The generated electric field in a piezoelectric crystal is given by $E = \frac{d}{\varepsilon} \cdot \frac{d}{DC} = A$ and the electric constant is $1500\, \text{F/m}^2$. The charge constant is $0.5 \times 10^{-9}$ coulomb. If a piece of metal with a radius of 2 mm is placed on the surface of the crystal, the electric displacement is $\frac{1}{2}$ of the initial value. The voltage is measured with some device. If it decreases, why is that? (1)

- Hall effect (1)
- Current-voltage relation (1)
- Proportional and photodiode (1, 2)
- Photocapacitance and photodiode (1, 2)
- Photocapacitance and photodiode (1, 2)
- Examination for silicon microelectronics (1, 2)
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- Examination for silicon microelectronics (1, 2)

2. Explain the two major methods of physical vapor deposition (1, 2).

- Chemical vapor deposition (1, 2)
- Physical sputtering (1, 2)
- Physical sputtering (1, 2)

3. Explain why all silicon microelectronics can be used.

- No written material is allowed.
5. a. What is the minimum diameter of a monocrystalline silicon wire that will support a weight of

6. What makes Wheatstone bridge convention and useful? (2)

8. Which kind of sensors is commonly used with Wheatstone bridge shown below. (2)

A. What is the maximum length in the case of silicon? (1) (p)
B. What is the maximum stress in the case of silicon? (1) (p)

\[ \frac{V}{I} \cdot \frac{N}{F} = \sigma \]

Assume 160 GPa for the Young’s modulus and 6.5 GPa for the maximum tensile stress (yield).

\( \sigma \) Strength of silicon

\( V \) Voltage

\( I \) Current

\( N \) Number of elements

\( F \) Force

\( L \) Length

\( r \) Radius

9. a. How long were of some material can you hang in earth’s gravity field (9.8 m/s²) before it breaks? (2) (p)

10. a. What is the minimum volume of the monocrystalline silicon wire that will support a weight of

11. A. What is the equation for the output voltage \( V_o \) of the Wheatstone bridge shown below. (3) (p)