Assignment 3

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

1) For tilted free liquid surface, in contact with an atmosphere at pressure $p_a$, what among the below statements is true?

(a) Fluid must start flowing when $\theta > 45^\circ$ and remains at rest before that.
(b) Must undergo shear stress but may not flow because forces are balanced.
(c) One cannot say about whether the fluid will flow or remain at rest because fluid is exposed to atmospheric pressure.
(d) Must undergo shear stress and hence begin to flow because of hydrostatic pressure.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d)

2)
A circular disc of radius $R$ is kept at a small height $h$ above a fixed bed by means of a layer of dynamic viscosity $\mu$ as shown. The disc is rotated at an angular velocity $\omega$. Assume linear variation of velocity within the oil film and ignore the edge effects. The viscous torque exerted by the oil on the disc will be

(a) $T = \frac{\pi \mu \omega R^4}{h^2}$
(b) $T = \frac{\pi \mu \omega R^4}{h^8}$
(c) $T = \frac{\pi \mu \omega R^4}{h^{16}}$
(d) $T = \frac{\pi \mu \omega R^4}{h^{32}}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)

A shaft having a length $L$ and radius $R_1$ is running at an angular velocity of $\omega$ in a concentric bearing with radius $R_2$. If the space between the shaft and bearing is flooded with a layer of dynamic viscosity $\mu$, the magnitude of the torque and power required to run the shaft is:

(a) $T = \frac{2\pi \mu L \omega R_1^2 R_2}{R_2 + R_1}$ and $P = \frac{2\pi \mu L \omega R_1^2 R_2}{R_2 - R_1}$
(b) $T = \frac{2\pi \mu L \omega R_1 R_2^2}{R_2 - R_1}$ and $P = \frac{\pi \mu L \omega R_1^2 R_2}{2(R_2 - R_1)}$
(c) $T = \frac{2\pi \mu L \omega R_2^2 R_1}{R_2 - R_1}$ and $P = \frac{2\pi \mu L \omega R_1^2 R_2}{R_2 - R_1}$
(d) None of the above.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d)

4)
In the above shaft-bearing system if the gap between the shaft and bearing is very thin then one can assume a linear variation of fluid velocity in the gap. In that case what among the below statements is correct:

(a) If one takes a thin gap limit \((R_3 \div R_1 \ll 1)\), then the expressions of torque and power in the previous problem coincides with this problem.

(b) In that case \((R_3 \div R_1 \ll 1)\) the torque will be infinite and power cannot be calculated.

(c) If one takes a limit \((R_1 \div R_3 \ll 1)\), then the expressions of torque and power in the previous problem coincides with this problem.

(d) None of the above.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)

5) The piezometric head in a static liquid
   (a) remains constant at all points in the liquid
   (b) increases linearly with depth below a free surface
   (c) decreases linearly with depth below a free surface
   (d) remains constant only in a horizontal plane

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)

6) A multitube manometer using water and mercury is used to measure the pressure of air in a vessel, as shown in the figure below. It is given that \(h_1 = 0.4\) m, \(h_2 = 0.5\) m, \(h_3 = 0.3\) m, \(h_4 = 0.7\) m, \(h_5 = 0.1\) m and \(h_6 = 0.5\) m. For the given values of heights, the gauge pressure in the vessel will be (density of water =1000 kg/m\(^3\) and density of mercury = 13600 kg/m\(^3\))

(a) 90 kN/m\(^2\)
(b) 190 kN/m\(^2\)
(c) 290 kN/m\(^2\)
(d) 390 kN/m\(^2\)
A differential U-tube mercury (density = 13600 kg/m^3) manometer is used to measure pressure difference between two sections of a vertical pipe through which oil of density 800 kg/m^3 flows upwards. The distance between the two sections is 40 cm. If the pressure difference between the two sections is 30 kN/m^2, the deflection in the mercury manom will be

(a) 11 cm  
(b) 16 cm  
(c) 21 cm  
(d) 26 cm

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
(b)  

8) A static fluid can have  
(a) non-zero normal and shear stress  
(b) zero normal stress and zero shear stress  
(c) non-zero normal stress and zero shear stress  
(d) zero normal stress and non-zero shear stress
9) A glass tube of 1 mm radius is immersed vertically in mercury (density = 13600 kg/m³). If the surface tension of mercury in contact with air is 0.44 N/m and the area wetting is 130°, there will be (g=9.81 m/s²)
   - (a) 2.12 mm capillary rise in the glass tube
   - (b) 2.12 mm capillary in the glass tube
   - (c) 4.24 mm capillary rise in the glass tube
   - (d) 4.24 mm capillary depression in the glass tube

No, the answer is incorrect.  
Score: 0
Accepted Answers:  
(a)  
(b)  
(c)  
(d)

10) If the surface tension at the water-air interface is 0.0718N/m, how much does the pressure in a cylindrical jet of water 4 mm in diameter exceed the pressure of the surrounding atmosphere?
   - (a) 35.9 N/m²
   - (b) 71.8 N/m²
   - (c) 143.6 N/m²
   - (d) 0 N/m²

No, the answer is incorrect.  
Score: 0
Accepted Answers:  
(a)  
(b)  
(c)  
(d)


A solid cylindrical needle of diameter \( d \), length \( L \) and density \( \rho \), may float in liquid of surface tension \( \gamma \). Neglecting buoyancy and assuming a contact angle of \( 0^\circ \), what will be the maximum diameter of the needle \( d_{\text{max}} \) which is able to float in the liquid?

\[
\begin{align*}
(a) \quad d_{\text{max}} &= \sqrt{\frac{4\gamma}{\rho g}} \\
(b) \quad d_{\text{max}} &= \sqrt{\frac{\gamma}{8\pi \rho g}} \\
(c) \quad d_{\text{max}} &= \sqrt{\frac{2\gamma}{\rho g}} \\
(d) \quad d_{\text{max}} &= \sqrt{\frac{8\gamma}{\pi \rho g}}
\end{align*}
\]

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d)

12) A soap bubble of diameter \( r_1 \) coalesces with another bubble of diameter \( r_2 \) to form a single bubble of diameter \( r_3 \) with the same amount of air. If we assume an isothermal process and take into account the atmospheric pressure and surface tension between liquid air (\( \sigma \)), then \( r_3 \) can be related to the given parameters as:

\[
\begin{align*}
(a) \quad \left( p_a + \frac{\sigma}{r_1} \right) r_1^2 + \left( p_a + \frac{\sigma}{r_2} \right) r_2^2 &= \left( p_a + \frac{\sigma}{r_3} \right) r_3^2 \\
(b) \quad 2p_a + \frac{\sigma}{r_1} r_1^2 + 2p_a + \frac{\sigma}{r_2} r_2^2 &= 2p_a + \frac{2\sigma}{r_3} r_3^2 \\
(c) \quad p_a + \frac{2\sigma}{r_1} r_1^2 + p_a + \frac{2\sigma}{r_2} r_2^2 &= p_a + \frac{2\sigma}{r_3} r_3^2 \\
(d) \quad p_a + \frac{4\sigma}{r_1} r_1^2 + p_a + \frac{4\sigma}{r_2} r_2^2 &= p_a + \frac{4\sigma}{r_3} r_3^2
\end{align*}
\]

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d)

13)
An inverted U-tube manometer is used to measure the pressure difference between two pipes A and B as shown. Pipe A is carrying oil (specific gravity=0.8) and pipe B is carrying water. The densities of oil and water are 1.16 \( \text{kg/m}^3 \) and 1000 \( \text{kg/m}^3 \), respectively. Considering \( g = 10 \text{m/s}^2 \) pressure difference between pipes A and B is:

(a) \( P_A - P_B = -1.19 \text{kPa} \)
(b) \( P_A - P_B = -2.19 \text{kPa} \)
(c) \( P_A - P_B = 1.19 \text{kPa} \)
(d) \( P_A - P_B = 0.19 \text{kPa} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b)

A water film is formed between two straight parallel wires of 10 cm each with a separation of 0.1 cm. If the distance between the wires is increased by 0.1 cm, and the surface tension has value \( 0.072 \text{N/m} \) then the work done will be:

(a) \( 1.44 \times 10^{-5} \text{J} \)
(b) \( 1.44 \times 10^{-4} \text{J} \)
(c) \( 1.44 \times 10^{-3} \text{J} \)
(d) None of the above.

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)
The work done in blowing a soap bubble in air, with radius = 5 cm. (Given: Surface tension \( \sigma \) of soap bubble is = 0.035 N/m.) is:

(a) \( 2.2 \times 10^{-7} J \)
(b) \( 2.2 \times 10^{-3} J \)
(c) \( 2.2 \times 10^{-4} J \)
(d) \( 2.2 \times 10^{-5} J \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b)