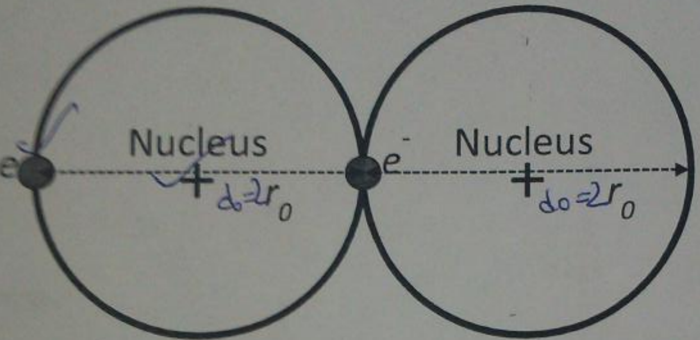
Total = 15 marks

EPL – 336 (Semiconductor Optoelectronics)

problems are compulsory. Answer all sub-parts of the same question in one sequence.

exam will be graded on a step-by-step basis, with partial credit being awarded for correct steps iques even if the answer is wrong. **FULL** credit will be awarded only if the right answer is obtained ght reason. **NO** credit will be given if the calculations are not completed and proper units not mentio if correct formulae have been used.

nsider two hydrogen atoms in contact as shown in the figure below.



ppose that one electron (1) is at the center and the other (2) is at the far left so that the two elect oid each other and the center electron is attracted by both nuclei, thereby enabling a covalent bond. dius r_o of the H atom is 0.0529nm and the PE of an isolated H atom is -27.2eV.

) Calculate the total PE of all the charges when they are arranged as shown in the figure. Is energetically favorable? [3]

) Using the Virial theorem, find the change in the total energy and hence the covalent bond energy. does this compare with 4.51eV? [2]

plain on the basis of energy bands and using band diagrams, why the sodium chloride crystal is a sulator. [3]

fusion reaction important in solar energy production involves capture of a proton by a carbon nuc ich has six times the charge of a proton and a radius $r \sim 2.0$fm.

) Estimate the Coulomb potential V experienced by the proton if it is at the nuclear surface. [2]

) Estimate the total energy of the proton assuming it to be $\sim 10k_BT$ where T is the internal tempera of the Sun (10^7 °K). Compare it with the height of the Coulomb barrier. [1]

) Calculate the probability that the proton can penetrate a rectangular barrier potential of hei extending from r to $2r$, the point at which the barrier potential drops to $V/2$. [2]

) Is the penetration through the actual Coulomb barrier potential greater or less than the rectan potential of (c)? [2]