A-Level Paper 3 Personal Learning Checklist

A. Practical Skills

LO	Learning Objectives:	Confidence		
A1	Solve problems set in practical contexts			
A2	Apply scientific knowledge to practical contexts			
A3	Comment on experimental design			
A4	Evaluate scientific methods.			
A5	Present data in appropriate ways			
A6	Evaluate results.			
A7	Draw conclusions with reference to measurement uncertainties and errors.			
A8	Identify variables including those that must be controlled			
A9	Plot and interpret graphs			
A10	Process and analyse data using appropriate mathematical skills as exemplified in the mathematical appendix.			
A11	Consider margins of error, accuracy and precision of data			
A12	Know and understand how to use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification			
	Core Practical			
	Investigation into the variation of the frequency of stationary waves on a string with length, tension and mass per unit length of the string.			
	Investigation of interference effects to include the Young's slit experiment and interference by a diffraction grating.			
	Determination of g by a free-fall method			
	Determination of the Young modulus by a simple method.			
	Determination of resistivity of a wire using a micrometre, ammeter and voltmeter.			
	Investigation of the EMF and internal resistance of electric cells and batteries by measuring the variation of the terminal p.d of the cell with current in it.			
	Investigation into simple harmonic motion using a mass-spring system and a simple pendulum.			
	Investigation of Boyle's (constant temperature) law and Charles's (constant pressure) law for a gas.			
	Investigation of the charge and discharge of capacitors. Analysis techniques should include log-linear plotting leading to a determination of the time constant RC.			
	Investigate how the force on a wire varies with flux density, current and length of wire using a top pan balance.			
	Investigate, using a search coil and oscilloscope, the effect on magnetic flux linkage of varying the angle between a search coil and magnetic field direction.			
	Investigation of the inverse-square law for gamma radiation.			

12. Turning Points

LO	Learning Objectives:	Confidence		
12.01	State what is meant by a cathode ray.			
12.02	Describe the structure of a discharge tube.			
12.03	Explain how cathode rays are produced in a discharge tube.			
12.04	Describe thermionic emission.			
12.05	Calculate the work done in accelerating an electron through a potential difference using $1/mv^2 = eV$			

12.06	Determine the specific charge of an electron.			
12.07	Explain the significance of Thomson's determination of the specific charge of an electron.			
12.08	Compare the specific charge of an electron to a hydrogen ion.			
12.09	State the conditions for holding a charged oil droplet stationary between two oppositely charged parallel plates.			
12.10	Understand and use $QV / d = mg$			
12.11	Describe the motion of a falling oil droplet without an electric field.			
12.12	Describe the motion of a falling oil droplet with an electric field.			
12.13	Use the terminal speed to determine the mass and charge of the droplet.			
12.14	State Stokes' law.			
12.15	Understand and use $F = 6\pi\eta rv$			
12.16	Explain the significance of Millikan's results.			
12.17	Explain why charge is considered quantised.			
12.18	State what is meant by wave-particle duality.			
12.19	Describe Huygen's wave theory in general terms.			
12.20	Describe Newton's corpuscular theory of the light.			
12.21	Compare Huygen's wave theory to Newton's corpuscular theory of light.			
12.22	Explain why Newton's theory was preferred.			
12.23	Explanation of fringes in Young's double slit experiment. (No calculations expected here).			
12.24	Explain why there was a delayed acceptance of Huygen's wave theory of light.			
12.25	Describe the nature of electromagnetic waves.			
12.26	Calculate the speed of electromagnetic waves in a vacuum using Maxwell's formula: $c = 1 / \sqrt{(m_0\varepsilon_0)}$			
12.27	Appreciate that m_0 relates to the electric field strength due to a charged object in free space and ε_0 relates to the magnetic flux density due to a current-carrying wire in free space.			
12.28	Describe how Hertz discovered radio waves.			
12.29	Describe how Hertz was able to take measurements to find the speed of radio waves.			
12.30	Describe Fizeau's determination of the speed of light			
12.31	Explain the implications of Fizeau's determination of the speed of light			
12.32	Describe the ultraviolet catastrophe.			
12.33	Describe the black-body radiation.			
12.34	Explain Planck's interpretation of photoelectricity in terms of quanta.			
12.35	Explain why classical wave theory failed to explain the observations of photoelectricity.			
12.36	Explain Einstein's explanation of photoelectricity.			
12.37	Describe the significance of Einstein's explanation of photoelectricity in terms of the nature of electromagnetic radiation.			
12.38	State de Broglie's hypothesis: $p = h / \lambda$; $\lambda = h / \sqrt{(2meV)}$			
12.39	Describing low-energy electron diffraction experiments.			
12.40	Explain the effect of a change of electron speed on the diffraction pattern.			
12.41	Estimate the anode voltage needed to produce wavelengths of the order of the size of the atom.			
12.42	Describe the principles of operation of the transmission electron microscope (TEM).			
12.43	Describe the principles of operation of the scanning tunneling microscope (STM).			
12.44	Describe the principles of the Michelson-Morley interferometer.			
12.45	Outline of the experiment as a means of detecting absolute motion.			
12.46	Explain the significance of the failure to detect absolute motion.			

12.47	State the invariance of the speed of light.			
12.48	Describe the concept of an inertial frame of reference.			
12.49	State the two postulates of Einstein's theory of special relativity.			
12.50	Explain the difference between proper time and time dilation as a consequence of special relativity.			
12.51	Calculate the time dilation using: $t = t_0 / \sqrt{(1 - (v^2 / c^2))}$			
12.52	Describe the evidence for time dilation from muon decay.			
12.53	Calculate length contraction using: $l = l_0 \sqrt{(1 - (v^2 / c^2))}$			
12.54	Calculate the equivalence of mass and energy using: $E = mc^2$ and $E = m_0c^2 / \sqrt{(1 - (v^2 / c^2))}$			
12.55	Sketch a graph of mass against speed.			
12.56	Sketch a graph of kinetic energy with speed.			
12.57	Describe Bertozzi's experiment.			
12.58	Explain how Bertozzi's experiment is direct evidence for the variation of kinetic energy with speed.			