

所別： 水文科學研究所碩士班

科目： 普通物理

1. Start from rest, a disk of radius r (0.5 m) has a constant angular acceleration α ($3.0 \text{ radians / sec}^2$), find (a) the linear or tangential speed of a particle on the rim, (b) the tangential acceleration of a particle on the rim, and (c) the centripetal acceleration of a particle on the rim, at the end of $t = 2.0$ second. [15%]
2. The attractive gravitational force between two spherical masses M and m can be written in vector form as $\mathbf{F} = -GMm/r^2 \mathbf{r}$, and the corresponding gravitational potential energy is $U = -GMm/r$.
 - (a) Show that the total mechanical energy of a satellite in a circular orbit r is $E = -GM_E m / 2r$ [10%]
 - (b) How much work must be done to lift an artificial satellite of mass m from the surface of the earth and put it in a circular orbit with a radius equal to twice the earth's radius (R_E)? [5%]
 - (c) Estimate the escape velocity (v_0) which is the minimum velocity required for a projectile fired vertically at the earth's surface to escape the gravitational force. [5%]
3. If the motions of the matter particles conveying the wave are perpendicular to the direction of propagation of the wave itself, we have a *transverse* wave. If the motion of the particles conveying a mechanical wave is back and forth along the direction of propagation, we then have a *longitudinal* wave. Please give four examples of waves (including sound waves, surface water waves) and explain what type of waves they belong. [15%]
4. Any system of mass m upon which a force $F = -kx$ acts (x is displacement from an equilibrium point) will be governed by $d^2x/dt^2 + k^1 m x = 0$, which is called simple harmonic oscillator. Please write a general solution for the equation of motion of a simple harmonic oscillator. Give some examples of motions that are approximately simple harmonic. [20%]
5. The speed of electromagnetic waves in vacuum is $3 \times 10^8 \text{ m s}^{-1}$. (a) Wavelengths in the visible part of the spectrum (light) range from about 4×10^{-7} meter in the violet to about 7×10^{-7} meter in the red. What is the range of frequencies of light waves? (b) The range of frequencies for shortwave radio (for example, FM radio and VHF television) is 1.5 megacycles/sec to 300 megacycles/sec. What is the corresponding wavelength range? (c) X rays are also electromagnetic. Their wavelength range extends from about 5×10^{-9} meter to 1.0×10^{-11} meter. What is the frequency range for x rays? [15%]
6. Explain the following: (a) temperature, (2) pressure, (3) the ideal gas law, (4) diffusion, (5) osmotic pressure. [15%]

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