Year 12 Physics Revision Table

Topics 9-12

Topic 9: Electromagnetic Waves

Expectation From SACE Subject Outline *Note: these can be asked in converse*	***Summary of things I know about this*** (for formulae, for example, this could be: what the symbols mean, what the units of each variable is, and some possible rearrangements)	***Example question(s) to practice until I can do under test conditions without help*** There are likely to be some in the textbook too; also take note of questions you'd like examples of from the teacher
Describe the relation between the oscillating electric and magnetic fields and the direction of travel of an electromagnetic wave.		Assignment Q1
Relate the frequency of radio or television waves to the frequency of oscillation of the electrons in the transmitting antenna.		Assignment Q2 (a), (c)
Relate the orientation of the receiving antenna to the plane of polarisation of radio or television waves.		Assignment Q2 (b) Mid Year Exam Q17 (c) (i)
Explain why transmissions from some country television channels are polarised at right angles to city channels.		Assignment Q3 Mid Year Exam Q17 (d)
Solve problems involving the use of $v = f\lambda$.		Assignment Q2 (d) Mid Year Exam Q17 (c) (ii)
Explain how the depth of a body of water can be determined by the detection of reflections of laser light from the surface and the bottom of the water.		Assignment Q4 (a)
Calculate the depth of water from given reflection times at normal incidence and the given speed of the light in water.		Assignment Q4 (b) Mid Year Exam Q17 (a)
Justify the use of powerful lasers because of light losses due to factors such as scattering by suspended sediment and absorption.		Assignment Q4 (c) Mid Year Exam Q17 (b)

Topic 10: Interference of Light

Expectation	*Summary of things I know about this*	*Example question(s) to practice*
Describe what is meant by two wave sources being in phase or out of phase.		Assignment 1 Q1 (a)
Give a qualitative explanation of why light from an incandescent source is neither coherent nor monochromatic.		Assignment 1 Q1 (b)
Describe constructive and destructive interference in terms of the principle of superposition.		Assignment 1 Q1 (c)
Perform a geometrical construction to identify the locations in two dimensions of the lines of maximum and minimum amplitude due to the interference of light from two wave sources of the same frequency.		
Explain the maximum and minimum amplitudes in terms of constructive and destructive interference.		
Identify the path difference associated with each line of maximum and minimum amplitude.		
Describe without detailed explanation the main feature of the diffraction of light by a narrow slit, where the width of the slit is about the same size as the wavelength.		Assignment 1 Q1 (d) Mid Year Exam Q19 (d)
Explain why a single slit is used before a double slit for two-slit interference when the light source used is not coherent.		Assignment 1 Q2 Mid Year Exam Q18 (a)
Describe how two-slit interference is produced in the laboratory.		
Describe how diffraction of the light by the slits in a two-slit interference apparatus allows the light to overlap and hence interfere.		

Sketch a graph of the intensity distribution for two-slit interference of monochromatic light. (Consider only cases where the slit separation is much greater than the width of the slits.)		Assignment 1 Q3
Explain the bright fringes of a two-slit interference pattern in terms of constructive interference, and the dark fringes in terms of destructive interference.		Assignment 1 Q3
Derive $d\sin\theta = m\lambda$ for two-slit interference, where d is the distance between the slits and θ is the angular position of the mth maximum.		Assignment 1 Q4 (a)
Solve problems involving the use of $d\sin\theta = m\lambda$ and $\Delta y = \lambda L/d$. Δy is the distance between adjacent minima or maxima on the screen and L is the slit-to-screen distance.		Assignment 1 Q4 (b)
Determine the wavelength of monochromatic light from measurements of the two-slit interference pattern.		
Describe how diffraction by the very thin slits in a grating allows the light from the slits to overlap and hence interfere to produce significant intensity maxima at large angles.		Assignment 1 Q5 (a)
Derive $d\sin\theta = m\lambda$ for the intensity maxima in the pattern produced by a transmission diffraction grating, where d is the distance between the slits in the grating and θ is the angular position of the mth maximum (m specifies the order of the maximum).		Assignment 2 Q1
Solve problems involving the use of $d\sin\theta = m\lambda$, where $d = 1/N$ for a grating with N slits per metre.		Assignment 1 Q5 (b) Mid Year Exam Q18 (c)
Sketch a graph of the intensity distribution of the maxima produced by a grating, for monochromatic light.		Assignment 2 Q2 (a) Mid Year Exam Q18 (b)

Determine, from the distance between the slits in the grating, the maximum number of orders possible for a given grating and wavelength.		Assignment 2 Q2 (b) Mid Year Exam Q19 (a)
Give a qualitative explanation of the negligible intensity between the maxima.		
Describe how a grating can be used to measure the wavelength of light from a monochromatic source.		Assignment 2 Q3
Describe and explain the white-light pattern produced by a grating.		Assignment 2 Q4 (a) Mid Year Exam Q19 (b)
Identify the properties of a grating which make it useful in spectroscopy.		Assignment 2 Q4 (b) Mid Year Exam Q19 (c)
Explain the speckle effect in terms of interference.		Assignment 2 Q5 (a)
Explain how the interference of light can be used to read the information stored on a compact disc or a DVD.		Assignment 2 Q5 (b)
Explain how a diffraction grating is used in the three-beam method to keep the laser on the correct track of a compact disc or a DVD.		Assignment 2 Q5 (c)

Topic 11: Photons

Expectation	*Summary of things I know about this*	*Example question(s) to practice*
Describe how microscopic observations of the building up of an image produced by light of very low intensity demonstrate the arrival of localised bundles of energy and momentum called 'photons'.		Assignment 1 Q1
Calculate the energy and momentum of the photons in various regions of the electromagnetic spectrum.		Assignment 1 Q2 Test Q1 (a) (i)
Describe how two-slit interference patterns build up over time when light of very low intensity is used.		Assignment 1 Q3
Describe an experimental method for investigating the relation between the maximum kinetic energy of the emitted electrons (calculated from the measured stopping voltage) and the frequency of the light incident on a metal surface.		Assignment 1 Q4 (a)
Describe how Einstein used the concept of photons and the conservation of energy to explain the photoelectric effect.		Assignment 1 Q5 Test Q1 (b)
Deduce the equation $K_{max} = hf - W$, where K_{max} is the maximum kinetic energy of the emitted electrons.		Assignment 2 Q1 (b) (3)
Plot experimental values of maximum kinetic energy versus frequency, and relate the slope and horizontal and vertical intercepts to the equation $K_{max} = hf - W$		Assignment 2 Q1 (a)
Using graphical and algebraic methods, solve problems that require the use of $K_{max} = hf - W$		Assignment 1 Q4 (b) (ii) Test Q1 (a) (ii)

Describe the following features of a simple X-ray tube: filament, target, high voltage supply, evacuated tube, and a means of cooling the target.		Assignment 2 Q2 (a) Test Q2 (a)
Explain how the electrons are accelerated in an X-ray tube, the choice of target material, and why the target needs to be cooled.		Assignment 2 Q2 (b) , (c) and (d) Test Q2 (b), (c)
Sketch a graph of the spectrum from an X-ray tube, showing the three main features of the spectrum.		Assignment 2 Q2 (e) Test Q2 (f)
Derive the equation for the maximum frequency, $f_{\max} = \frac{e\Delta V}{h}$ where ΔV is the potential difference across the X-ray tube.		Assignment 2 Q3 (a) Test Q2 (e)
Solve problems involving the use of $f_{\max} = \frac{e\Delta V}{h}$		Assignment 2 Q3 (b)
Relate the attenuation of X-rays to the types of tissue through which they pass (e.g. soft tissue or bone).		Assignment 2 Q4 (a)
Relate the penetrating power (hardness) of X-rays required to pass through a particular type of tissue to the energy and frequency of the X-rays, and hence to the potential difference across the X-ray tube.		Assignment 2 Q4 (b) Test Q2 (d)
Relate the minimum exposure time for X-ray photographs of a given hardness to the intensity of the X-rays, and hence to the tube current, which is determined by the filament current.		Assignment 2 Q4 (c)

Topic 12: Wave Behaviour of Particles

Expectation	*Summary of things I know about this*	*Example question(s) to practice*
Solve problems involving the use of the equation $\lambda = \frac{h}{p}$ for electrons and other particles.		Assignment Q1 (b)
Describe the Davisson–Germer experiment, in which the diffraction of electrons by the surface layers of a crystal lattice was observed.		
Using the grating equation $d \sin\theta = m\lambda$, and the measured angle θ of the first-order maximum from the Davisson–Germer experiment, calculate the wavelength of the electrons used in the experiment.		Assignment Q2 (d) Test Q3 (b)
Calculate the momentum of the electrons used in the Davisson–Germer experiment, and hence verify that $\lambda = \frac{h}{p}$		Assignment Q2 (e) Test Q3 (a)
Explain how the very short wavelength of electrons, and the ability to use electric or magnetic fields to focus them, allows electron microscopes to achieve very high resolution.		Assignment Q3 Test Q3 (c)