

所別：太空科學研究所碩士班

科目：普通物理

1. Terminology and short questions. (10%)
 - (i) state Kepler's laws and their applications
 - (ii) state Maxwell's equations and their applications
2. An object experiences a potential of $U=4(x-5)^2$. If the total energy is 36 joules, determine (i) the turning points, (ii) the stable equilibrium point, and (iii) the force at $x=3$ meters. (10%)
3. A space vehicle is traveling at 3600 km/hr with respect to the Earth when the exhaust motor is disengaged and sent backwards at 90 km/hr with respect to the command module. The mass of the motor is 5 times the mass of the module. Determine the speed of the command module after separation. (10%)
4. Two 2.0 kg balls are attached to opposite ends of thin horizontal 50 cm long rod of negligible mass. The rod is free to revolve about a horizontal axis through its center. A 50 gram putty wad drops onto one of the balls with a speed of 3.0 m/s and sticks to it. What is the angular speed of the system just after the putty hits? (10%)
5. A damped harmonic oscillator consists of a block ($m=100$ kg) and a spring ($k=630\text{nt/m}$). During the first 10 seconds the oscillator executes 4 complete oscillations and amplitude decrease 50% of the initial amplitude. (i) What fraction of the amplitude (in %) is lost in each cycle and (ii) What is the undamped resonant angular frequency of the oscillator (in rad/sec). (10%)
6. An 80 cm long wire is stretched between fixed supports. It resonates at 350 and 420 Hz with and at no other frequencies in between. (i) What is the lowest resonant frequency of this string (in Hz)? (ii) What is the wave speed in the string (in m/s)? (10%)
7. Two isolated solid conducting spheres A and B have radii R and $2R$ and charges of $-Q$ and $+2Q$, respectively. The spheres are brought in contact and then separated. What are (i) the charges of the two spheres and (ii) the associated electric fields on the two spheres, respectively? (10%)
8. A beam of 0.90 keV identical charged particles pass through mutually perpendicular electric and magnetic fields of 10500 V/m and 63.2 millitesla without being deflected. When the magnetic field is turned off the particle experiences a force of 5.04×10^{-15} Newtons. Determine (i) the mass and (ii) charge of the particles. (10%)
9. A copper ring of resistance 7.5×10^{-3} ohms and area magnetic field 58.5 m^2 is placed symmetrically in a circular magnetic field of area 20 m^2 . The time varying field is given by $B = 0.15 \sin(2\pi t)$ tesla. Determine the maximum value of the induced (i) EMF and the (ii) current. (10%)
10. Two airplanes are equipped with radio receivers which are able to detect signals as weak as 2.5×10^{-10} watt/ m^2 . The transmitters in each plane radiates at 100 watts in all directions. Determine the maximum distance apart the planes can be and still communicate. (10%)

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