Superposition **(COMPILED BY ADRIAN HARTANTO – 1207PE14)**

**June 02**

7 (a) Figure 7.1 (a): approximately circular wavefronts M1

centred on gap A1

Constant wavelength (allow this **(a)** or **(b)**) B1

Figure 7.1 (b) wavefronts plane at centre M1

curved at edges A1 [5]

(b) θ = ½ (162 – 136) = 13o  C1

*d* *sin* θ = *nλ* C1

*d sin 13 =* 2 x 630 x 10-9 C1

d = 5.6 x 10-6 m A1 [4]

*(Use of θ = 162o or 136o, max ½ )*

**November 02**

5 (a) displacement & direction of energy travel normal to one another B1 [1]

(b)i phase angle of 60o correct *(need to see 1½ wavelengths)*  B1

lags behind T1 B1 [2]

ii waves must be in the same place (at same time ) B1

resultant displacement = sum of individual displacements B1 [2]

iii 1. -1/2*A* B1

2. ½*A* (allow e.c.f) B1

3. zero (allow e.c.f) B1 [3]

**June 03**

4 (a) e.g. both transverse/longitudinal/same type

meet at a point,

same direction of polarisation, etc.......1 each, max 3 B3 [3]

*(allow 1 mark for any condition for observable interference)*

(b) (i)1 allow 0.3 mm → 3 mm B1

(i)2 λ = ax/D (allow any subject) B1

(ii)1 separation increased B1

less bright B1

(ii)2 separation increased B1

less bright B1

(ii)3 separation unchanged B1

fringes brighter B1

further detail, i.e quantitive aspect in (ii)1 or (ii)2 B1 [7]

(in (b), do not allow e.c.f. from (b)(i)2)

**November 03**

(b) (i) 1.7(2) μm A1

(ii) d sin2 = nλ (double slit formula scores 0/2)

1.72 x 10-6 x sin *2* = 590 x 10-9 C1

2 = 20.1° (allow 20°) A1

(iii) ½L = 1.5 tan20.1 C1

L = 1.1 m A1 [5]

**June 04**

6 (a) When two (or more) waves meet (not 'superpose' or 'interfere') B1

resultant displacement M1

is the sum of individual (displacements) A1 [3]

(b) (i) any correct line through points of intersection of crests B1

(ii) any correct line through intersections of a crest and a trough B1 [2]

(c) (i) λ = ax/D OR λ = asin θ and θ = x/D C1

650 x 10-9= (a x 0.70 x 10-3)/1.2 C1

a = 1.1 x 10-3m A1 [3]

(ii) 1 no change B1

2 brighter B1

3 no change (accept stay/remain dark) B1 [3]

Total [11]

**November 04**

4 (a) wavelength = 1.50 m B1 [1]

(b) v = f λ C1

speed = 540 m s-1 A1 [2]

(c) (progressive) wave reflected at the (fixed) ends B1

wave is formed by superposition of (two travelling) waves B1

this quantity is the speed of the travelling wave B1 [3]

**June 05**

5 (a) When a wave (front) is incident on an edge

or an obstacle/slit/gap M1

Wave ‘bends’ into the geometrical

shadow/changes direction/spreads A1 [2]

(b) (i) d = 1/(750 × 103) C1

= 1.33 × 10-6 m A1 [2]

(ii) 1.33 × 10-6 × sin90° = n × 590 × 10-9 C1

n = 2 (must be an integer) A1 [2]

(iii) formula assumes no path difference of light before

entering grating or

there is a path difference before the grating B1 [1]

(c) e.g. lines further apart in second order

lines fainter in second order

*(allow any sensible difference: 1 each, max 2)* B2 [2]

*(if differences stated but without reference to the orders, max 1 mark)*

**June 06**

6 (a) (i) correct shape drawn B1 [1]

(ii) two nodes marked correctly B1 [1]

(b) ½λ = 0.324 m C1

v = fλ C1

= 512 × 2 × 0.324

= 332 m s–1 A1 [3]

(c) ¼λ = 16.2 cm C1

*either antinode is 0.5 cm above top of tube*

*or antinode is 16.2 cm above water surface* A1 [2]

**November 06**

4 (a) (i) when two (or more) waves meet (at a point) M1

there is a change in overall intensity / displacement A1

(ii) constant phase difference (between waves) B1 [3]

(b) (i) *dsin*θ = nλ B1

(10-3 / 550) sin90 = n × 644 × 10-9 C1

n = 2.8 C1

so two orders A1 [4]

(power-of-ten error giving 2800 orders, allow 1/3 only for calculation of n)

(ii) 1. dsinθ = nλ (either here or in (i) – not both)

θ is greater so λ is greater B1 [1]

2. when n is larger, Δθ is larger M1

so greater in second order A1 [2]

**June 07**

5 (b) (i) at (displacement) antinodes / where there are no heaps, wave has

maximum amplitude (of vibration) B1

at (displacement) nodes/where there are heaps, amplitude of vibration is

zero/minimum B1

dust is pushed to / settles at (displacement) nodes B1 [3]

(ii) 2.5λ = 39 cm C1

v = fλ C1

v = 2.14 × 103 × 15.6 × 10-2

= 334 m s-1 (allow 330, not 340) A1 [3]

(c) Stationary wave formed by interference / superposition / overlap of B1

**either** wave travelling down tube and its reflection

**or**  two waves of same (type and) frequency travelling in opposite directions B1

speed is the speed of the incident / reflected waves B1 [3]

**November 07**

5 (b) λ = ax / D C1

540 × 10–9 = (0.700 × 10–3 x) / 2.75 C1

x = 2.12 mm A1 [3]

(c) (i) same separation B1

bright areas brighter (1)

dark areas, no change (1)

*(allow ‘contrast greater’ for 1 mark if dark/light areas not discussed)*

*fewer fringes observed (1) any two, 1 each*  B2 [3]

(ii) smaller separation of fringes B1

no change in brightness B1 [2]

**June 08**

5 (b) (i) does not transfer energy (along the wave) B1 [1]

(ii) position (along wave) where amplitude of vibration is a maximum B1 [1]

(iii) all three positions marked B1 [1]

(c) wavelength = 2 × 17.8 = 35.6 cm C1

v = fλ C1

v = 125 × 0.356

= 44.5 m s–1 C1

44.52 = 4.00 / m C1

m = 2.0 × 10–3 kg m–1 A1 [5]

**November 08**

6 (a) wave incident at an edge / aperture / slit /(edge of) obstacle M1

bending / spreading of wave (into geometrical shadow) A1 [2]

(award 0/2 for bending at a boundary)

(b) (i) apparatus e.g. laser & slit / point source & slit / lamp and slit & slit

microwave source & slit

water / ripple tank, source & barrier B1

detector e.g. screen

aerial / microwave probe

strobe / lamp B1

what is observed B1 [3]

(ii) apparatus e.g. loudspeaker, and slit / edge B1

detector e.g. microphone & c.r.o. / ear B1

what is observed B1 [3]