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Part I. Multiple choice questions (1.5pt each)

- Which statement is correct about the pressure under a fluid in a container?
(A) It depends on the volume of the fluid (C) It depends on the density of the fluid
(B) It depends on the shape of the container (D) It is independent of the depth of the fluid
- A table-tennis ball which is spherical in shape has a diameter of 6 cm and average density of 0.4 g/cm^3 . What force is required to hold it completely submerged under water?
(A) 0.68 N downward (C) 1.13 N downward
(B) 0.68 N upward (D) 1.13 N upward
- Lead has a greater density than iron, and both are denser than water. Comparing the buoyant force on the lead object to the buoyant force on the iron object of same volume.
(A) the buoyant force on the lead object is greater than the buoyant force on an iron object
(B) the buoyant force on the lead object is less than the buoyant force on an iron object
(C) the buoyant force on the lead object is equal to the buoyant force on an iron object
(D) None of the above
- Two tubes of different cross-sectional areas are connected together horizontally. Which of the following is a true statement about a fluid flowing through the tubes
(A) The amount of fluid that leaves the wider tube is less than the amount of fluid that enters the narrower tube in the same interval of time.
(B) The speed of the fluid in the narrower tube is greater than the speed of the fluid in the wider tube.
(C) The pressure of the fluid in the narrower tube is greater than that in the wider tube.
(D) The speed of the fluid in the narrower tube is less than the speed of the fluid in the wider tube.
(E) The amount of fluid that leaves the wider tube is greater than the amount of fluid that enters the narrower tube in the same interval of time.
- A garden hose has an inside diameter of 16 cm. The hose can fill a 10 liter bucket in 2 seconds. If the diameter of the nozzle is reduced to 8 cm,
(A) Water exits with a speed twice the speed inside the hose.
(B) A 10 liter bucket can be filled in 10 seconds
(C) A 20 liter bucket can be filled in 40 seconds
(D) Water exits with a speed half the speed inside the hose.

Part II. Give short answer /1.5pt each/

1. A layer of oil with density 800 kg/m^3 floats on top of a volume of fresh water. A block of some material of density 950 kg/m^3 , a uniform cross-sectional area A and height h floats at oil-water interface, as shown in figure below.



(a) What fraction of the block is in water? _____

(b) What fraction of the block is in oil? _____

2. An object is suspended by a cord as shown in *figure 'a'* and the tension in the cord is $T_1 = 10 \text{ N}$. The object is then immersed to the water as shown in *figure 'b'*. In this case the tension in the cord is $T_2 = 6 \text{ N}$.

Determine the density of the object. _____



Fig a

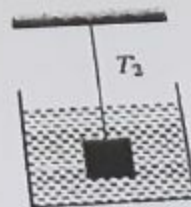


Fig b

3. A small block of wood, of density $0.4 \times 10^3 \text{ kg/m}^3$, is submerged in water at a depth of

6. When a load of 500 kg is hanging from a steel wire of length 3 m and cross sectional area 0.2 cm^2 , the wire stretches beyond its no load length. If the young's modulus for the wire made of steel is $Y = 2 \times 10^{11} \text{ Pa}$, what is the change in length of the wire beyond its no-load length?
- (A) 3.75 mm (B) 2.75 mm (C) 1.75 mm (D) 0.75 mm
7. What is Thermal expansion?
- A) The transfer of thermal energy between materials by the collisions of particles
B) Is a decrease in a materials size when temperature decreases
C) An increase in a materials size when temperature increases
D) All
8. Which of the following statements is false?
- A) Gaps need to be left in lengths of railway lines to prevent buckling in hot weather
B) Bimetallic strips are used in thermostats, a thermostat being a temperature- operated switch
C) As the temperature of water is decreased from 4°C to 0°C contraction occurs
D) A change of temperature of 15°C is equivalent to a change of temperature of 15 K
9. If the coefficient of linear expansion is A, the coefficient of superficial expansion is B and the coefficient of cubic expansion is C, which of the following is false?
- A. $C = 3A$ B. $A = B/2$ C. $B = 3C/2$ D. $A = C/3$
10. The temperature of land rises more quickly than that of the sea because the specific heat of soil is
- A) more than water C) less than water
B) equal to water D) neutral

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4. A glass contains 0.25kg of Omni-Cola (mostly water) initially at 25°C . How much ice, initially at -20°C , must you add to obtain a final temperature of 0°C with all the ice melted? Neglect the heat capacity of the glass. ($c_{\text{water}} = 4190 \text{ J / kg }^{\circ}\text{C}$ and $c_{\text{ice}} = 2100 \text{ J/kg}^{\circ}\text{C}$, and $L_f = 3.34 \times 10^5 \text{ J/kg}$) [3pts]

3. A 1kg block of aluminum is heated at atmospheric pressure so that its temperature increases from 22°C to 40°C . Find [4pts]

- (a) The work done on the aluminum,
- (b) The energy added to it by heat, and
- (c) The change in its internal energy

2. In an engine, a piston oscillates with simple harmonic motion so that its position varies according to the expression : $x(t) = 5 \cos \left(2t + \frac{\pi}{6} \right)$

Where x is in meters and t is in seconds. find [4pts]

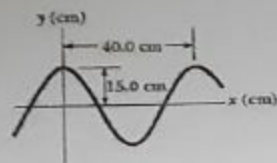
- (a) The position of the particle, at $t = 0$
- (b) Its time varying velocity
- (c) Its maximum acceleration
- (d) The period

Part III. Workout: Show all the necessary steps clearly for the following problems /15pt/

1. A horizontal pipe of 10 cm in diameter has a smooth reduction to a pipe of 5 cm in diameter. If the pressure of the water in the larger pipe is 80kPa and the pressure in the smaller is 60kPa, at what rate does the water flow through the smaller pipe? [4pts]

7. The condition of resonance occurs when the driving frequency becomes equal to _____ of the oscillator.

8. A sinusoidal wave traveling in the positive x -direction has a wavelength of 40cm, and a frequency of 8Hz. The vertical position of an element of the medium at $t = 0$ and $x = 0$ is also 15cm as shown in figure below. The period T & linear speed of the wave are _____ and _____ respectively.



9. A car with a mass of 1300 kg is constructed so that its frame is supported by four springs. Each spring has a force constant of 20,000 N/m. Two people riding in the car have a combined mass of 160 kg. Find the frequency of vibration of the car after it is driven in the road and the car oscillates vertically. _____
10. Rubber has a negative average coefficient of linear expansion. What happens to the size of a piece of rubber as it is warmed? _____