induction which ρexplains that the magnetic field B is induced along a closed loop by the changing electric flux Φ_E in the region encircled by that loop. This symmetry between electric and magnetic fields explains the existence of electromagnetic waves such as radio waves, gamma rays, infrared rays etc.

26. Fraunhofer lines.

When the spectrum obtained from the Sun is examined, it consists of large number of dark lines (line absorption spectrum). These dark lines in the solar spectrum are known as Fraunhofer lines.

27. Rayleigh's scattering

If the scattering of light is by atoms and molecules which have size a very much less than that of the wave length λ of light, ($a<<\lambda$) then the scattering is called Rayleigh's scattering.

28. Rayleigh's scattering law

The intensity of light scattered in Rayleigh's scattering is inversely proportional to fourth power of wavelength.

$$I \propto \frac{1}{\lambda^4}$$

29. Huygens' Principle

According to Huygens principle, each point on the wavefront behaves as the source of secondary wavelets spreading out in all directions with the speed of the wave. These are called as secondary wavelets. The envelope to all these wavelets gives the position and shape of the new wavefront at a later time.

30. Rayleigh's criterion for diffraction

According to Rayleigh's criterion, the two points on an image are said to be just resolved when the central maximum of one diffraction pattern coincides with the first minimum of the other and vice-versa.

31. Malus' law

Malus discovered that when a beam of plane polarised light of intensity I_0 is incident on an analyser, the intensity of light I transmitted from the analyser varies directly as the square of the cosine of the angle θ between the transmission axes of polariser and analyser.

$$I = I_0 \cos^2 \theta$$

32. Brewster's Law

Brewster's law states that the tangent of the polarising angle for a transparent medium is equal to its refractive index.

33. Snell's law

The ratio of sine of angle of incident i in the first medium to the sine of angle of refraction r in the second medium is equal to the ratio of refractive index n_2 of the second medium to the refractive index n_1 of the first medium.

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$

34. Fresnel's distance

Fresnel's distance is the distance upto which the ray optics is obeyed and beyond which the ray optics is not obeyed; but, the wave optics becomes significant.

35. de Broglie hypothesis

According to de Broglie hypothesis, all material particles like electrons, protons, neutrons in motion are associated with waves. These waves are called de Broglie waves or matter waves.

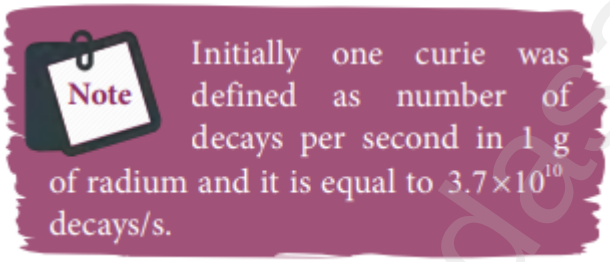
36. Define Becquerel

The SI unit of activity R is Becquerel and one Becquerel (Bq) is equal to one decay per second.

37. Define Curie

1 Curie = 1 Ci = 3.7×10^{10} decays per second

1 Ci = 3.7×10^{10} Bq



38. Barkhausen conditions for sustained oscillations

The following conditions called Barkhausen conditions should be satisfied for sustained oscillations in the oscillator.

- There should be positive feedback.
- The loop phase shift must be 0^0 or integral multiples of 2π.
- The loop gain must be unity. That is, $|A\beta| = 1$.

Here, A is the voltage gain of the amplifier, β is the feedback ratio (the fraction of the output that is fed back to the input).

39. De Morgan's First Theorem

The first theorem states that the complement of the sum of two logical inputs is equal to the product of its complements.

$$\overline{A+B}=\overline{A}\cdot\overline{B}.$$

40. De Morgan's Second Theorem

The second theorem states that the complement of the product of two inputs is equal to the sum of its complements.

$$\overline{A.B}=\overline{A}+\overline{B}.$$