Exercise 1: Select the correct answer.

	A	B	C	D
1. How does illumination with light greater than the bandgap affect semiconductor conductivity?	It drops to zero immediately.	It remains completely constant.	It increases; absorbed photons generate extra electron-hole pairs	It decreases due to photon scattering..
2.What type of impurity must be added to Germanium to turn it into an n-type semiconductor?	Only heavy interstitial Silicon atoms.	Balanced, identical quantities of both donor and acceptor impurities.	Pure, un-ionized Gallium atoms exclusively.	An insulating oxide layer across the entire surface.
3. In a photovoltaic solar cell, what does the Open-Circuit Voc represent?	The maximum current when terminals are shorted.	The voltage across the cell when the net external current is exactly zero.	The temperature coefficient of the solar panel.	The voltage drop caused by shading from dust.
4. What is the expected emission spectrum for an AlGaAs LED with a bandgap energy of 1.8 eV?	Hard X-Ray	Deep Ultraviolet	Visible	RedFar-Infrared

Exercise 2: Solar cell characterization

A bismuth telluride thermoelectric generator (TEG) module is tested under an incident thermal heat flux density$Q_{in} = 1000W/m^2$. The module surface area is $40cm^2$. The test yields an open-circuit voltage $V_{OC} = 4.8V$, a short-circuit current $Isc = 2.54$, a voltage at maximum power point \(V_{\text{mp}} = 2.4\text{ V}\), and a current at maximum power point $I_{mp} = 2.2A$.

1. Calculate the maximum power Pmax produced by the cell.
2. Calculate the voltage-current quality factor (the ratio of Pmax to the product of Voc and Isc.
3. Calculate quantu efficiency η.

Exercise 3: Laser diode design and thermal analysis

To succeed on this section of the final exam, you must prepare to integrate quantum mechanics, electrical performance, and thermal degradation into a single device design scenario. Review the target concepts, operational traps, and preparation actions detailed below.

1. Core Concepts to Review

Energy-to-Wavelength Relationships: Master the inverse relationship between a semiconductor's bandgap energy and its light emission wavelength. Practice converting energy states into nanometers to identify spectral bands.

Laser Threshold Mechanics: Understand that laser diodes do not emit stimulated light until they pass a specific electrical barrier. Learn to isolate active operating currents from static threshold states.

Thermal Property Decay: Study how localized heating degrades a semiconductor's physical potentials. Review how to use negative linear coefficients to calculate parameter losses over a temperature span.

High-Temperature Solid-State Theory: Prepare a written, qualitative defense explaining why heat triggers carrier leakage, shifts operational thresholds, and creates risks like efficiency collapse.

2. Common Traps to Avoid

The Flat Multiplication Error: Never multiply efficiency directly by total operating current. You must account for the dead zone below the threshold barrier.

Temperature Delta Confusion: Do not multiply coefficients directly by the final temperature. Always establish the exact difference between the heated state and the original room temperature baseline first.

Unit Conversion Oversights: Keep milli-scale values completely separate from baseline metrics to prevent fatal decimal placement errors on your final values.

3. Action Plan for Study

Practice Inversions: Run practice problems calculating wavelengths from electron-Volts, ensuring your answers match real-world telecom boundaries.

Map Characteristic Curves: Sketch a standard power-current curve. Visualizing how the line shifts to the right under heat will help you ace both the calculation and the essay question.

Check Physical Sanity: Condition your mind to check your answers against reality. Calculated operational voltages must always drop as your device heats up.

4. Summary of required formulas

$$P_{max} = V_{mp}.I_{mp}$$

$$FF = \frac{P_{max}}{V_{OC}.I_{SC}}$$

$$\eta = \frac{P_{max}}{P_{in}.Area}$$

$$\lambda = \frac{1240eV.nm}{E_g}$$

$$P_0 = \eta_{slope}.(I - I_{th})$$