Wave Basics

Mark Scheme 2

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Waves
Sub Topic	Wave Basics
Paper Type	Theory
Booklet	Mark Scheme 2

Time Allowed: **76 minutes**

Score: **/63**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a** when waves overlap / meet B1
the resultant displacement is the sum of the individual displacements of the waves B1 [2]

(b) (i) 1. phase difference = 180 º / (n + ½) 360 º (allow in rad) B1 [1]

2. phase difference = 0 / 360 º / (n360 º) (allow in rad) B1 [1]

(ii) $v = f\lambda$ C1
λ = 320 / 400 = 0.80 m A [2]

(iii) path difference = 7 – 5 = 2 (m)
= 2.5 λ M1
hence minimum
or maximum if phase change at P is suggested A1 [2]

2 **(a** travel through a vacuum / free space B1 [1]

(b) (i) B : name: **microwaves** wavelength: 10^{-4} to 10^{-1} m B1
C : name: **ultra-violet / UV** wavelength: 10^{-7} to 10^{-9} m B1
F : name: **X –rays** wavelength: 10^{-9} to 10^{-12} m B1 [3]

(ii) $f = \dfrac{3 \times 10^{8}}{500 \times 10^{-9}}$ C1

f = 6(.0) × 10^{14} Hz A1 [2]

(c) vibrations are in one direction M1
perpendicular to direction of propagation / energy transfer
or good sketch showing this A1 [2]

3 **(a)** transverse waves have vibrations that are perpendicular / normal to the direction of energy travel B1
longitudinal waves have vibrations that are parallel to the direction of energy travel B1 [2]

(b) vibrations are in a single direction M1
either applies to transverse waves
or normal to direction of wave energy travel
or normal to direction of wave propagation A1 [2]

(c) **1.** amplitude = 2.8 cm B1 [1]

2. phase difference = 135° *or* 0.75π rad *or* ¾π rad *or* 2.36 radians (three sf needed)
numerical value M1
unit A1 [2]

(ii) amplitude = 3.96 cm (4.0 cm) [1]

4 **(a (i)** amplitude = 7.6 mm allow 7.5 mm A1 [1]

(ii) 180° / π rad A1 [1]

(iii) $v = f \times \lambda$
$= 15 \times 0.8$ C1
$= 12\ m\,s^{-1}$ A1 [2]

(b) correct sketch with peak moved to the right B1
curve moved by the correct phase angle / time period of 0.25 *T* B1 [2]

(c) zero (rad) A1 [1]

(ii) antinode maximum amplitude,
node zero amplitude / displacement A1 [1]

(iii) 3 A1 [1]

(iv) horizontal line through central section of wave B1 [1]

5	(a)	(i)	distance (of point on wave) from rest/ ;equilibrium position	B1	[1]
		(ii)	distance moved by wave energy / wavefront during one cycle of the source or minimum distance between two points with the same phase or between adjacent crests or troughs	B1	[1]
	(b)	(i)	$T = 0.60$s	B1	[1]
		(ii)	$2 = 4.0$cm	B1	[1]
		(iii)	*either* $v = 2/T$ *or* $v = f2$ and $f = 1/T$ $v = 6.?$cms^{-1}	C1 A1	[2]
	(c)	(i)	amplitude is decreasing so, it is losing power	M1 A1	[2]
		(ii)	*intensity* = *(amplitude)*^{2} ratio= $2.a^2 / 1.1^2$ = 3.3	C1 C1 A1	[3]

6 **(a) (i) 1** number of oscillations per unit time (not per second) B1 [1]

2 $n\lambda$ A1 [1]

(ii) v = distance / time = $n\lambda/t$ M1
$n/t = f$ hence $v = f\lambda$ A1
or f oscillations per unit time so $f\lambda$ is distance per unit time M1
distance per unit time is v so $v = f\lambda$ A1 [2]

(b) (i) 1.0 period is 3 × 2 = 6.0 ms C1
frequency = $1/(6 \times 10^{-3})$ = 170 Hz [2]

(ii) wave (with approx. same amplitude and) with correct phase difference B1 [1]

7 **(a)** transfer / propagation of energy M1
as a result of oscillations / vibrations ..... A1 [2]

(b) (i) displacement / velocity / acceleration (of particles in the wave) ..... B1 [1]

(ii) displacement etc. is normal to direction of energy transfer /
travel of wave / propagation of wave ……(*not 'wave motion'*) ..... B1 [1]

(iii) displacement etc. along / same direction of energy transfer /
travel of wave / propagation of wave ……(*not 'wave motion'*) ..... B1 [1]

(c) diffraction: suitable object, means of observation M1
either laser *or* lamp and aperture
or distant source M1
light region where darkness expected A1

interference: suitable object, means of observation and illumination B1
light and dark fringes observed B1
appropriate reference to a dimension for diffraction or
for interference ..... B1 [6

[Total: 11]