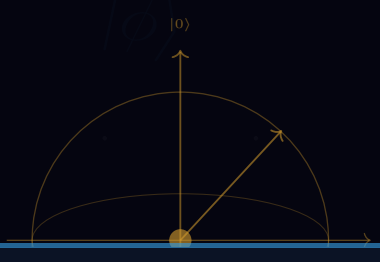
Global Quantum Mechanics Challenge

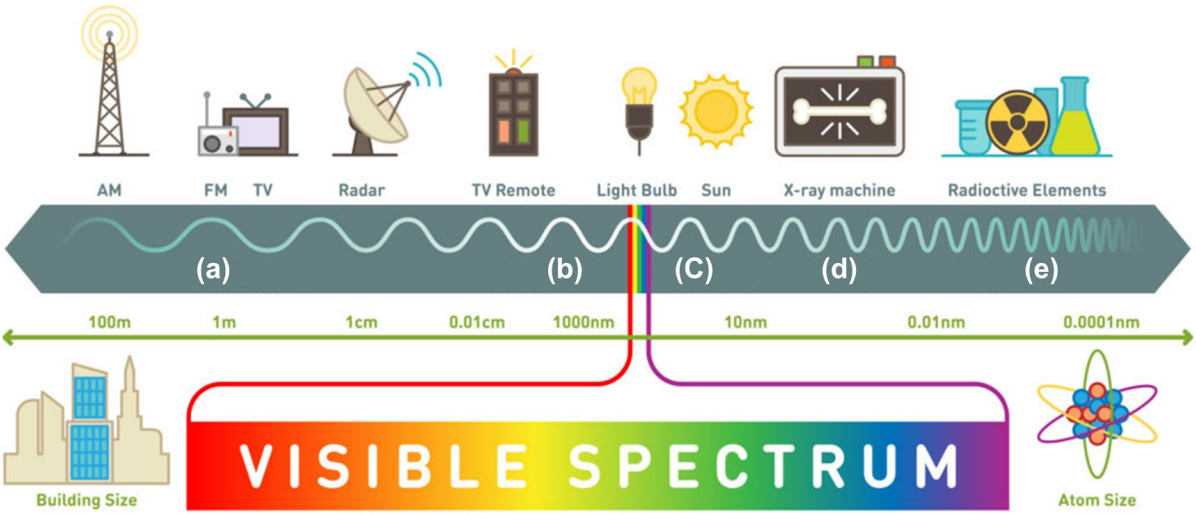
Qualification Round

Edition of 2026



Problem A: What is Light? (5 Points)

Light connects us to the universe. In its electromagnetic form, light travels on wavelengths stretching from atomic scales all the way up to the size of a modern building. While our eyes can only detect a narrow visible spectrum, other regions such as infrared, gamma rays, radio waves, ultraviolet, and X-rays surround us and serve many practical purposes in everyday life. Using the image below, identify these five regions (a)–(e) arranged in order of increasing energy of light:



Problem B: Light, Photon, and Energy (5 Points)

In 1900, Max Planck discovered that light doesn't just travel as continuous waves; it also comes in tiny, distinct packets of energy called photons. A photon is a particle with no mass or charge that travels through empty space at 3×10^8 m/s, carrying an amount of energy that is entirely determined by its frequency.

A red light has a wavelength of 650 nm while a green light has a wavelength of 532 nm. What would be the energy of every single photon carrying green and red light in the electron Volt (eV) unit?

Problem C: Photoelectric Effect

If a photon with sufficient energy hits a metal surface, electrons from the surface are emitted. This phenomenon is known as the photoelectric effect, and the electrons emitted are known as photoelectrons. According to Albert Einstein's Nobel Prize-winning work on explaining the photoelectric effect, the energy of the incoming photon is used to provide a minimum energy for an electron to leave the metal, known as the work function, and the maximum photoelectron kinetic energy.

(a) What would be the minimum frequency of a photon to make an electron leave from a metal surface with a work function of 2.3 eV?

(b) If a photon with a wavelength of 2500 Å hits the same metal surface, what would be the maximum kinetic energy of the emitted photoelectron?

Problem D: Uncertainty Principle

Arriving from both the particle nature of waves or the wave nature of particles, there is always an uncertainty in various conjugate pairs of physical properties, such as energy–time, position–momentum, etc.

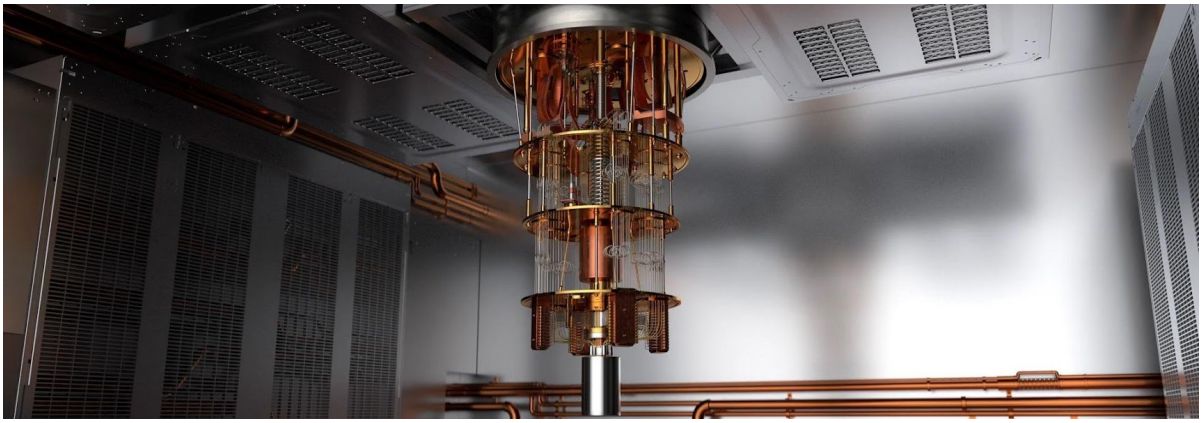
$$\Delta E \Delta t \geq \frac{h}{4\pi} \qquad \Delta x \Delta p \geq \frac{h}{4\pi}$$

While in the macroscopic world such uncertainties can be negligible, they are significant in the quantum world. Estimate the uncertainty in the position of:

(a) a photoelectron moving at 5×10^5 m s^{-1}, and

(b) a 75 kg person moving at 3 m s^{-1}.

Problem E: Quantum Technologies



Using quantum states like superposition and entanglement, quantum computers can process, in parallel, complex multidimensional data that classical computers cannot handle in a reasonable time. They also offer exponential speedups for specialized tasks because of how they encode exponentially more information than classical bits.

- Name two fields where scientists hope quantum computers will be especially useful and briefly say why.
- Explain why today's laptops are still better than quantum computers for most everyday tasks like web browsing or word processing.

Participation Instructions

- ✓ Write your solutions by hand on sheets of paper or type them on a computer.
- ✓ **Submit your solutions online by Sunday, 21 June 2026, 23:59 UTC+0**
  Website: `https://glqmc.org/submission`
- ✓ You do not need to include the problem statements in your solution document.
- ✓ Show your work to receive full marks.
- ✓ Clearly label each problem and highlight your final answers.
- ✓ You need to score at least **12/14/17 points** as Junior/Youth/Senior to qualify for the Semi-Final Round. See `https://glqmc.org/age-groups` for details.
- ✓ If you have questions, reach out to us at: `info@glqmc.org`

Good Luck!