TUTORIAL QUESTIONS PHASES OF MATTER

Question 1

Pressure at x = 100 k + hpg

= 100 k + (1 sin 30°)(1020)(9.81)

= 105 kPa (Answer: C)

Question 2

P + xρg (Answer: D)

Question 3

a.) **Similarity – both changes the matter from liquid phase to gas phase.**
Difference – evaporation occurs at any temperature, boiling occurs at fixed temperature

b.) i **Atoms arranged in regular pattern that repeats itself within the crystalline solid.**

ii **A long chains of atoms / molecules whereby the chain consists of "unit" that repeat themselves called the monomer. Most polymers are non-crystalline.**

Question 4

Answer: C

Question 5

a.)

Copper has density 8930 kg m^{-3} and zinc has density 7140 kg m^{-3}. Brass is an alloy consisting of 70% copper and 30% zinc by volume. Assume that the volume of the alloy is equal to the sum of the volume of the copper and zinc used. Consider one cubic metre of brass. Complete Fig. 5.1 in order to find the density of the brass.

metal	volume / m^3	mass / kg	density / kg m^{-3}
copper	0.70	**6251**	8930
zinc	0.30	**2142**	7140
brass	**1.00**	**8393**	**8393**

Fig 5.1

b.) **Volume of brass will be lesser. Atoms of one metal will slip in and take up the empty space / position of lattice of another metal.**

Question 6

a.) **Brownian motion is a random motion of a suspended particle in a fluid.**

b.) **The motion of particle is random because of the unbalanced collision rates due to the random motion of gas molecules / atoms.**

c.) **Large particles are more massive / heavier / greater inertia, therefore only causing small movements which can be undetectable. OR**
Large surface area, thus force acting on every direction is averaged out.

Question 7

i.) Pressure is the same at the surface of the mercury because of the same horizontal / depth level.

ii.) hρg is same for both at the surface of mercury.
$(53 \times 10^{-2})x(1.0 \times 10^{3})xg = (71 \times 10^{-2})x\rho xg$
$\rho = 7.5 \times 10^{2}$ kg m^{-3}

Question 8

i.) Mass = Ahρ

ii.) Pressure = force / area = weight of liquid / area
$= Ah\rho g / A$
$= h\rho g$

iii.) $\frac{V_{vapour}}{V_{water}} = \frac{(m / \rho_{vapour})}{(m / \rho_{water})} = \frac{1600}{1}$ or 1600: 1

iv.) $\frac{d_{vapour}}{d_{water}} = \frac{V_{vapour}}{V_{water}} = (1600)^{1/3}$
$= 11.7$ or 12

> **Remember:** ***Mass of one molecule will be the same regardless water vapour or liquid water.***

v.) Density for solids and liquids are about equal / same.

vi.) Strong forces because the solids have fixed volume.
Rigid forces because solids retain its shape, molecules do not flow.

Question 9

Both pails weigh the same. The wood displaces the volume of the water with weight equal to the weight of the wood. Some of the water will overflow the pail, but the spilled water has weight equal to that of the wood, so the pails have the same weight.

Question 10

$F_{applied}$ + Upthrust = mg

$F_{applied}$ = mg – upthrust

$F_{applied}$ = $(70 \times 9.81) - (1.025 \times 10^{3} \times 3.0 \times 10^{-2} \times 9.81)$

$F_{applied}$ = **385 N**

Question 11

a.) T + U = mg

U = mg – T = (14.7 – 13.4) x 9.81 = 12.753 N

U is the weight of water displaced = $m_{water}g = (\rho_{water}V_{water})g = 12.753$

$V_{water} = 1.3 \times 10^{-3}\ m^{-3}$

ρ_{crown} = mass of crown / volume of crown

= $14.7 / (1.3 \times 10^{-3})$; since volume of crown = volume of water displaced

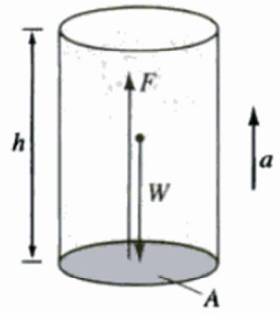
= $11.3 \times 10^{3}\ kgm^{-3}$

b.) density of gold = $19.3 \times 10^{3}\ kgm^{-3}$

Thus, the crown is not made of gold.

Question 12

(a)

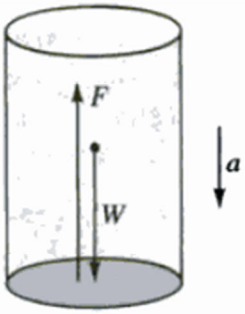


Weight W of liquid on the base of area $A = Ah\rho g$.

If F = normal reaction when the vessel moves upwards with acceleraton a, then

$$F - W = ma, \text{ where } m \text{ is mass of the liquid.}$$
$$\therefore F = W + Ah\rho a$$
$$= Ah\rho(g + a)$$
$$\therefore \text{pressure, } p = \frac{F}{A}$$
$$= h\rho(g + a)$$

(b)



When the vessel is accelerating downwards,

$$W - F = ma$$
$$F = W - ma$$
$$= Ah\rho g - Ah\rho a$$
$$= Ah\rho(g - a)$$
$$\therefore \text{pressure, } p = \frac{F}{A}$$
$$= \rho(g - a)$$

(c) When the vessel is in free fall,

$$a = g.$$

Therefore, from **(b)** above,

$$\text{pressure, } p = h\rho(g - g) \qquad [\text{as } a = g]$$
$$= 0$$

Question 13

Let h_A and h_B be the heights of points A and B above and below the normal water surface, respectively.
If p_A = pressure at A, then

$$\begin{aligned} p_A + h_A\rho g &= \text{atmospheric pressure, } p_o \\ \therefore\ p_A &= p_o - h_A\rho g \\ &= p_o - (60 \times 10^{-3})(0{\cdot}9 \times 10^3) \times 10 \\ &= p_o - 5{\cdot}4 \times 10^2 \text{ Pa} \\ \text{Pressure at } A &= 5{\cdot}4 \times 10^2 \text{ Pa below atmospheric pressure} \\ \text{Pressure at } B &= p_o + h_B\rho g \\ &= p_o + (20 \times 10^{-3})(0{\cdot}9 \times 10^3) \times 10 \\ &= p_o + 1{\cdot}8 \times 10^2 \text{ Pa} \\ &= 1{\cdot}8 \times 10^2 \text{ Pa above atmospheric pressure} \end{aligned}$$

When the finger is removed from B, liquid runs out because the pressure inside the tube at B is greater than the pressure outside, the atmospheric pressure.
The flow will stop only when the liquid level in the beaker comes down to the level of B.

Question 14

Upthrust, U = weight of liquid displaced

= $(5.556 \times 10^{-5}) \times (1 \times 10^3) \times 9.81$

= 0.545 N

$W_{block} = T + U$

$T = W_{block} - U$

$T = (0.5 \times 9.81) - 0.545$

= 4.36 N

Question 15

Apparent weight of bag = actual weight of bag filled with air – upthrust --- (1)

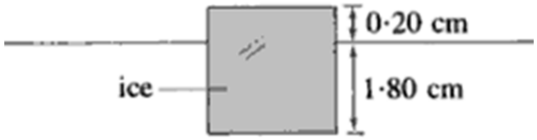
Actual weight of bag filled with air = weight of bag without air + weight of air in bag --- (2)

Upthrust = weight of air displaced = weight of air in the bag --- (3)

Thus, substituting (2) & (3) into (1),
Apparent weight of bag = (weight of bag without air + weight of air in bag) – (weight of air in the bag)

Apparent weight of bag = weight of bag without air
Hence, apparent mass of bag = mass of bag without air = m

Question 16



By Archimedes' Principle, when an object floats on a liquid,

$$\text{weight of object} = \text{weight of liquid displaced}$$

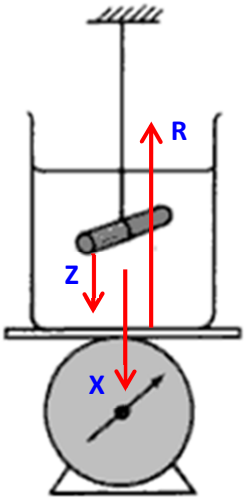
$$V_{ice}\,\rho_{ice}\,g = V_{tea}\,\rho_{tea}\,g$$

$$\therefore \text{density of tea, } \rho_{tea} = \frac{(2 \times 2 \times 2)}{(2 \times 2 \times 1{\cdot}8)} \times 920 \text{ kg m}^{-3}$$

$$= 1{\cdot}022 \times 10^3 \text{ kg m}^{-3}$$

Question 17

Free-body diagram of beaker will give us the below 3 forces acting on it.



Force that the solid exert on water in beaker = Z

Normal reaction force the balance exert on beaker = R

Weight of water and beaker = X

Since system is in equilibrium, R = X + Z

Balance reading = R = X + Z (Answer: B)