1. Describe below in brief.
   (a) LIGO (2%) (b) Big Bang (2%) (c) Fermions (2%)
   (d) Wien's displacement law (2%) (e) Cooper pairs (2%).

2. Twin A makes a round trip at 0.6*c* to a start 12 light-years away, while twin B stays on the earth. Each twin sends the other a signal once a year by his own reckoning.
   (a) How many signals does A send during the trip? How about B? (5%)
   (b) How many signals does A receive? How about B? (5%)

3. Calculate the wavelength in nm of electrons which have been accelerated from rest through a potential difference of 6 V. (20%)

4. We wish to measure simultaneously the wavelength and position of a photon. Assume the wavelength measurement gives $\lambda = 600$ nm to an accuracy to one part in a million, that is, $\Delta\lambda/\lambda = 10^{-6}$. Determine the minimum uncertainty in the position of the photon. (20%)

5. A light source of wavelength λ illuminates a metal and ejects photoelectrons with a maximum kinetic energy of 1.00 eV. A second light source with half the wavelength of the first ejects photoelectrons with a maximum kinetic energy of 4.00 eV. Determine the work function of the metal. (20%)

6. A proton is confined in an infinite square well of width 10 fm. (The nuclear potential that binds protons and neutrons in the nucleus of an atom is often approximated by an infinite square well potential.)
   (a) Calculate the energy and wavelength of the photon emitted when the proton undergoes a transition from the first excited state ($n = 2$) to the ground state ($n = 1$). (15%)
   (b) In what region of the electromagnetic spectrum does this wavelength belong? (5%)