

۱- الف) می تواند (ب) $\frac{1}{4}$ (پ) کمتر (ت) جرم آونگ (ث) مرئی (ج) $\frac{v}{\lambda}$

۲- الف) t_2 (ب) تندشونده (پ) t_4 (ت) خلاف جهت

۳-

$$n = \frac{\lambda Pt}{hc} = \frac{620 \times 320 \times 1}{1240 \times 1/6 \times 10^{-19}} = 10^{21}$$

۴- الف) منفی (ب) مثبت (پ) مثبت (ت) صفر (ث) ۲ بار

۵- الف

۶-

$$\frac{F_h}{F_e} = \left(\frac{R_e}{R_e + h} \right)^2 \rightarrow \frac{\frac{4}{9} F_m}{F_m} = \left(\frac{R_e}{R_e + h} \right)^2$$

$$\frac{2}{3} = \frac{R_e}{R_e + h} \rightarrow 2R_e = 2R_e + 2h \quad h + \frac{1}{3}R_e \quad r = R_e + h = 1/5 R_e = 1/5 \times 6400 = 9600 \text{ km}$$

۷- الف) ۴S

$$\Delta v_{\phi \rightarrow \lambda} = -s = -\lambda \text{ (ب)}$$

$$v_{\lambda} - v_{\phi} = -\lambda \rightarrow v_{\phi} = \Delta \rightarrow v_{\phi} = \Delta \frac{m}{s} \rightarrow t_{\phi} = 6/5s \text{ (پ)}$$

v_{λ}
ب
-۳

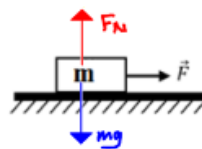
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$$m = 0.5 \text{ kg}$$

$$f_{s, \max} = \mu_s F_N = \mu_s mg = 1 \times 0.5 \times 10 = 5 \text{ N}$$

$$\text{الف) } F < f_{s, \max} \rightarrow \text{جسم ساکن} \rightarrow f_s = F = 4 \text{ N}$$

$$\text{ب) } F > f_{s, \max} \rightarrow \text{در حال حرکت} \rightarrow f_k = \mu_k F_N = 0.8 \times 5 = 4 \text{ N}$$



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$$t_s = -\frac{v_s}{a}$$

$$\Delta = \frac{-1.0}{a} \rightarrow a = -2 \frac{m}{s^2} \rightarrow -f_k = ma \rightarrow a = -\mu_k g \rightarrow -2 = -\mu_k \times g \rightarrow \mu_k = 0.2$$

۱۰- الف) P

$$\text{ب) } \Delta x = \frac{v_s v_p \Delta t}{v_p - v_s} = \frac{3 \times 1/5 \times 4 \times 6.0}{1/5 - 3} = 120.0 \text{ km}$$

۱۱- الف) طولی ب) λ

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$$\frac{A_A}{A_B} = 2$$

$$\frac{\lambda_A}{\lambda_B} = \frac{4}{8} = \frac{1}{2}$$

$$f = \frac{v}{\lambda} \quad \frac{f_A}{f_B} = \frac{\lambda_B}{\lambda_A} = 2$$

$$\frac{I_A}{I_B} = \left(\frac{f_A}{f_B} \times \frac{A_A}{A_B} \right)^2 \times \left(\frac{r_B}{r_A} \right)^2 = (2 \times 2)^2 = 16$$

$$\Delta \beta = 10 \log \frac{I_A}{I_B} = 10 \log 2^4 = 40 \log 2 = 12 \text{ dB}$$

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$$\frac{\sin \theta_r}{\sin \theta_i} = \frac{\lambda_r}{\lambda_i} \rightarrow \frac{\sin \theta_r}{\sin \theta_i} = \frac{1}{1.6} \rightarrow \sin \theta_r = \frac{1}{2} \rightarrow \theta_r = 30^\circ$$

ب- محیط ۱

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$$A = 0.5 \text{ m} \quad m = 0.5 \text{ kg} \quad f = 2 \text{ Hz} \quad E = km = 8.0 \times 10^{-3} \text{ J}$$

$$E = 2m\pi^2 A^2 f^2 \rightarrow A \times 10^{-2} = 2 \times 0.5 \times 10^{-1} \times 10 \times 25 \times 10^{-4} f^2 \rightarrow f = 2 \text{ Hz}$$

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$$\rho = 4 \times 10^3 \frac{kg}{m^3}$$

$$v = \lambda f = 0.4 \times 25 = 10 \frac{m}{s} = \frac{3\lambda}{2} \rightarrow \lambda = 4 \text{ cm} \quad v = \sqrt{\frac{F}{\rho A}} \rightarrow 10 = \sqrt{\frac{F}{4 \times 10^3 \times 10^{-5}}}$$

$$\rightarrow 10^2 = \frac{F}{4 \times 10^{-2}}$$

$$F = 4N$$

۱۶- الف) $+3/4 \text{ eV}$ ب) $-13/6 \text{ eV}$ پ) از $n = 0$ به $n = 3$

$$hf = \Delta E \rightarrow \frac{hc}{\lambda} = \Delta E \rightarrow \lambda_{\min} = \frac{1240}{0.0101} = 121 \text{ nm}$$

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$$\frac{hc}{\lambda} = \Delta E = E_u - E_1 \rightarrow \frac{1224}{120} = E_u - \left(-\frac{13}{6}\right) \rightarrow 10.2 = \frac{E_u}{\frac{3}{4 \text{ eV}}} + 13/6 \rightarrow E_u = \frac{-E_R}{n_u^2} \rightarrow n_u^2 = 4$$

$$\rightarrow n_u = 2$$

ب- فرابنفش

۱۸- الف) (۲) ب) (۱)

$$\rightarrow n = 7 \rightarrow n = \frac{t}{T_{\frac{1}{7}}} \rightarrow v = \frac{t}{15} \rightarrow t = 1.5 \text{ day}$$