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Q. No **NO 1:** → **Speed limit :** Speed limit would be 50ms^{-1}. It would be impossible for material objects to attain such speed.

→ **Relativistic factors:** Effects of relativity would be much more noticeable at lower speeds compared to our reality Time Dilation, length contraction and increased mass would become much more visible

→ **Communication Delay:** With slower speed communication would experience significant delays.

→ **Technology and Internet:** Internet latency would be much higher, browsing and streaming content would be much lower

→ **Daily Perception :** Human perception of events would not change directly as our sensory senses arent tied to speed of light

→ **CONCLUSION:** Altering speed would have far more consequences.

Q. No. **NO 2** Stars that appear **bluish** have higher surface temprature

→ **EXPLANATION:**

Wein's displacement law states "As temprature of black body increases, the peak wavelength emitted by it becomes shorter."

Mathematically: $\lambda_{max} T = T_{constant}$ $T = \frac{constant}{\lambda_{max}}$

For stars of red colour: $\lambda = 700nm$, $T = 4140K$

For stars of blue colour: $\lambda = 475nm$, $T = 6100K$

Thus, $\lambda_{blue} < \lambda_{red}$ and $T_{blue} > T_{red}$.

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→ **CONCLUSION:**

Therefore, looking at the stars, we can determined which one will have higher surface temprature by judging its colour.

Cutting Line

متعلقہ سوال کا جواب صرف مختص کردہ جگہ پر دیا جائے۔

Q. No. 3 No, not necessarily.

→ **REASON:** Specific details of photoelectric effect can vary depending upon properties of material.

(i) Work Function: Different metals have different work functions and this influences the ease with which electrons can be emitted. **Mathematically:** $\Phi = hf_0 = hc/\lambda_0$

(ii) Threshold Frequency: Photoelectric effect occurs when frequency of light is greater than a certain threshold frequency. This frequency is related to the work function of a material.

(iii) Surface Properties and Electron Binding Energies: Surface properties and electron binding energies affect photoelectric effect and these varry from material to material.

→ **CONCLUSION:** If threshold frequency, work function of one metal are less, then electrons are emitted for same conditions for another metal otherwise no.

Q. No. 4 No, a light bulb at 2500K doesn't produce as white light as Sun at 6000K

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→ **EXPLANATION:**

Stefan Boltzman law states "Radiant heat energy emitted from a unit area of black body in one second is directly proportional to fourth power of its absolute temperature."

Mathematically: $E = \sigma T^4$

Light bulb: Being relatively cooler, radiates less total energy and has spectrum that may be skewed towards longer wavelengths resulting in warmer, yellowish appearance.

Sun: Sun radiates higher energy and emits a spectrum that includes a significant amount of visible light resulting in white light appearance.

Q. No. 5: Beam of **red light** contains greater number of photons.

→**EXPLANATION:**

Wavelength: wavelength of red light is greater than wavelength of blue light $\lambda_{red} > \lambda_{blue}$

Energy: Energy of both is same.

Mathematically:

$E = hf = h\frac{c}{\lambda}$ for 'n' photons,

$E_n = n\frac{hc}{\lambda}$ here 'h' and 'c' are constant and E_n is same thus. $E_n \propto n^1/\lambda$

Photons: Thus to balance equation, photons of blue light are less than that of red beam

$n_{red} > n_{blue}$

→**CONCLUSION:** It's a matter of wavelength as energies are same thus photons vary to keep energy same.

Q. No. 6 If rest mass of photon isn't taken as zero, apparent mass becomes infinite as photon travels with the speed of light.

→**Mathematically:**

$m = m^o/\sqrt{1-\frac{v^2}{c^2}}$ $(c=v)$

$m = m^o/\sqrt{1-\frac{c^2}{c^2}}$

$m = m^o/\sqrt{1-1}$

$m = m^o/\sqrt{0}$

$m = \frac{m^o}{0}$ where $1/0 = \infty$

thus $m = \infty$

alternate method:

$m = m^o/\sqrt{1-\frac{v^2}{c^2}}$ (putting $c=v$)

$m = m^o/\sqrt{1-\frac{c^2}{c^2}}$

$m^o = m\sqrt{1-\frac{c^2}{c^2}}$ (by cross multiplication)

$m^o = m\sqrt{1-1}$

$m^o = m(0)$

$m^o = 0$ Therefore rest mass of photon is zero.

→**CONCLUSION:** In order to escape from the mathematical controversy $(m=\infty)$ we take rest mass of photon to be zero

Q. No.7: →**REASON:** Due to larger wavelength of visible light, compton's effect can not be observed.

→**EXPLANATION:**

Compton Scattering is more pronounced at shorter wavelengths and higher energies like X-rays

Small change in wavelength for visible light: visible light photons have lower energy as compared to xrays and have low frequency as well. Thus smaller change in wavelength is observed upon collision with electrons which isn't noticeable as compared to interactions with high energy photons

→**CONCLUSION:** Compton scattering is universal, its effects become more prominent in high energy region of electromagnetic spectrum.

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Q. No.8: Speed of electron will be greater.

→**EXPLANATION:**

According to De Broglie's Hypothesis: wavelength of wave associated with moving particle is $\lambda = h/mv$ or $v = \frac{h}{m\lambda}$ since λ is same thus

Mathematically: $\uparrow v \propto \frac{1}{m\downarrow}$ (i)

Mass of proton: 1836 times mass of electron

Thus $m_e < m_p$ (ii)

Result: comparing (i) and (ii) we conclude that $v_e > v_p$

→**CONCLUSION:** Since momenta are equal, and mass of proton is 1836 times greater than the mass of electron, velocity of electron must be much greater than velocity of proton to maintain equality of momentum.

Q. No:9 **Electron**, having much smaller mass, has greater de-Broglie wavelength.

→Mathematical calculations:

We know that $eV = \frac{1}{2}mv^2$ or $2eV = mv^2$ (multiplying b.s by m) $2meV = m^2v^2$ (taking underroot)

$$\sqrt{2eVm} = mv \quad (i)$$

From deBroglie's equation; $\lambda = \frac{h}{mv}$ (ii)

putting value of mv from(ii) in(i) we get

$\frac{h}{\sqrt{2eVm}} = \lambda$ where V, e are same for both and his constant.

Thus $\lambda \propto \frac{1}{\sqrt{m}}$ (iii)

→ CONCLUSION: as $m_e < m_p$ therefore by equation (iii) we can conclude that $\lambda_e > \lambda_p$.

Q. No:10 **1. Wavelength Variation:** UV radiation has shorter wavelengths as compared to visible light allowing it to penetrate skin more deeply and damage DNA

2. Cellular Impact: UV radiation is absorbed by skin cells, leading to the production of free radicals that harm cellular structures while visible light generally has less energy and doesn't cause same level of damage.

3. Immune Supression: UV radiation can suppress the immune system in the skin making it less effective in protecting against infections a concern not shared with visible light.

4. Collagen Breakdown: UV radiation causes collagen causing premature aging and wrinkles.