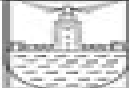


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Eng. Mathematics & Eng. Physics Dept.	قسم الرياضيات الهندسية والفيزياء الهندسية	
June 2020	يونيو 2020	
Eng. Physics I	الفيزياء الهندسية 1	

*Gas constant ( $R = 8.314 \text{ J/mole}\cdot\text{K}$ )*

*Stefan's constant ( $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\cdot\text{K}^4$ )*

*Heat rate conducted through a cylindrical shell  $\frac{dQ}{dt} = 2\pi K \ell \frac{\theta_1 - \theta_2}{\ln(b/a)}$*

### Question One

**I.** The maximum velocity for a liquid flowing through a capillary tube with radius (a) and length (L) is given by:  $v_{\max} = \frac{\Delta P \cdot a^2}{4\eta L}$ , where  $\Delta P$  is the pressure difference and  $\eta$  is the viscosity coefficient of the liquid.

- Find the dimensions of the viscosity coefficient.
- If the volume flow rate for the liquid (Q) depends on the radius of the tube (a), the pressure gradient across the tube (x) and the viscosity coefficient of the liquid use the dimension analysis to find the rule that gives (Q).

**II.** Find the dimensions of the electric potential difference (V) and the electric resistance (R). If you know that the stored energy inside a capacitor is given by  $E = \frac{1}{2} CV^2$  find the dimensions of the capacitance (C).

**III.** Find the cgs equivalent for the following physical quantities:

- Thermal conductivity of 395 SI.
- Specific heat of 4200 SI
- Linear acceleration of  $140 \text{ m/min}^2$ .

**IV.** The periodic time ( $\tau$ ) for a compound pendulum depends on the distance from the hanging point to the center (h), the weight of the pendulum (W) and the moment of inertia for the pendulum (I). Use the dimensional analysis to get the rule that gives ( $\tau$ )

### Question Two

**I.** A cube with mass (55 g) has a side length (3 cm) and a specific heat for its material ( $490 \text{ J/kg}\cdot\text{K}$ ). The cube with surface emissivity ( $\epsilon$ ) is hung by a (18-cm) copper wire with radius (1.5 mm) and thermal conduction coefficient of ( $395 \text{ W/m}\cdot\text{K}$ ). The cube's initial temperature was ( $160^\circ\text{C}$ ) and it cools off at a rate of ( $0.55^\circ\text{C/s}$ ). The upper end of the wire shares the same temperature of the room at ( $21^\circ\text{C}$ ) and the rate of convective heat loss from cube's surface is ( $6.73 \text{ W}$ ). At this instant, calculate:

- The rate of heat conducted through the wire.
- The thermal convection coefficient for air surrounding the cube.
- The emissivity for cube's surface.

**II.** A (90 g) aluminum container ( $c_{Al}=890 \text{ J/kg}\cdot\text{K}$ ) contains 150 g of ice ( $c_{ice} = 2090 \text{ J/kg}\cdot\text{K}$ ) at a temperature of ( $-5^\circ\text{C}$ ). To the ice is added (m g) of water ( $c_w=4200 \text{ J/kg}\cdot\text{K}$ ) at ( $95^\circ\text{C}$ ). If the temperature of the system at equilibrium is ( $35^\circ\text{C}$ ), find the value of (m). Hint: The system is at atmospheric pressure and the latent heat of ice melting is ( $3.33 \times 10^5 \text{ J/kg}$ ).

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