TSOKOS READING ACTIVITY
Section 12-1B

1. Essential Idea: The microscopic quantum world offers a range of phenomena, the interpretation and explanation of which require new ideas and concepts not found in the classical world.

2. Nature Of Science:

   a. Observations: Much of the work towards a quantum theory of atoms was guided by the need to explain the observed patterns in atomic spectra. The first quantum model of matter is the Bohr model for hydrogen. (1.8)

   b. Paradigm shift: The acceptance of the wave–particle duality paradox for light and particles required scientists in many fields to view research from new perspectives.

3. Theory Of Knowledge:

   a. The duality of matter and tunnelling are cases where the laws of classical physics are violated.

   b. To what extent have advances in technology enabled paradigm shifts in science?

4. Understandings:

   a. Photons

   b. The photoelectric effect

   c. Matter waves

   d. Pair production and pair annihilation

   e. Quantization of angular momentum in the Bohr model for hydrogen

   f. The wave function

   g. The uncertainty principle for energy and time and position and momentum

   h. Tunneling, potential barrier and factors affecting tunneling probability

5. Applications And Skills:

   a. Discussing the photoelectric effect experiment and explaining which features of the experiment cannot be explained by the classical wave theory of light

   b. Solving photoelectric problems both graphically and algebraically

   c. Discussing experimental evidence for matter waves, including an experiment in which the wave nature of electrons is evident

   d. Stating order of magnitude estimates from the uncertainty principle

6. Guidance:

   a. The order of magnitude estimates from the uncertainty principle may include (but is not limited to) estimates of the energy of the ground state of an atom, the impossibility of an electron existing within a nucleus, and the lifetime of an electron in an excited energy state

b. Tunnelling to be treated qualitatively using the idea of continuity of wave functions

7. Data Booklet Reference:

    a. $E = hf$

    b. $E_{max} = hf - \Phi$

    c. $E = -\dfrac{13.6}{n^2} eV$

    d. $mvr = \dfrac{nh}{2\pi}$

    e. $P(r) = |\psi|^2 \Delta V$

    f. $\Delta x \Delta p \geq \dfrac{h}{4\pi}$

    g. $\Delta E \Delta t \geq \dfrac{h}{4\pi}$

8. Utilization:

    a. The electron microscope and the tunnelling electron microscope rely on the findings from studies in quantum physics

    b. Probability is treated in a mathematical sense in Mathematical studies SL sub-topics 3.6–3.7

9. Aims:

    a. Aim 1: study of quantum phenomena introduces students to an exciting new world that is not experienced at the macroscopic level. The study of tunneling is a novel phenomenon not observed in macroscopic physics.

    b. Aim 6: the photoelectric effect can be investigated using LEDs

    c. Aim 9: the Bohr model is very successful with hydrogen but not of any use for other elements

10. Read pages 492 to 502 in your textbook.

11. Create a block diagram showing how the terms listed below are related to each other:

    a. Angular momentum

    b. Quantized energy

    c. Schrödinger Theory

    d. Wavefunction

    e. Copenhagen interpretation

    f. Heisenberg Uncertainty Principle

    g. Electron in a box

    h. Uncertainty in energy and time

    i. Uncertainty in position and momentum

    j. Tunnelling

For illustrative purposes only
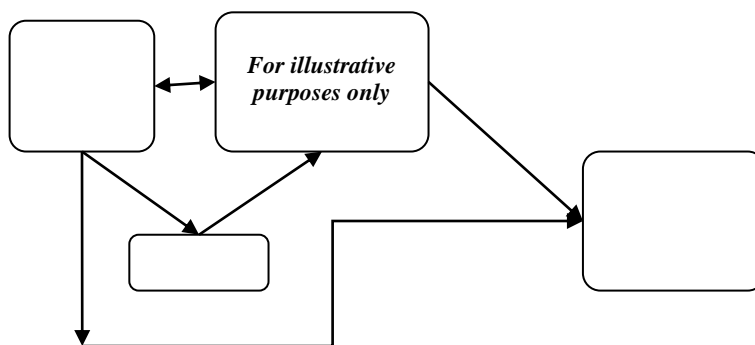
12. The diagram may be freehand, but try to make use of the 'Flowchart' section of the MS 'Shapes' function or make a pictorial chart using the 'Insert' 'Clipart" function of MS Word.

13. You do not need to include these instructions with your diagram as long as you remember to put your name on it!!!!!!!!!!!!!!!