Test: The Wave Nature of Light

1. Describe an experiment that demonstrates the wave nature of light. [2002]

2. A sound wave is diffracted as it passes through a doorway but a light wave is not. Explain why. [2006]

3. Why does diffraction not occur when light passes through a window? [2008]

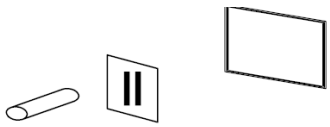
4. What is a diffraction grating?

5. Derive the formula for a diffraction grating ($n\lambda = d \sin\theta$).

6. A diffraction grating has 200 lines per mm.
   What is the value of d in the diffraction grating formula $n\lambda = d \sin\theta$? [2002]

7. When a parallel beam of monochromatic light is incident normally on a diffraction grating having 400 lines per mm on it, the angle between the second order image and the normal to the grating is 31^0. What is the wavelength of the light?

8. [2005]
   A student used a laser, as shown, to demonstrate that light is a wave motion.
   (i) Name the two phenomena that occur when light passes through the pair of narrow slits.
   (ii) A pattern is formed on the screen. Explain how the pattern is formed.
   (iii) What is the effect on the pattern when
   (a) the wavelength of the light is increased?
   (b) the distance between the slits is increased?



9. What is the significance of the fact that light can be polarised?

10. Describe an experiment to demonstrate that light waves are transverse waves. [2005]

11. (i) Define *dispersion*.
    (ii) Explain why dispersion occurs in a prism.
    (iii) Explain why dispersion occurs in a diffraction grating.

12. Name three different electromagnetic radiations. [2008]

13. Put the following types of radiation in order of increasing frequency:
    X-rays, radio waves, microwaves, visible light, IR, Gamma rays, UV.

14. Draw a diagram showing how the primary and secondary colours are interconnected.

15. Give two characteristics of (i) IR and (ii) UV radiation.

16. (i) How is infra-red radiation detected? [2007]
    (ii) How is ultra-violet radiation detected?

17. (i) State the adjustments that should be made to a spectrometer before use.
    (ii) List the main parts of the spectrometer.

18. [2006]
In an experiment to measure the wavelength of monochromatic light, a narrow beam of the light fell normally on a diffraction grating. The grating had 300 lines per millimetre. A diffraction pattern was produced. The angle between the second order image to the left and the second order image to the right of the central bright image in the pattern was measured. The angle measured was 40.6^o.

(i) Describe, with the aid of a labelled diagram, how the data was obtained.
(ii) How was a narrow beam of light produced?
(iii) Use the data to calculate the wavelength of the monochromatic light.
(iv) Explain how using a diffraction grating of 500 lines /mm leads to a more accurate result.
(v) Give another way of improving the accuracy of this experiment.

19. [2004]
In an experiment to measure the wavelength of monochromatic light, the angle θ between a central bright image (n = 0) and the first and second order images to the left and the right was measured.
A diffraction grating with 500 lines per mm was used.

n	2	1	0	1	2
θ / degrees	36.2	17.1	0	17.2	36.3

(i) Describe, with the aid of a diagram, how the student obtained the data.
(ii) Use all of the data to calculate a value for the wavelength of the light.
(iii) Explain how using a diffraction grating with 100 lines per mm leads to a less accurate result.
(iv) The values for the angles on the left of the central image are smaller than the corresponding ones on the right. Suggest a possible reason for this.

20. [2008]
In an experiment to measure the wavelength of monochromatic light, a diffraction pattern was produced using a diffraction grating with 500 lines per mm. The angle between the first order images was measured. This was repeated for the second and the third order images.
The table shows the recorded data.

Angle between first order images	Angle between second order images	Angle between third order images
34.2^0	71.6^0	121.6^0

(i) Draw a labelled diagram of the apparatus used in the experiment.
(ii) Explain how the first order images were identified.
(iii) Describe how the angle between the first order images was measured.
(iv) Use the data to calculate the wavelength of the monochromatic light.