(Q.1) For the nucleate boiling to initiate from the wall, the wall superheat

a. must be sufficient to ensure that vapor nuclei are stable
b. must be sufficient to ensure that vapor nuclei are unstable
c. has no effect on the bubble inception
d. none of the above

(Q.2) A vapor bubble is initiated and grows in liquid water at 110 °C. Find the time at which the bubble sizes predicted by the inertia controlled and heat transfer controlled models are same.

a. $1.2 \times 10^{-5} \text{s}$
b. $2.3 \times 10^{-5} \text{s}$
c. $4.6 \times 10^{-5} \text{s}$
d. $2 \times 10^{-3} \text{s}$

Solution: The saturation temperature at 1 atm is $T_{sat} = 100 \ °C = 373.15 \ K$. The properties of water at this temperature are $\sigma = 58.9 \times 10^{-3} \text{N/m}$, $h_{lv} = 2251.2 \text{kJ/kg}$, $\rho_l = 958.77 \text{kg/m}^3$, $\rho_v = 0.5974 \text{kg/m}^3$, $c_{pl} = 4.216 \text{kJ/kg-K}$, and $k_l = 0.68 \text{W/m-K}$. The thermal diffusivity is $\alpha_l = k_l/(\rho_l c_{pl}) = 1.68 \times 10^{-7} \text{m}^2/\text{s}$.

The Jakob number is obtained from eq. (10.30), i.e.,

$$Ja = \frac{\rho_l c_{pl} [T(\infty) - T_{sat}(p_v)]}{\rho_v h_{lv}} = \frac{958.77 \times 4.216 \times (110 - 100)}{0.596 \times 2251.2} = 30.125$$

and $C_R$ for the heat transfer-controlled model can be obtained from eq. (10.29):

$$C_R = \sqrt{\frac{3}{\pi}} Ja = \sqrt{\frac{3}{\pi}} \times 30.125 = 29.44$$

The bubble sizes in the inertia-controlled model and heat transfer-controlled model can be obtained from eqs. (10.24) and (10.28),
(Q.3) Bubble departure diameter is calculated by balancing

a. Buoyancy and inertia forces
b. Gravity and buoyancy forces
c. Buoyancy and Surface tension forces
d. Surface tension and inertia forces

(Q.4) Given the following conditions for group number, which one satisfy criteria for single droplet combustion

a. \( G > 1 \)
b. \( G < 1 \)

(Q.5) what causes the flame to be in tear drop shape?

a. Buoyancy driven convection
b. Molecular diffusion
c. None of the above