

※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

1. The 2020 Nobel Prize in Physics was awarded jointly to Roger Penrose from Britain, Reinhard Genzel from Germany and Andrea Ghez from the US. Please describe their discoveries in brief. (10%)
2. Calculate the wavelength in nm of electrons which have been accelerated from rest through a potential difference of 54V. (15%)
3. In the Bohr model of the hydrogen-like atom of atomic number Z the atomic energy levels of a single-electron are quantized with values given by $E_n = \frac{Z^2 m e^4}{8 \epsilon_0^2 h^2 n^2}$, where m is the mass of the electron, e is the electronic charge, and n is an integer greater than zero (principal quantum number).
 - (a) What additional quantum numbers are needed to specify fully an atomic quantum state and what physical quantities do they quantify? (10%)
 - (b) List the allowed quantum numbers for $n = 1$ and $n = 2$ and specify fully the electronic quantum numbers for the ground state of the Carbon atom (atomic number $Z = 6$). (10%)
4. A 1.00 g marble is constrained to roll inside a tube of length $L = 1$ cm. The tube is capped at both ends.
 - (a) Modelling this as a one-dimensional infinite square well, determine the value of the quantum number n if the marble is initially given an energy of 1 mJ. (10%)
 - (b) Calculate the excitation energy required to promote the marble to the next available energy state. (10%)
5. Use the uncertainty principle to make an order of magnitude estimate for the kinetic energy (in eV) of an electron in a hydrogen atom. (15%)
6. X-rays with an energy of 300 keV undergo Compton scattering with a target. If the scattered X-rays are detected at 30° relative to the incident X-rays, determine below.
 - (a) The Compton shift at this angle. (8%)
 - (b) The energy of the scattered X-ray. (6%)
 - (c) The energy of the recoiling electron. (6%)

試題隨卷繳回