

Interference and Resolution [84 marks]

1. [1 mark]

Markscheme

C

2. [1 mark]

Markscheme

C

3. [1 mark]

Markscheme

B

4. [1 mark]

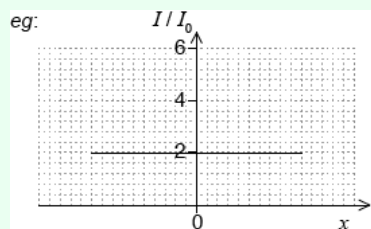
Markscheme

D

5a. [1 mark]

Markscheme

horizontal straight line through $I = 2$



Accept a curve that falls from $I = 2$ as distance increases from centre but not if it falls to zero.

[1 mark]

5b.

[3 marks]

Markscheme

«standard two slit pattern»

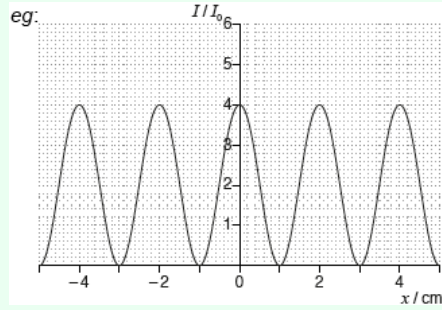
general shape with a maximum at $x = 0$

maxima at $4l_0$

maxima separated by «

$$\frac{D\lambda}{s} \Rightarrow 2.0 \text{ cm}$$

Accept single slit modulated pattern provided central maximum is at 4. ie height of peaks decrease as they go away from central maximum. Peaks must be of the same width



[3 marks]

5c.

[1 mark]

Markscheme

fringe width/separation decreases

OR

more maxima seen

[1 mark]

6.

[1 mark]

Markscheme

A

7.

[1 mark]

Markscheme

A

8.

[1 mark]

Markscheme

B

9. **Markscheme** [1 mark]
D

10. **Markscheme** [1 mark]
C

11. **Markscheme** [1 mark]
D

12. **Markscheme** [1 mark]
C

13. **Markscheme** [1 mark]
B

14. **Markscheme** [1 mark]
C

15. **Markscheme** [1 mark]
B

16. **Markscheme** [1 mark]
B

17. **Markscheme** [1 mark]
A

18a. [1 mark]

Markscheme

$$\lambda' = \frac{\lambda}{1.33} = \frac{572}{1.3} = 440 \text{ nm};$$

18b. [1 mark]

Markscheme

110 nm;

18c. [2 marks]

Markscheme

there would be a full wavelength within the film;

but the phase change at the first surface means that there is always destructive interference;

19. [1 mark]

Markscheme

C

20. [1 mark]

Markscheme

D

21a. [2 marks]

Markscheme

diffraction angle=0.05 rad;

$$b = \left(\frac{\lambda}{\theta} = \frac{7.0 \times 10^{-7}}{0.050} \right) 1.4 \times 10^{-5} \text{ (m)}; \text{ (do not accept use of 1.22)}$$

Award [2] for a bald correct answer.

21b. [1 mark]

Markscheme

same shape with narrower central maximum;

Ignore height of intensity peak.

21c. [2 marks]

Markscheme

blue light gives better resolution;

blue light has shorter wavelength than red light;

giving smaller angle of diffraction;

Allow reverse argument for red light.

22. [1 mark]

Markscheme

C

23. [1 mark]

Markscheme

A

24a. [2 marks]

Markscheme

- (i) constant/zero phase difference (between the light waves);
(ii) single/same wavelength/frequency; (allow "narrow band" OWTTE)
Do not allow "single colour".

24b. [1 mark]

Markscheme

$180^\circ/\pi\text{rad}$;
Do not accept $\frac{\lambda}{2}$.

24c. [4 marks]

Markscheme

- (i) use of $\lambda = \frac{sd}{D}$;
 $s = 2 \times 1.8$ (mm); (award this mark for any evidence for the factor of 2)
 $\lambda = \frac{2 \times 1.8 \times 10^{-3} \times 0.30 \times 10^{-3}}{1.5}$ / OWTTE;
(= 7.2×10^{-7} m)
Exact answer is given, award marks for correct working.
(ii) 3.6×10^{-7} m or 360 nm;
Allow ECF from (c)(i).

25. [1 mark]

Markscheme

B

26. [1 mark]

Markscheme

D

27. [1 mark]

Markscheme

A

28. [1 mark]

Markscheme

C

29a. [1 mark]

Markscheme

$180^\circ / \pi$;

29b. [3 marks]

Markscheme

path difference must be $\frac{\lambda}{2}$;

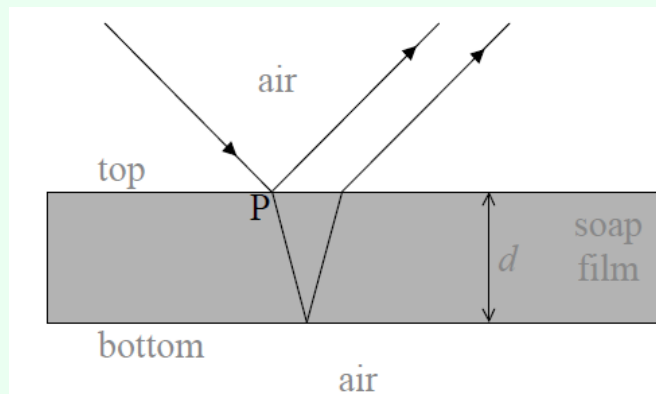
physical thickness must be $\frac{\lambda}{2n}$;

so, maximum wavelength (is $[2nt = [m + \frac{1}{2}] \lambda] \rightarrow \lambda = 4n_c d$) = 528 (nm);

Allow any valid alternative method.

30a. [1 mark]

Markscheme



P as shown;

30b.

[4 marks]

Markscheme

(i) for destructive interference, use of $2\mu d = n\lambda$ to give $\lambda = 2\mu d$ (ie $n=1$);

$$\lambda = 2 \times 1.34 \times 225;$$

(603nm)

Answer given, look for correct working.

(ii) the reflected light is white minus the wavelengths that suffer destructive interference;

some colours are determined by the missing wavelengths;

some colours are enhanced due to constructive interference;

31a.

[1 mark]

Markscheme

the light from the sources must be coherent / phase difference must be constant (allow "in phase") / the electric fields must have the same polarization;

31b.

[2 marks]

Markscheme

$$\text{fringe spacing} = \frac{1.60\text{m} \times 410\text{nm}}{0.30\text{mm}};$$

2.2 mm;

Award [2 max] for a response that makes use of $n\lambda$ in the double slit formula

Award ECF [1 max] if answer is for a value of n greater than 1.

Award [2] for a bald correct answer.

31c.

[3 marks]

Markscheme

sharper fringes / OWTTE;

brighter;

same spacing;

32.

[1 mark]

Markscheme

A

33.

[1 mark]

Markscheme

D

34.

[1 mark]

Markscheme

C

35. [1 mark]

Markscheme

C

36a. [1 mark]

Markscheme

the two sources are seen as two distinct sources / two distinct images are formed / the central maximum of one source coincides with the first minimum of the other;

36b. [3 marks]

Markscheme

(i) realization that the diffraction angle of the one source diffraction pattern is at 0.008 radians;
and so separation $(=1.60 \times 0.008 = 1.28) \approx 0.013\text{m}$;

$$(ii) \left(1.22 \frac{528 \times 10^{-9}}{b} = 0.008 \Rightarrow \right) b = 0.081\text{mm};$$

37. [1 mark]

Markscheme

A

38. [1 mark]

Markscheme

C

39a. [4 marks]

Markscheme

$$d = \frac{1}{8.00 \times 10^5} = 1.25 \times 10^{-6}\text{m};$$

$$d \sin \theta = n \lambda \Rightarrow \theta \sin^{-1} \left[\frac{n \lambda}{d} \right];$$

$$\sin^{-1} \left[\frac{2 \times 589 \times 10^{-9}}{1.25 \times 10^{-6}} \right] = 70.5^\circ, \sin^{-1} \left[\frac{2 \times 590 \times 10^{-9}}{1.25 \times 10^{-6}} \right] = 70.7^\circ;$$

$$70.7^\circ - 70.5^\circ = 0.2^\circ;$$

39b. [1 mark]

Markscheme

the lines are closer together / not clearly separate in the first order spectrum;

40a. [1 mark]

Markscheme

light reflected from the top slide interferes with light reflected from the bottom slide;

40b. [1 mark]

Markscheme

the light reflected from the bottom slide undergoes a π change in phase;

40c. [3 marks]

Markscheme

in moving from one (bright) fringe to the next the thickness of the air film changes by $\frac{\lambda}{2}$;

in 5.0 cm number of fringes = $\frac{5}{0.940} \times 50 = 266$;

therefore diameter of hair = $133 \times 5.92 \times 10^{-7} = 7.87 \times 10^{-5} \text{ m}$;

$80 \mu\text{m}$

41. [1 mark]

Markscheme

A

42. [1 mark]

Markscheme

D

43. [1 mark]

Markscheme

A

44. [1 mark]

Markscheme

A