CIE A Levels Physics (9702)

Grade Booster – A2 – FAQs

Frequently Asked Questions

Circular Motion

1. **Define the radian.**
    - The radian is a unit of measurement for an angle, where one radian is defined as the angle subtended at the center of a circle by an arc that is equal in length to the radius of the circle.
    - The Radian is the unit for the ratio of the circumference to the radius of the circle.
2. **Why one complete revolution is equivalent to an angular displacement of 2π radians.**
   One complete revolution of a circle is equivalent to an angular displacement of 2π radians because the circumference of a circle is 2π times the radius. Therefore, one complete revolution corresponds to an angle of 2π radians.
3. **Explain what is meant by angular speed.**
   Angular speed refers to the rate of change of the angle of an object moving in circular motion, measured in radians per second.

Gravitational Fields

1. **Explain what is meant by gravitational field.**
   A gravitational field is a region in space where a mass experiences a force due to the presence of another mass. It is a vector field, meaning that it has both a magnitude (the strength of the field) and a direction (towards the source of the field).
2. **Explain why the normal reaction on a mass will have different values at the equator and at the poles.**

$$mr\omega^2 = \frac{GMm}{R^2} - N$$

$$N = \frac{GMm}{R^2} - mr\omega^2$$

The value of r in expression $mr\omega^2$ decreases from equator to poles and becomes zero at poles so the mass at poles is not in circular motion due to zero centripetal force. Hence normal reaction is greater at poles than equator.

3. **Define gravitational field strength.**
   Gravitational field strength is defined as the force per unit mass experienced by a small test mass placed in a gravitational field. Its SI unit is Newtons per kilogram (N/kg).

4. **Define gravitational potential at a point.**
   Gravitational potential at a point is defined as the amount of work done per unit mass in bringing a small test mass from infinity to that point in the gravitational field. Its SI unit is joules per kilogram (J/kg).
5. **State what is meant by a field of force.**
   A field of force is a region in space where a force exists and is exerted on objects that are present in that region.
6. **Gravitational fields and electric fields are two examples of fields of force. State one similarity and one difference between these two fields of force.**
   - Similarity: They both follow the inverse-square law, meaning that the strength of the field decreases with the square of the distance from the source.
   - Difference: Gravitational fields are always attractive, while electric fields can be either attractive or repulsive.
7. **State Newton's law of gravitation.**
   Newton's law of gravitation states that every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.
8. **Explain what is meant by Geostationary orbit.**
   A geostationary orbit is an orbit around the Earth at a fixed altitude and in the same direction as the Earth's rotation, such that the orbiting object remains fixed above a particular location on the Earth's surface.

Thermal Physics: Temperature, Thermodynamics, Ideal Gases

1. **Explain what is meant by Brownian motion.**
   Brownian motion is the random, erratic movement of microscopic particles suspended in a fluid, caused by collisions with molecules of the surrounding fluid.

2. **Suggest and explain why Brownian motion provides evidence for movement of molecules as is assumed in the kinetic theory of gases.**
   The abrupt changes of paths of smoke particles are due to the uneven bombardment of invisible air particles from different directions and at different times. This indicates the random motion of molecules of gases.
3. **State what is meant by a mole.**
   A mole is a unit of measurement in chemistry that represents a certain number of particles. Specifically, one mole of a substance contains Avogadro's constant (6.02×10^{23}) particles.
4. **One assumption of the kinetic theory of gases is that the gas molecules behave as if they are hard elastic identical spheres. State two other assumptions of kinetic theory of gases.**
   - The gas molecules are in constant random motion, and their velocity is proportional to the temperature of the gas.
   - The gas molecules do not interact with each other except during collisions, which are perfectly elastic.
5. **State what is meant by internal energy of a substance.**
   The internal energy of a substance is the sum of the kinetic and potential energies of its particles. It represents the total energy of the particles that make up a substance, including their random motion and interactions with each other.
6.
   a. **Describe apparatus that demonstrates Brownian motion. Include a diagram.**

   b. **Describe the observations made using the apparatus.**
   Random motion of smoke particles shows the random motion of gas or air particles continuous motion of smoke particles provide evidence for the perpetual motion of gas or air particles
   c. **State and explain two conclusions about the properties of molecules of a gas that follow from observations in that experiment.**
      - Random motion of smoke particles shows the random motion of gas or air particles.
      - Continuous motion of smoke particles provided evidence for the perpetual motion of gas or air particles.

7. **State what is meant by an ideal gas.**

   An ideal gas is a hypothetical gas that follows the kinetic theory of gases assumptions perfectly. It is composed of identical particles (usually atoms or molecules) that are in constant random motion and do not interact with each other except during perfectly elastic collisions.

8. **State what is meant by Avogadro's constant.**

   Avogadro's constant is the number of particles in one mole of a substance. It is equal to 6.02×10^{23} particles per mole.

9. **In a graph of any thermometric property versus the temperature which feature would indicate the sensitivity of the thermometer?**

   In a graph of any thermometric property versus the temperature, the sensitivity of the thermometer would be indicated by the slope of the graph. A steeper slope would indicate a more sensitive thermometer.

10. **State two reasons why the temperature of a body is not a measure of the quantity of thermal energy in the body.**

    - The temperature of a body is not a measure of the quantity of thermal energy in the body because the specific heat capacity of the material making up the body can vary, meaning different materials can have the same temperature but different amounts of thermal energy.
    - Additionally, the thermal energy of a body depends not only on its temperature but also on its mass.

11. **The mercury in a glass thermometer is used to measure the boiling point of a liquid. Suggest why the measured value of the boiling point will not be affected by the thermal energy absorbed by the thermometer bulb.**

    The heat absorbed by mercury in bulb can vary only the rate of boiling but temperature of the boiling point remains constant.

12. **Explain what is meant by the statement that two bodies are in thermal equilibrium.**

    When two bodies are in thermal equilibrium, it means that they are at the same temperature and there is no net flow of heat between them.

13. **Suggest suitable types of thermometers, one in each case to measure:**

    a. **the temperature of the flame of a Bunsen burner**

       Thermocouple

    b. **the change in temperature of a small crystal when it is exposed to a pulse of ultrasound energy.**

       Thermistor

14. **State what is meant by specific latent heat.**
    Specific latent heat is the amount of energy required per unit mass to change the state of a substance without changing its temperature.
15. **Define specific latent heat of fusion.**
    Specific latent heat of fusion is the amount of energy required per unit mass to change a substance from a solid to a liquid at its melting point.
16. **Define specific latent heat of vaporization.**
    Specific latent heat of vaporization is the amount of energy required per unit mass to change a substance from a liquid to a gas at its boiling point.
17. **Explain in terms of internal energy why the specific latent heat of vaporization of a substance is greater than its specific latent heat fusion.**
    Specific latent heat of vaporization is greater because of overcoming greater intermolecular potential energies compared to specific latent heat of fusion. The kinetic energy is remains unchanged during the respective change of state.
18. **Compare the pattern of movement and the speed of molecules in water and water vapor at same temperature.**
    In water, the molecules are closely packed together and have a relatively low speed of movement compared to water vapor at the same temperature, where the molecules are widely spaced and have a higher speed of movement due to the higher kinetic energy.
19. **Use the kinetic theory of matter to explain why melting requires energy but there is no change in temperature.**
    Melting requires energy because the bonds between the molecules in a solid must be broken in order for the substance to become a liquid. However, during the melting process, the energy is absorbed by the substance as potential energy, rather than increasing its temperature. This is because the energy is being used to overcome the forces of attraction between the molecules, rather than increasing their kinetic energy.
20. **Write down an equation to represent the first law of thermodynamics in terms of heating Q of a system, the work W done on the system, and increase in the internal energy U of the system.**

$$\Delta U = \Delta Q + \Delta W$$

21. **State two processes for which thermal energy is required during boiling.**
    - The breaking of intermolecular bonds between liquid molecules, which requires energy to overcome the attractive forces between them.
    - Terminology is also needed to do work against atmospheric pressure during expansion

22. **State one similarity between the processes of evaporation and boiling.**
    One similarity between the processes of evaporation and boiling is that both involve the conversion of a liquid into a gas phase. In both processes, energy is required to overcome the intermolecular forces holding the liquid molecules together.
23. **State two differences between the processes of evaporation and boiling.**
    - Boiling occurs at a fixed temperature, while evaporation can occur at any temperature. Boiling occurs when the vapor pressure of a liquid equals the external pressure, while evaporation can occur at any temperature if the liquid is exposed to air.
    - Boiling involves the formation of bubbles in the liquid, while evaporation does not. In boiling, the bubbles form and rise through the liquid, while in evaporation, the liquid gradually turns into a gas phase without forming bubbles.
24. **State the basic assumption of the kinetic theory of gases that leads to the conclusion that the potential energy between the atoms of an ideal gas is 0.**
    The basic assumption of the kinetic theory of gases that leads to the conclusion that the potential energy between the atoms of an ideal gas is 0 is that gas molecules are assumed to be point masses with no size and no intermolecular forces acting between them except during collisions. This assumption leads to the conclusion that the potential energy between the molecules is negligible, and thus the internal energy of the gas depends solely on the kinetic energy of the molecules.
25. **Explain why an increase in internal energy of an ideal gas is directly related to a rise in temperature of the gas.**
    An increase in internal energy of an ideal gas is directly related to a rise in temperature of the gas because the internal energy of an ideal gas is directly proportional to the kinetic energy of its molecules. As the temperature of the gas increases, the average kinetic energy of the gas molecules also increases, leading to an increase in the internal energy of the gas. This increase in internal energy can manifest in various ways, such as an increase in temperature, pressure, or volume.

Oscillations

1. **Explain what is meant by damping.**
   Damping is a phenomenon where the amplitude of oscillations of a system gradually decreases over time due to the dissipation of energy into the surrounding environment. This can be caused by various factors such as friction, air resistance, or electrical resistance in a circuit.

2. **State what is meant by simple harmonic motion.**

   The periodic motion in which acceleration is directly proportional to displacement from the main position and is always directed towards the mean position.

3. **Distinguish between free oscillations and forced oscillations.**
   - Free oscillations refer to the type of oscillations where a system is set into motion with an initial displacement or velocity and then allowed to oscillate freely without any external forces acting on it. The frequency and amplitude of these oscillations are determined solely by the properties of the system and the initial conditions.
   - Forced oscillations, on the other hand, occur when an external force is applied to a system that is already in motion. The frequency of these oscillations is equal to the frequency of the applied force, and the amplitude of the oscillations depends on the magnitude and frequency of the applied force as well as the properties of the system. A common example of forced oscillations is the motion of a child on a swing, where the child applies a periodic force by kicking their legs.

Electric Fields

1. **State coulomb's law**

   Coulomb's law states that the electrostatic force of attraction or repulsion between two point charges is directly proportional to the product of their magnitudes and inversely proportional to the square of the distance between them.

$$F = k\frac{Q_1 Q_2}{r^2}$$

   where F is the force between the charges, Q_1 and Q_2 are the magnitudes of the charges, r is the distance between them, and k is Coulomb's constant.

2. **Define electric potential at a point.**
   - The electric potential at a point is the electric potential energy per unit charge at that point.
   - It is defined as the amount of work done in bringing a unit positive test charge from infinity to that point in the electric field, without any acceleration,

$$V = \frac{W}{Q}$$

   where V is the electric potential, W is the work done, and Q is the test charge.

3. **Define electric field strength.**
    - Electric field strength is defined as the force experienced by a unit positive test charge placed in the electric field.

$$E = \frac{F}{Q}$$

where E is the electric field strength, F is the force experienced by the test charge, and Q is the magnitude of the test charge.

Capacitance

1. **Define the capacitance of a parallel plate capacitor.**
The capacitance of a parallel plate capacitor is defined as the ratio of the magnitude of the charge on one plate of the capacitor to the potential difference between the two plates of the capacitor. It is denoted by C and its unit is Farad (F).
2. **Explain whether increasing the separation of plates increases or decreases the energy stored in a capacitor.**
Increasing the separation of plates of a capacitor decreases the energy stored in it. This is because the capacitance of a capacitor is inversely proportional to the distance between the plates. So, as the distance between the plates increases, the capacitance decreases, and hence the energy stored in it decreases.
3. **State three functions of capacitors in electrical circuits.**
    - <u>Energy storage</u>: Capacitors are used to store electrical energy and discharge it when required. They are commonly used in electronic devices like cameras, flashlights, and power supply units.
    - <u>Filtering:</u> Capacitors are used to remove unwanted signals and noise from electronic circuits by acting as filters.
    - <u>Timing</u>: Capacitors can be used to create timing circuits and oscillators, as they charge and discharge at a constant rate, allowing precise timing intervals to be established.
    - <u>Smoothing</u>: To smooth out rectifier outputs.

Alternating Current

1. **State what is meant by rectification.**
Rectification is the process of converting an alternating current (AC) into a direct current (DC).

2. **State, by reference to the power dissipated in a resistor, what is meant by the root-mean-square (r.m.s) value of an alternating voltage.**
   The root-mean-square (r.m.s) value of an alternating voltage is a measure of the effective voltage of an AC signal. It is equal to the DC voltage that would dissipate the same amount of power in a resistor as the AC voltage.
3. **By reference to the heating effect, explain what is meant by the root-mean-square (r.m.s) value of an alternating current.**
   The root-mean-square (r.m.s) value of an alternating current is a measure of the effective current of an AC signal. It is equal to the DC current that would produce the same heating effect in a resistor as the AC current.

Magnetic Fields and Electromagnetic Induction

1. **Explain what is meant by a magnetic field.**
   A magnetic field is a region in space where a magnetic force can be observed. It is created by a magnet or a moving charged particle and can exert a force on other magnets, magnetic materials, or moving charged particles.
2. **Define magnetic flux.**
   Magnetic flux is the amount of magnetic field passing through a surface or a loop of wire, defined as the product of the magnetic field strength and the area of the surface or the loop.
3. **Define Magnetic flux density.**
   Magnetic flux density is the amount of magnetic field passing through a unit area, defined as the magnetic flux per unit area.
4. **Define Tesla.**
   Magnetic flux density is equal to 1 Tesla if force of 1 Newton is experienced by 1 meter length of a conductor carrying one ampere current when placed perpendicular to field lines.
5. **State Faraday's law of electromagnetic induction.**
   Faraday's law of electromagnetic induction states that a changing magnetic field in a coil of wire induces an electromotive force (EMF) in the coil, which results in the generation of an electric current in the wire.
6. **State Lenz' law of electromagnetic induction.**
   Lenz' law of electromagnetic induction states that the direction of the induced EMF is such that it opposes the change in magnetic flux that produced it.

7. **State two situations in which a charged particle in a magnetic field does not experience a force.**
    - If the charged particle moves parallel to the magnetic field, i.e if the angle between the velocity of the charged particle and the magnetic field is zero or 180 degrees, then magnetic force on the particle is zero.
    - If the charged particle is at rest in the magnetic field. When a charged particle is at rest, its velocity is zero, and there is no magnetic force acting on it.

$$F = Bqv\sin\theta$$

8. **Define eddy currents.**
    Eddy currents are electrical currents induced in a conductor when the conductor is exposed to a changing magnetic field, as a result of the electromagnetic induction. Eddy currents can cause heating and energy losses in the conductor.

Quantum Physics

1. **State what is meant by a photon.**
    - A photon is a fundamental particle of electromagnetic radiation with zero mass and zero electric charge, which carries energy and momentum.
    - Discrete packet or quantum of energy of electromagnetic radiation.
2. **State what is meant by the photoelectric effect.**
    The photoelectric effect is the phenomenon in which electrons are emitted from a metal surface when it is exposed to light of a certain frequency or higher.
3. **State what is meant by the work function energy of a metal.**
    The work function energy of a metal is the minimum energy required to remove an electron from the metal surface and is specific to each metal.
4. **Explain how the emission spectrum of hydrogen provides evidence for the existence of discrete energy levels for the electron in a hydrogen atom.**
    The emission spectrum of hydrogen consists of discrete lines of different wavelengths, indicating that the energy of the electron in a hydrogen atom is quantized and can only take on specific values corresponding to the energy differences between the levels.
5. **State one piece of experimental evidence for**
    a. **The particulate nature of electromagnetic radiation**
        Photoelectric effect
    b. **The wave nature of matter**
        Electron diffraction

6. **State the name given to the wavelength of the moving particle.**
   The de Broglie wavelength.
7. **State the name of the frequency below which no photoelectric current is produced. Explain how the photon model of electromagnetic radiation accounts for this phenomenon.**
   The threshold frequency. The photon model explains that a photon of sufficient energy is required to overcome the work function energy of the metal and eject an electron, so below the threshold frequency, no electrons are emitted because the photons do not have enough energy.
8. **Explain why the maximum kinetic energy of the electron is independent of the intensity of the incident radiation.**
   The maximum kinetic energy of the electron is determined solely by the energy of the incident photon and the work function energy of the metal and is independent of the intensity of the radiation. This is because increasing the intensity of the radiation only increases the number of photons, not their energy, so the maximum kinetic energy of each electron is not affected.
9. **State three pieces of observations associated with photoelectric emission that provide evidence for the particulate nature of electromagnetic radiation.**
   - The existence of threshold frequency.
   - The maximum kinetic energy of the photoelectrons is determined by the frequency of the incident radiation.
   - Instantaneous emission of photoelectrons.
   - The photoelectric current is directly proportional to the intensity of the illumination.

Nuclear Physics

1. **State what is meant by radioactive decay.**
   Radioactive decay is the spontaneous process by which unstable atomic nuclei emit particles or electromagnetic radiation in order to become more stable.
2. **Radioactive decay is both a random and a spontaneous process. State what is meant by:**
   a. **Random**
      Random means that the decay of a radioactive nucleus cannot be predicted or influenced by any external factors. Each decay event is entirely independent and occurs with a certain probability over a given time interval.
   b. **Spontaneous**
      Spontaneous decay means that the rate of decay is not affected by external physical factors such as temperature, pressure, humidity, electric or magnetic fields.

3. **State what is meant by nuclear binding energy.**
   Nuclear binding energy is the energy required to completely separate the nucleons (protons and neutrons) in the nucleus of an atom. It is the energy released when nucleons are brought together to form a nucleus.
4. **Define radioactive decay constant.**
   Radioactive decay constant is the probability of decay per unit time of a radioactive substance. It is a characteristic property of a particular radioactive isotope and is used to determine the rate of decay of the substance.
5. **Explain what is meant by a nuclear fission reaction.**
   Nuclear fission is a process in which the nucleus of an atom is split into two or more smaller nuclei, along with the release of a large amount of energy in the form of kinetic energy of the fission products and gamma radiation. This process is typically initiated by bombarding a heavy nucleus with a neutron, which causes it to become unstable and split into two lighter nuclei.

6. **Explain what is meant by a nuclear fusion reaction.**
   Nuclear fusion is a process in which two or more atomic nuclei combine to form a heavier nucleus, along with the release of a large amount of energy in the form of kinetic energy of the fusion products and gamma radiation. This process typically requires very high temperatures and pressures in order to overcome the strong electrostatic repulsion between positively charged nuclei.
7. **State what is meant by the mass defect of a nucleus.**
   The mass defect of a nucleus is the difference between the mass of the individual nucleons (protons and neutrons) and the mass of the nucleus as a whole. It is caused by the conversion of a small amount of mass into energy during the formation of the nucleus, according to Einstein's equation $E = mc^2$. The greater the mass defect of a nucleus, the greater the binding energy per nucleon and the more stable the nucleus.

Medical Physics

1. **Define specific acoustic impedance.**
   Specific acoustic impedance is a measure of the resistance offered by a material to the propagation of an ultrasound wave.
2. **State what is meant by attenuation of an ultrasound wave.**
   Attenuation of an ultrasound wave refers to the decrease in the intensity of the wave as it propagates through a medium due to absorption, reflection, and scattering.

3. **Explain the principles of the generation of ultrasound waves for use in medical diagnosis.**
    - Ultrasound waves are generated through the use of a quartz crystal.
    - When an alternating potential difference (p.d.) is applied across the crystal, it vibrates at its natural frequency. If the frequency of the applied p.d. matches the natural frequency of the crystal, resonance occurs, and ultrasound waves are generated. The natural frequency of the crystal is in the ultrasound range of frequencies, typically above 20 kHz.
    - These waves are then directed into the body and the echoes that are produced as they bounce off internal structures are detected to create an image.
4. **Explain the main principles behind the use of ultrasound to obtain diagnostic information about internal body structures.**
    - Ultrasound is used to obtain diagnostic information about internal body structures.
    - A pulse of ultrasound is generated by a quartz crystal, and transmitted into the body. The pulse is then reflected at the boundaries between different tissues, and some of the reflected waves return to the surface of the body where they are detected.
    - To minimise reflection at the skin surface, a gel is used to couple the ultrasound wave between the skin and the transducer.
    - The ultrasound can be detected by a quartz crystal as well. The time delay between the generation and detection of the ultrasound wave gives information about the depth of the boundary, while the intensity of the reflected wave gives information about the nature of the boundary.
    - By analyzing the reflected waves, an image of the internal body structure can be constructed, allowing for diagnosis of medical conditions.
5. **Explain the principles of the detection of ultrasound waves for medical diagnosis.**
    - Pulses of ultrasound are sent towards the body tissue being examined and are reflected from tissue boundaries.
    - The reflected ultrasound waves hit a quartz crystal which generates an alternating electric potential difference (emf) across the crystal.
    - The emf generated by the crystal is amplified and processed by the software, which generates an image or other diagnostic information based on the received signals.
6. **Explain how X-rays are produced for use in medical diagnosis.**

    X-rays are produced when electrons are accelerated by an applied potential difference and collide with a target material. The kinetic energy of the electrons is converted into electromagnetic radiation, including X-rays, when they decelerate.

7. **Outline the principles of computed tomography (CT) scanning.**
    - CT scanning uses X-rays to create images of internal body structures.
    - The body is scanned in sections, typically about 1-10 mm thick, to create detailed images of specific areas of interest.
    - The X-ray source and detector rotate around the body to obtain images from many different angles, which allows for the creation of a three-dimensional image.
    - Each section is imaged in two dimensions, typically using a digital detector array, which generates a large number of pixels that represent the intensity of X-rays passing through the body at each location.
    - The scanning process is repeated for many sections of the body, creating a series of 2D images that can be combined to create a 3D representation of the internal structures.
    - Images from many different sections are combined using specialized software to create a 3D image that can be viewed and manipulated by a radiologist.
8. **State, for an X-ray image, what is meant by:**
    a. **Sharpness**

    Sharpness in an X-ray image refers to the clarity of the edges and details in the image. It depends on factors such as the resolution of the X-ray detector, the focal spot size of the X-ray tube, and the distance between the patient and the detector.

    b. **Contrast**

    Contrast in an X-ray image refers to the difference in brightness or density between different areas of the image. It is controlled by adjusting the X-ray beam energy, exposure time, and the use of contrast agents to enhance visibility of certain structures or tissues.
9. **State how, in a modern X-ray tube, the intensity of the X-ray beam and its hardness are controlled.**

    In a modern X-ray tube, the intensity of the X-ray beam and its hardness are controlled by adjusting the tube voltage and current. Increasing the voltage increases the energy of the X-rays produced, while increasing the current increases the number of X-rays produced. Filters and collimators are also used to shape and attenuate the X-ray beam.
10. **Explain how positrons come to be present in the body during PET scanning.**

    Positrons come to be present in the body during PET scanning as a result of the decay of a radioactive tracer that is introduced into the body. This tracer is usually a small amount of a radioactive substance that is chemically bound to a biologically active molecule, such as glucose, and is injected into the patient's bloodstream.

11. **Explain how positrons cause the emission of gamma radiation from the body during PET scanning.**
    When a positron encounters an electron in the body, they annihilate each other and release two gamma rays that travel in opposite directions. These gamma rays are detected by the PET scanner and used to create an image of the distribution of the tracer in the body. The emission of gamma radiation is a result of the conversion of mass into energy during the annihilation process.

Astrology and Cosmology

1. **State what is meant a standard candle.**
   A standard candle is an astronomical object that has a known luminosity due to a characteristic quality possessed by that class of object. Examples of standard candles are Cepheid variable stars and Type Ia supernovae.
2. **State what is meant luminosity of a star.**
   Luminosity is the total amount of energy emitted by a star per unit time. It is measured in watts (W).
3. **State Wien's displacement law.**
   Wien's displacement law states that the hotter the body, the shorter the wavelength corresponding to the emission peak in the radiation curve.
   $$\lambda_{max} \propto \frac{1}{T}$$
4. **Explain how the surface temperature of a distant star may be determined from the wavelength spectrum of the light from the star.**
   The surface temperature of a distant star may be determined from the wavelength spectrum of the light from the star using Wien's displacement law which states that the hotter the body, the shorter the wavelength corresponding to the emission peak in the radiation curve.
5. **State what is meant by redshift.**
   Redshift is a phenomenon where light from an object moving away from an observer appears shifted towards longer wavelengths (towards red) compared to its original wavelength.
6. **Explain how cosmologists can determine that light from a distant star has undergone redshift.**
   Cosmologists can determine that light from a distant star has undergone redshift by analyzing its spectrum and comparing it with that of a stationary source.
7. **State Stefan-Boltzmann's Law.**

The Stefan-Boltzmann law states that the total energy radiated per unit surface area of a black body across all wavelengths per unit time is directly proportional to the fourth power of the black body's thermodynamic temperature T.

8. **State Hubble's Law.**

   Hubble's Law states that galaxies are moving away from us with velocities proportional to their distance from us.

9. **How do cosmologists estimate the distances to far away stars or galaxies?**

   The distance of a star can be determined by measuring its parallax, which is the small angular displacement it shows when observed from two points on opposite sides of Earth's orbit. The parallax angle, the radius of Earth's orbit, and some trigonometry can be used to calculate the star distance. This method works for nearby stars, up to about 400 light-years from Earth. For more distant stars,other methods based on estimating their intrinsic brightness are sometimes used.