

1) a) $F_1 = 1 \text{ kHz} = 10^3 \text{ Hz}$ < $I_1 = 0.6 \text{ W/m}^2$ < $F_2 = 2.5 \times 10^3 \text{ Hz}$, $I_2 = ?$

$(S_{\text{max}})_1 = (S_{\text{max}})_2$ — (1)

$\therefore I = \frac{1}{2} \rho v \omega^2 s_{\text{max}}^2 \Rightarrow s_{\text{max}} = \frac{1}{\omega} \sqrt{\frac{2I}{\rho v}} = \frac{1}{2\pi F} \sqrt{\frac{2I}{\rho v}}$

$\frac{1}{2\pi F_1} \sqrt{\frac{2I_1}{\rho v}} = \frac{1}{2\pi F_2} \sqrt{\frac{2I_2}{\rho v}} \Rightarrow \frac{I_1}{F_1^2} = \frac{I_2}{F_2^2} \Rightarrow I_2 = I_1 \left(\frac{F_2}{F_1}\right)^2$ — بالعكس (1)

$I_2 = 0.6 \left[\frac{2.5 \times 10^3}{1 \times 10^3} \right]^2 = 0.6 \times 6.25 = 3.75 \text{ W/m}^2$

b) $(S_{\text{max}})_3 = 2(S_{\text{max}})_1$ < $I_1 = 0.6 \text{ W/m}^2$ < $I_3 = ?$ < $F_1 = 10^3 \text{ Hz}$

$F_3 = 0.5 \times 10^3 \text{ Hz}$

$I_3 = 4 I_1 \left(\frac{F_3}{F_1}\right)^2 = 4 \times 0.6 \times \frac{1}{4} = 0.6 \text{ W/m}^2$ — بالعكس عند $\frac{1}{4}$

21) $\beta_1 = 10 \log \left[\frac{I_1}{I_0} \right]$ < $\beta_2 = 10 \log \left[\frac{I_2}{I_0} \right]$

$\Rightarrow \beta_2 - \beta_1 = 10 \log \left[\frac{I_2}{I_0} \right] - 10 \log \left[\frac{I_1}{I_0} \right] =$

$= 10 \log I_2 - 10 \log I_0 - 10 \log I_1 + 10 \log I_0$

$= 10 \log I_2 - 10 \log I_1 = 10 [\log I_2 - \log I_1]$

$= 10 \log \left[\frac{I_2}{I_1} \right]$

$\Rightarrow \beta_2 - \beta_1 = 10 \log \left[\left(\frac{r_1}{r_2}\right)^2 \right]$

$\beta_2 - \beta_1 = 2 \times 10 \log \left(\frac{r_1}{r_2}\right) = 20 \log \left(\frac{r_1}{r_2}\right)$

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$\frac{I_2}{I_1} = \frac{r_1^2}{r_2^2}$

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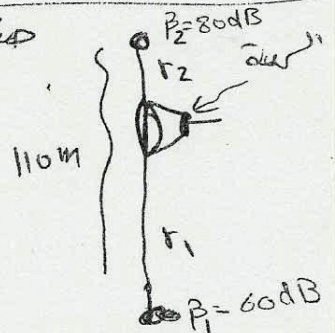
هنا علينا استنتاج العلاقة بين عزم

$\beta_2 - \beta_1 = 20 \log \left[\frac{r_1}{r_2} \right] \Rightarrow 80 - 60 = 20 \log \left(\frac{r_1}{r_2}\right)$

$\Rightarrow \log \frac{r_1}{r_2} = 1 \Rightarrow r_1 = 10 r_2$ — (1)

$\therefore r_1 + r_2 = 110 \text{ m}$ — (2)

$\therefore 10 r_2 + r_2 = 110 \Rightarrow r_2 = \frac{110}{11} = 10 \text{ m}$ < $\therefore r_1 = 100 \text{ m}$



24) a) $r_{\text{AC}} = \sqrt{3^2 + 4^2} = 5 \text{ m} \Rightarrow I = \frac{P_{\text{av}}}{4\pi r^2} = \frac{1 \times 10^{-3}}{4 \times 3.14 \times 5^2} = 3.18 \times 10^{-6} \text{ W/m}^2$ — 1 mW

$\Rightarrow \beta = 10 \log \left[\frac{3.18 \times 10^{-6}}{10^{-12}} \right] = 10 \times 6.5 = 65 \text{ dB}$

$$b) r_{BC} = \sqrt{(2)^2 + (4)^2} = 4.47 \text{ m} \Rightarrow I = \frac{1.5 \times 10^{-3}}{4 \times 3.14 \times (4.47)^2} = 5.97 \times 10^{-6} \quad (3)$$

$$\Rightarrow \beta = 10 \log \left[\frac{5.97 \times 10^{-6}}{10^{-12}} \right] = 67.8 \text{ dB}$$

$$c) I = I_A + I_B = 3.18 \times 10^{-6} + 5.97 \times 10^{-6} = 9.15 \times 10^{-6} \text{ W/m}^2$$

$$\Rightarrow \beta = 10 \log \left[\frac{9.15 \times 10^{-6}}{10^{-12}} \right] = 69.6 \text{ dB}$$

$$25) I = \frac{P_{av}}{4\pi r^2} \quad \beta = 10 \log \left(\frac{I}{I_0} \right) \Rightarrow I = 10^{-12} \times 10^{\frac{\beta}{10}} = 10^{-12} \times 10^{\frac{10}{10}} = 10^{-12} \times 10^1 = 10^{-11} \text{ W/m}^2$$

$$\Rightarrow P_{av} = 4\pi r^2 I = 4 \times 3.14 \times (3)^2 \times 10^{-11} = 1.13 \times 10^{-10} \text{ W}$$

$$27) r_1 = 3 \text{ m} \quad \beta_1 = 120 \quad r_2 = ? \quad \beta_2 = 100 \text{ dB} \quad r_3 = ? \quad \beta_3 = 10 \text{ dB}$$

$$I_1 = 10^{-12} \times 10^{\frac{120}{10}} = 10^{-12} \times 10^{12} = 1 \text{ W/m}^2$$

$$I_2 = 10^{-12} \times 10^{\frac{100}{10}} = 10^{-12} \times 10^{10} = 10^{-2} \text{ W/m}^2$$

$$I_3 = 10^{-12} \times 10^{\frac{10}{10}} = 10^{-12} \times 10^1 = 10^{-11} \text{ W/m}^2$$

عند انتقال الصوت،

$$\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2} \Rightarrow r_2 = r_1 \sqrt{\frac{I_1}{I_2}} = 3 \sqrt{\frac{1}{10^{-2}}} = 30 \text{ m}$$

$$\frac{I_1}{I_3} = \frac{r_3^2}{r_1^2} \Rightarrow r_3 = r_1 \sqrt{\frac{I_1}{I_3}} = 3 \sqrt{\frac{1}{10^{-11}}} = 3 \times 3.16 \times 10^5 = 9.49 \times 10^5 \text{ m}$$

$$31) v_s = 40 \text{ m/s} \quad f = 320 \text{ Hz} \quad f' = ? \quad v_o = 0 \quad \lambda' = ?$$

$$f' = \left(\frac{v + v_o}{v - v_s} \right) f = \left(\frac{343}{343 - 40} \right) 320 = 362.2 \text{ Hz}$$

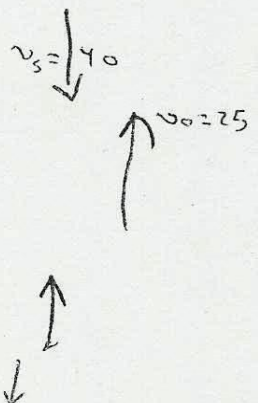
$$\lambda' = \lambda - \Delta \lambda = \frac{v}{f} - \frac{v_s}{f} = \frac{343 - 40}{320} = 0.95 \text{ m}$$

$$32) a) f' = \left(\frac{v + v_o}{v - v_s} \right) f = \left(\frac{343 + 25}{343 - 40} \right) 2500$$

$$= \left(\frac{368}{303} \right) 2500 = 3.036 \times 10^3 \text{ Hz}$$

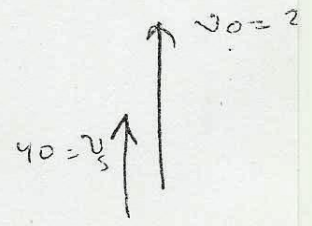
$$b) f' = \left(\frac{v - v_o}{v + v_s} \right) f = \left(\frac{343 - 25}{343 + 40} \right) 2500 = \left(\frac{318}{383} \right) 2500$$

$$= 2.075 \times 10^3 \text{ Hz}$$

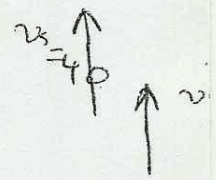


(4)

c) a') $f' = \left(\frac{v - v_0}{v - v_s} \right) f = \left(\frac{343 - 25}{343 - 40} \right) 2500$
 $= \left(\frac{318}{303} \right) 2500 = 2.623 \times 10^3 \text{ Hz}$



b') $f' = \left(\frac{v + v_0}{v + v_s} \right) f = \left(\frac{348}{383} \right) 2500 = 2.402 \times 10^3 \text{ Hz}$



33) $560 = \left(\frac{343 + 0}{343 - v_s} \right) f \longrightarrow \textcircled{1}$

$480 = \left(\frac{343}{343 + v_s} \right) f \longrightarrow \textcircled{2}$

②, ①

$\Rightarrow 560 \left(1 - \frac{v_s}{v} \right) = 480 \left(1 + \frac{v_s}{v} \right) \Rightarrow 1040 \frac{v_s}{v} = 80$

$\Rightarrow v_s = \frac{80 \times 343}{1040} = 26.4 \text{ m/s}$