

編號： 471 系所：環境醫學研究所甲組

科目：物理學

本試題是否可以使用計算機： 可使用， 不可使用（請命題老師勾選）

1. A boy is driving along a straight highway. At time $t = 0$, when the boy is moving at 10 m/s in the positive x -direction, he passes a signpost at $x = 50$ m. His acceleration is a function of time:

$$a = 2.0 \text{ m/s}^2 - (0.10 \text{ m/s}^3)t.$$

- a) Derive expressions for his velocity and position as functions of time. (2.5%) b) At what time is his velocity greatest? (2.5%) c) what is the maximum velocity? (2.5%) d) Where is the car when it reaches maximum velocity? (2.5%)
2. In a carnival ride, the passengers travel at constant speed in a circle of radius 5.0 m. They make one complete circle in 4.0 s. What is their acceleration? (10%)
3. One kilogram of water at 0°C is heated 100°C . Compute its change in entropy. (10%)
4. On a day when the speed of sound is 345 m/s, the fundamental frequency of a stopped organ pipe is 220 Hz. a) How long is this stopped pipe? (5%) b) The second *overtone* of this pipe has the same wavelength as the third *harmonic* of an open pipe. How long is the open pipe? (5%)
5. The Concorde is flying at Mach 1.75 at an altitude of 8000 m, where the speed of sound is 320 m/s. How long after the plane passes directly overhead will you hear the sonic boom? (10%)
6. The plates of a parallelplate capacitor in vacuum are 5.00 mm apart and 2.00 m^2 in area. A potential difference of 10,000 V (10.0 kV) is applied across the capacitor. Compute a) the capacitance; (5%) b) the charge on each plate; (2.5%) and c) the magnitude of the electric field in the space between them. (2.5%)
7. A coil consisting of 100 circular loops with radius 0.60 m carries a current of 5.0 A. a) Find the magnetic field at a point along the axis of the coil, 0.80 m from the center. (5%) b) Along the axis, at what distance from the center is the field magnitude 1/8 as great as it is at the center? (5%)
8. A gamma-ray photon emitted during the decay of a radioactive cobalt-60 nucleus has an energy of $2.135 \times 10^{-13} \text{ J}$. What are the frequency and wavelength of this electromagnetic radiation? (10%)
9. You direct a beam of x rays with wavelength 0.154 nm at certain planes of a silicon crystal. As you increase the angle of incidence from zero, you find the first strong interference maximum from these planes when the beam makes an angle of 34.5° with the planes. a) How far apart are the planes? (5%) b) Will you find other interference maxima from these planes at larger angles? (5%)

(背面仍有題目,請繼續作答)

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10. Before 1900 the activity per mass of atmospheric carbon due to the presence of ^{14}C averaged about 0.255 Bq per gram of carbon. a) What fraction of carbon atoms were ^{14}C ? (5%) b) In analyzing an archeological specimen containing 500 mg of carbon, you observe 174 decays in one hour. What is the age of the specimen, assuming that its activity per mass of carbon when it died was that average value of the air? (5%)