Please choose the best answer for the following 9 questions and fill the table (Show your calculations).

1	2	3	4	5	6	7	8	9
B	C	E	A	B	B	B	B	D

3 X 2.5

Q1 Cadmium sulfide has a band gap of 1.85 eV. Find maximum wavelength for resistance change by photon absorption. Note that 1 eV = 1.6×10^{-19} J, Planck's constant h=6.63×10^{-34} J.s, speed of light c=3×10^{8}m/s

2.96×10^{-19}

$\lambda_{max} = \frac{HC}{\Delta w_g}(E_{gap}) \Rightarrow \frac{6.63\times10^{-34}\times3\times10^{8}}{w_g} E_g$

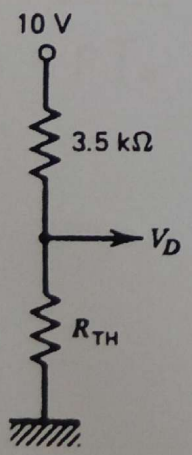
A) 510 nm B) 672 nm C) 691 nm D) 734 nm E) 762 nm

Q2 Adding impurities to semiconducting material in photodiode sensors will:

A) Increase series resistance B) Narrow depletion region

C) Make the device faster D) A+C E) B+C

Q3 A thermistor has a 3.5 kΩ resistance at 20°C. The dissipation constant is P_D=30 mw/°C. The sensor is used in the following circuit to provide 5 V at 20°C. Evaluate the error from self-heating in °C



A) 0.185 B) 0.201 C) 0.238 D) 0.255 E) 0.313

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Q4 Compared with thermistors a platinum RTD has lower :

A) Sensitivity B) predictability C) linearity

D) Temperature range E) Non of the above

Q5 The table for J type thermocouple is attached. Find the output voltage if the sensor is measuring a temperature of 114 °C with a reference of 25 °C: (mV)

$V_o = ?$

A) 3.258 B) 3.706 C) 3.813 D) 4.020 E) 4.755

Q6 For Q5, the sensitivity of this sensor at 110°C is (V/°C)

$$\text{Sensitivity} = \frac{\Delta V}{\Delta T}$$

A) 0.054 B) 0.064 C) 0.074 D) 0.084 E) 0.094

Q7 A photovoltaic cell is to be used with radiation of intensity from 5 to 12 mw/cm^2. Its unloaded output voltage ranges from 0.22 to 0.41 V over this intensity while it delivers current from 0.5 mA to 1.7 mA into a 150 Ω load. The short circuit current range is (mA):

$I_{sc} = P I_o$

A) 0.875 – 10.133 B) 0.890 – 9.795 C) 0.801 – 8.133

D) 0.758 – 4.497 E) 0.705 – 4.315

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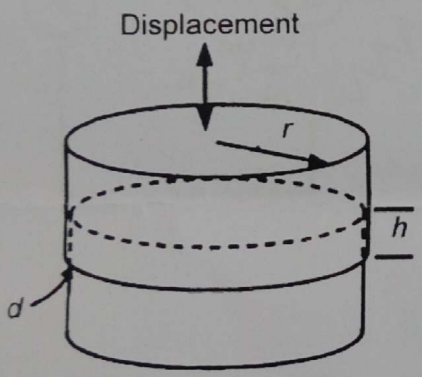
Q8 for Q7,If the unloaded output voltage ranges from 0.3 to 0.6 V, and short circuit current range from 0. 5 to 1.5 mA. The optimum value for load resistor when the cell is used as a generator is: (Ω)

A) 123 B) 147 C) 215 D) 295 E) 344

Q9 Figure below shows a capacitive-displacement sensor. The two metal cylinders are separated by a plastic sheath of thickness 1 mm and dielectric constant of 3. If the radius is 2.5 cm, find the sensitivity in pF/m as the upper part slides in and out of the lower cylinder. (note that air permittivity is 8.85 pF/m)

A) 2085 B) 2780 C) 3475 D) 4170 E) 4865



$$C = \frac{\varepsilon_r \varepsilon_0 R \pi}{D}$$

$$\Rightarrow \frac{dC}{dH} = \frac{2 \varepsilon_r \varepsilon_0 R \pi}{D}$$

$$= \frac{2 * 8.85 * 10^{-12} * 2.5 * 10^{-2} * \pi}{1 * 10^{-3}}$$

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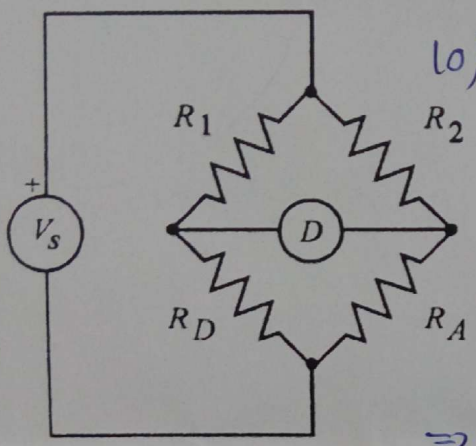
A strain gage with gage factor G=2.03. The gage is connected in an equal arms bridge where all resistors equal 250 Ω as shown below(where R_A is the active strain gage). If Vs=10 V, Solve questions 10, 11, and 12.

Q10) what is the detector voltage if a strain of 1 mm/m is applied.

Q11)If a raise in temperature increased only the strain gage resistor R_A by 1 Ω(R_1, R_2, and R_D are not affected by this temperature). Find the percentage error for the 1 mm/m strain in Q10.

Q12)If R_D is a dummy gage and it is affected by temperature as R_A resolve Q11.



10) $V_{th} = \dfrac{V_s\left(-\frac{\Delta R}{R}\right)}{(1+n)^2}$ (1)

$\Rightarrow V_{th} = 10($

$\Rightarrow \dfrac{\Delta R}{R} = G.\varepsilon \Rightarrow 2.03 *$ (0.5)

$\Rightarrow \dfrac{10(\Delta R)}{1+1)^2}$

$\Rightarrow \dfrac{-\Delta}{R} = G$

(2) $E_r = 0$