Chapter 7 Outline 99/00

Lesson length = 65 mins
Lessons available: 6

Section	Lessons	Main concepts and key words	In class	Private study
7.1	2	Graininess of photons, random arrival (cf wave model in Ch6) E=hf	Display D20S Images with increasing exposure, Demo A20D Listening to photons arriving; perhaps demo photoelectric effect and read SG p.161 Experiment A10E Relating energy to frequency, Q20S Photons streaming from a lamp	Reading 30T The range of quantum physics SG p.164 Q1,2
		Quantum behaviour – 'try all paths' approach, phasors lining up and curling up, probability $\propto A^2$	Quick demos of models, based on A50S How exploring paths leads to arrows, A60S Curl and line; displays D30O A path contributes an arrow, D40O Finding probabilities, D50O Three paths to an amplitude, SG p.163 Q10S Rotations for exploring paths, Q30S Path lengths and arrow rotations	SG p.164 Q 3,4
		2 slit interference as first example	Models: trundle wheel, many paths software A70S A photon explores two holes	SG p.164 Q5,6
7.2	2	Quantum description of optical phenomena: Reflection	Trundle wheels – quick(?) version of A80E Calculating for a mirror on the bench. Many paths software A90S Calculating for a mirror on the screen; D70O Mirror: Putting all the lessons together, SG p.165	Q40S Three paths on a mirror, Q50S Path triplets on a mirror (get started on this in class?)
		Rectilinear propagation	Models A120S Many photons make a beam, A130S photons propagating, SG p.168	
		Least time path is where phasors line up	D110O Making connections between trip times and arrows; perhaps models A100S Trip times for a mirror, A110S A few mirror paths	

		Reflection gratings – removing some paths Curved mirrors Refraction Single-slit diffraction	Model A140S Checking the ends of the mirror (confusing instructions?), possibly A150P Reflection gratings: a selection Model A170S Engineering a focusing mirror Perhaps lens OHT D180O Quick recap, D190P Many paths for a single slit	Q60X Spacing a grating, Q70X CD: Mirror and grating?; perhaps A160H CD – many paths at home One of Q80D A large mirror, Q90C Mirror for precision engineering Read SG p.166-7, Q100S Paths through a block; optional extras A180S Least time and refraction, A 190S Refraction and least time, A200S Engineering a lens Read SG p.169-70, perhaps A 210S Photons explore a narrow hole, A220S A photon exploring an edge
7.3	1	Electron diffraction, $f=E_k/h$ for electron, de Broglie's formula Quantum behaviour is les obvious as KE grows	Demos: deflection tube to revise electron beams, A 240D Superposing electrons Q150S Arrows for electrons, Q160S Electrons through gratings Quick demo A250S Exploring paths with chnging kinetic energy, perhaps D210O Quantum and classical; Q170S More kinetic energy, more classical	Extra reading for more able: R10T The principle of least action, R20W Energy, momentum and quantum behaviour, 40T How 'try all paths' predicts the wavelength for particles Qs from SG p.173