

**1. Transmission Electron Microscopy****Problems**

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1.1. Are there any advantages to using high-energy electrons instead of visible light to image nanomaterials? Explain. (Do not duplicate verbatim text given in these notes or from other sources!)

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1.2. These questions involve the wavelength  $\lambda$  of electrons accelerated to relativistic energy  $E$ .

a) Write a formula for  $\lambda$ .

b) Compute  $\lambda$  (in nm) for the energies listed below:

i) 52 KeV                      ii)  $8.5 \times 10^2$  KeV                      iii) 4.1 MeV

Express your answers with appropriate significant figures.

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1.3. Express the following lengths in units of nm:

a)  $2.7 \times 10^{-6}$  in                      b)  $0.142 \mu\text{m}$                       c)  $68 \text{ \AA}$

d) the distance light travels in a vacuum in 0.56 fs. (1 fs =  $10^{-15}$  s)

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1.4. Find the angle  $\theta$  (in rad) subtended by an arc of length  $\ell = 0.80$  mm with radius of curvature  $R = 6.4$  mm.

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