2.3 Simple harmonic motion

- ❑ 1 Describe examples of simple harmonic motion (SHM).
- ❑ 2 State that in SHM the unbalanced force is proportional to the displacement of the body and acts in the opposite direction.
- ❑ 3 State and explain the equation $\frac{d^2y}{dt^2} = -\omega^2 y$ for SHM.
- ❑ 4 Show that $y = A\cos\omega t$ and $y = A\sin\omega t$ are solutions of the equation for SHM.
- ❑ 5 Show that $v = \pm\,\omega\sqrt{(A^2 - y^2)}$ for the relationships in 4.
- ❑ 6 State and explain what factors affect the period of oscillation for an object which moves with SHM.
- ❑ 7 Derive the expressions $\frac{1}{2}m\omega^2(A^2 - y^2)$ and $\frac{1}{2}m\omega^2y^2$ for the kinetic and potential energies of a particle executing SHM.
- ❑ 8 State that damping on an oscillatory system causes the amplitude of oscillation to decay.

2.4 Waves

- ☐ 1 State that in wave motion energy is transferred with no net mass transport.
- ☐ 2 Energy transferred by a wave is directly proportional to the square of the amplitude. Carry out calculations involving the relationship $E=kA^2$
- ☐ 3 State the sine or cosine variation is the simplest form of a wave.
- ☐ 4 State that all waveforms can be described by the superposition of sine or cosine waves.
- ☐ 5 Carry out calculations using the relationship $y = A \sin 2\pi(ft - \frac{x}{\lambda})$ for a travelling wave.
- ☐ 6 Explain what is meant by phase difference.
- ☐ 7 Explain what is meant by phase angle and carryout calculations using the relationship $\phi = 2\pi x/\lambda$
- ☐ 8 Explain the superposition of waves and stationary waves.
- ☐ 9 Define the terms Node and Antinode.

2.5 Interference

- ❑ 1 State what is meant by the principle of interference by division of amplitude.
- ❑ 2 State in simple terms the condition for two light beams to be coherent.
- ❑ 3 State the reasons why the conditions for coherence are usually more difficult to satisfy for light than for sound and microwaves.
- ❑ 4 Define the term ‘optical path difference’ and relate it to phase difference.
- ❑ 5 Carry out calculations involving optical path difference (opd), geometrical path difference (gpd) and refractive index.
  opd= n (gpd)
- ❑ 6 State what is meant by the principle of interference by division of amplitude.
- ❑ 7 Describe how the division of amplitude enables an extended source to be used.
- ❑ 8 State that there is a phase change of π on reflection at an interface where there is an increase in optical density and that there is no change in phase on reflection at an interface where there is a decrease in optical density.
- ❑ 9 State the expressions for maxima and minima in the fringes formed by reflection and transmission of normally incident monochromatic light or microwaves in a ‘thin film’.
- ❑ 10 Carry out calculations involving ‘thin films’ using
  $opd = m\lambda$ or $(m + \frac{1}{2})\lambda$

- ❑ 11 Derive the expression $\Delta x = \lambda l/2d$ for distance between the fringes, formed by reflection of light at normal incidence from a 'thin wedge'.
- ❑ 12 Carry out calculations involving fringes formed at a 'thin wedge'.
- ❑ 13 Explain how lenses are made non-reflecting for a specific wavelength of light.
- ❑ 14 Derive the expression $d = \lambda/4n$ for the thickness of a non-reflecting coating.
- ❑ 15 Carry out calculations involving non-reflective coatings.
- ❑ 16 Explain why coated (bloomed) lenses have a coloured hue when viewed in reflected light.
- ❑ 17 Explain the formation of coloured fringes in a thin film illuminated by white light.
- ❑ 18 State what is meant by the principle of interference by division of a wavefront.
- ❑ 19 Explain why the principle of division of a wavefront requires the use of a 'point' or 'line' source.
- ❑ 20 Derive the expression $\Delta x = \lambda D/d$ for the fringe spacing in the Young's slit experiment for $\Delta x << D$.
- ❑ 21 Carry out calculations using the above expression.

2.6 Polarisation

- ❑ 1 Explain the difference between polarised and unpolaried light
- ❑ 2 State that only transverse waves can be polarized.
- ❑ 3 State that light can be linearly polarized using a polaroid filter.
- ❑ 4 Investigate polarisation of microwaves and light.
- ❑ 5 Explain how a combination of polariser and analyser can prevent the transmission of light.
- ❑ 6 Explain what is meant by Brewsters angle, i_p.
- ❑ 7 Derive the expression $n = \tan i_p$.
- ❑ 8 Carry out calculations using the relationship $n = \tan i_p$.