# 试卷参考答案

## 一、填空题：（12 题，共 48 分）

1. $v=\sqrt{(\frac{dx}{dt})^2+(\frac{dy}{dt})^2}=12(m/s)$　　$a_t=\frac{dv}{dt}=0$　　$a_n=\frac{v^2}{R}=\frac{12^2}{3}=48(m/s^2)$

2. $J=\frac{1}{3}m(2R)^2+\frac{1}{2}mR^2+m(3R)^2=10\frac{5}{6}mR^2$

3. $\omega(t+\frac{x_0}{u})+\varphi=\omega t+\varphi_0$　　$y=A\cos[\omega(t+\frac{x}{u})+\varphi_0-\frac{\omega x_0}{u}]$ (m)

4. $\Delta\varphi=\frac{\pi}{4}-\frac{2\pi}{16}(14-12)=0$　　$A=A_1+A_2=0.50(m)$

5. 速率大小在 $v_1\sim v_2$ 之间的分子的平动动能之和。

6. $A=\sqrt{A_1^2+A_2^2+2A_1A_2\cos(\varphi_2-\varphi_1)}=\sqrt{6^2+2^2+24\cos\pi}\times10^{-2}=4\times10^{-2}(m)$　　$\varphi=\frac{\pi}{2}$

7. $E=\nu\frac{i}{2}RT=\frac{i}{2}pV$　　$\frac{E_1}{E_2}=\frac{i_1pV_1}{i_2pV_2}=\frac{5\times1}{3\times2}=\frac{5}{6}$

8. $\Delta S=\nu C_V\ln\frac{T}{T_0}+\nu R\ln\frac{V}{V_0}=R(\frac{3}{2}\ln\frac{0.5\times4}{1}+\ln\frac{4}{1})=\frac{7}{2}R\ln2$

9. $\nu'=\frac{u+v}{u-(v_S-v)}\nu=\frac{340+20}{340-10}\times440=480(Hz)$

10. $A=E-E_0=m_0c^2(\frac{1}{\sqrt{1-0.6^2}}-1)=\frac{1}{4}m_0c^2$

11. $\Delta t'=\frac{\Delta t-\Delta x\cdot u/c^2}{\sqrt{1-u^2/c^2}}=-\frac{2L_0\cdot u/c^2}{\sqrt{1-u^2/c^2}}$

12. $\Phi_e=\oint E\cdot dS=b\cdot(2a-a)\cdot a^2=ba^3$　　$q=\varepsilon_0\Phi_e=\varepsilon_0ba^3$

## 二、计算题：（6 题，共 52 分）

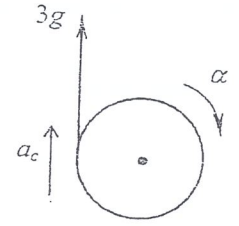
1. $T-mg=ma_c$　　$TR=J\alpha=\frac{1}{2}mR^2\alpha$

$a_c=3g-\alpha R$

或：非惯性系瞬时轴　$(mg+3mg)R=(\frac{1}{2}mR^2+mR^2)\alpha$

或：非惯性系质心轴　$mg+3mg-T=ma'$　　$a'=\alpha R$

$\alpha=\frac{8g}{3R}$　　$a_c=\frac{g}{3}$　　$T=\frac{4}{3}mg$




2. $mv_0l=J\omega$　　$J=\frac{1}{3}Ml^2+ml^2$　　$\frac{1}{2}J\omega^2=2mgl+Mgl$

或：$\frac{1}{2}J\omega^2=(m+M)g\cdot2l_c$　　$l_c=\frac{Ml/2+ml}{m+M}$

$v_0=\frac{1}{m}\sqrt{\frac{2}{3}gl(M+2m)(M+3m)}$

3. (1) $\int_0^{v_0} Av^3 dv = \frac{A}{4}v_0^4 = 1 \qquad A = \frac{4}{v_0^4}$

(2) $\int_0^{v_0} vAv^3 dv = \frac{A}{5}v_0^5 = \frac{4}{5}v_0$

(3) $\int_0^{v_1} Av^3 dv = \frac{A}{4}v_1^4 = \frac{1}{81} \qquad v_1 = \frac{v_0}{3}$

4. $i = 3 \qquad \gamma = \frac{5}{3} \qquad p_b V_b^\gamma = p_c V_c^\gamma$

$p_c = p_b(\frac{V_b}{V_c})^\gamma = 10.4 \times (\frac{1.22}{9.13})^{5/3} = 0.36(\text{atm})$

(1) $Q_{ab} = \nu C_V \Delta T = \frac{i}{2}(p_b - p_c)V_b = 1.86 \times 10^6(\text{J})$

$Q_{ca} = \nu C_p \Delta T = \frac{i+2}{2}p_c(V_b - V_c) = -7.28 \times 10^5(\text{J}) \qquad Q_{bc} = 0$

(2) $A = Q_{ab} + Q_{ca} = 1.13 \times 10^6(\text{J})$

(3) $\eta = \frac{A}{Q_{ab}} = 0.61$

5. $\omega = 2\pi\nu = \frac{2\pi u}{\lambda}$

$y = A\cos(\omega t + \varphi) \qquad \cos(2\omega + \varphi) = 0$

$2\omega + \varphi = -\frac{\pi}{2} \qquad \varphi = -2\omega - \frac{\pi}{2}$

$y = A\cos[\frac{2\pi u}{\lambda}(t-2) + \frac{2\pi x}{\lambda} - \frac{\pi}{2}]$

$y_P = A\cos[\frac{2\pi u}{\lambda}(t-2) + \frac{2\pi}{\lambda}\cdot\frac{\lambda}{2} - \frac{\pi}{2}] = A\cos[\frac{2\pi u}{\lambda}(t-2) + \frac{\pi}{2}]$

6. (1) $\oint E \cdot dS = \frac{1}{\varepsilon_0}\int \rho dV$

$0 \le r \le R \qquad E_1 \cdot 4\pi r^2 = \frac{1}{\varepsilon_0}q'$

$q' = \int kr^2 \cdot 4\pi r^2 dr = \frac{4}{5}k\pi r^5 \qquad E_1 = \frac{kr^3}{5\varepsilon_0}$

$R \le r < \infty \qquad E_2 \cdot 4\pi r^2 = \frac{1}{\varepsilon_0}q''$

$q'' = \int_0^R kr^2 \cdot 4\pi r^2 dr = \frac{4}{5}k\pi R^5 \qquad E_2 = \frac{kR^5}{5\varepsilon_0 r^2}$

(2) $dF = Edq \qquad dq = \lambda dr$

$F = \int Edq = \int_{R+l}^{R+2l} \frac{kR^5}{5\varepsilon_0 r^2}\cdot\lambda dr = \frac{k\lambda R^5}{5\varepsilon_0}(\frac{1}{R+l} - \frac{1}{R+2l})$