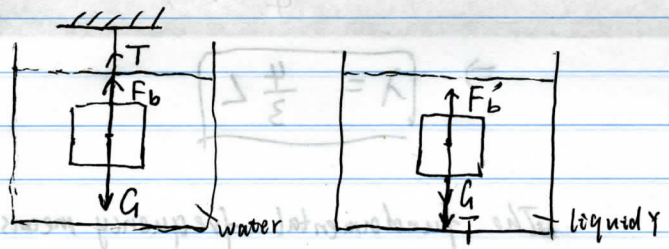
Solutions for practice quiz 1-2.

1. (a)



T : tension

F_b, F_b' : buoyant force

G : gravitational force

For the left situation : $T + F_b - G = 0$ ... ①

For the right situation : $F_b' - G - T = 0$ ... ②

(b) Based on eq.① & eq.②,

$F_b = G - T$, $F_b' = G + T$

$\Rightarrow F_b < G < F_b'$.

since $F_b = \rho_w V g$, $G = \rho_{obj} V g$, $F_b' = \rho_\gamma V g$,

where V is the volume of the object,

we have $\boxed{\rho_w < \rho_{obj} < \rho_\gamma}$

(c) eq.① + eq.② on both sides :

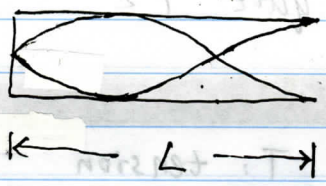
$F_b' + F_b - 2G = 0$.

$\Rightarrow \rho_\gamma V g + \rho_w V g - 2\rho_{obj} V g = 0$.

$\Rightarrow \rho_\gamma + \rho_w - 2\rho_{obj} = 0$.

i.e. $\boxed{\rho_{obj} = \frac{1}{2}(\rho_\gamma + \rho_w)}$

2. (a)

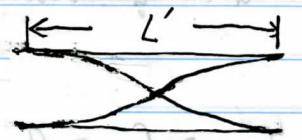


According to the figure,

$$L = \frac{3}{4}\lambda,$$

$$\Rightarrow \boxed{\lambda = \frac{4}{3}L}$$

(b)



The fundamental frequency means there is only one node. Thus,

$$L' = \frac{1}{2}\lambda'.$$

Since the frequencies are equal and the wave speed does not change,

$$\lambda' = \lambda.$$

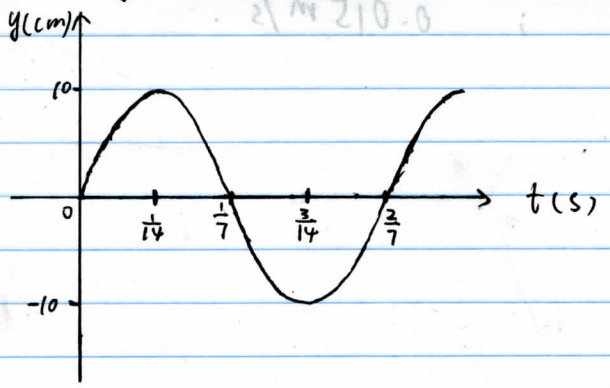
Thus, the length of the new pipe is

$$\boxed{L' = \frac{2}{3}L}.$$

3. (a) wavelength : $\lambda = 16\ cm = 0.16\ m$.

frequency : $f = \frac{v}{\lambda} = 3.5\ Hz$.

(b) period : $T = \frac{1}{f} = \frac{2}{7}\ s$.



(c) Based on the graph,

$A = 10\ cm$, $k = \frac{2\pi}{\lambda} = \frac{2\pi}{16\,cm} = \frac{\pi}{8}\ cm^{-1}$

$\omega = 2\pi f = 7\pi\ Hz$.

since the wave travels leftward, the sign is positive.

Thus, $y(x,t) = 10\ cm \cdot \cos\left(\frac{\pi}{8}x + 7\pi t + \phi_0\right)$

when $t=0$, $x=0$, $y(0,0) = 0 \Rightarrow \cos\phi_0 = 0$

$\Rightarrow \phi_0 = \frac{\pi}{2}$ or $\frac{3}{2}\pi$.

since when $t=0$, $0 < x < 8\ cm$, $y(x,0) > 0$

$\Rightarrow \phi_0 = \frac{3}{2}\pi$.

Therefore, $\boxed{y(x,t) = 10\ cm\ \cos\left(\frac{\pi}{8}x + 7\pi t + \frac{3}{2}\pi\right)}$,

where x's unit is cm, and t's unit is sec.

4. remains the same, increases.

5. 0.36 mW. (revise: 10^{12} W/m² ⟶ 10^{-12} W/m²)

6. 16.0 m/s ; 0.015 m³/s.

7. 3 cm/s