WAVES TEST CORE MARCH 2012 MARKSCHEME

1. C
2. C
3. C
4. A
5. C
6. B
7. B
8. C
9. C
10. D
11. D
12. A
13. C

B2. Part 1 Simple harmonic motion and waves

(a) is proportional to the displacement/distance (of the particle) from its equilibrium position;
is directed towards the equilibrium position; *[2]*

(b) (i) overall correct shape;
with max of 0.06 J at $x = \pm 0.05$ and zero at $x = 0$; *[2]*

(ii) $E_{K_{max}} = \frac{1}{2} 4\pi^2 m f^2 x_0^2$;
from the graph $E_{K_{max}} = 0.06 (J)$;
and $x_0 = 0.050 (\text{m})$;
$f = \sqrt{\frac{2 E_{K_{max}}}{4\pi^2 m x_0^2}}$;
to give $f = 2.0\,\text{Hz}$ *[4]*

or

$k = \frac{2 E_{K_{max}}}{x_0^2}$;
$= \frac{2 \times 0.06}{0.05^2}$;
$= 48$;
use of $f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$;
$= 2.0\,\text{Hz}$

(c) (i) the energy of the wave is propagated in a direction at right angles;
to the direction of oscillation of the particles; *[2]*

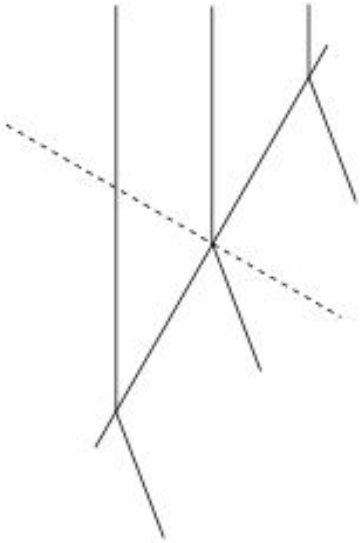
(ii) $\lambda = 0.40\,\text{m}$; *[1]*

(d) (i) use of $\sin\theta_2 = \frac{v_2}{v_1}\sin\theta_1$;

$\frac{v_2}{v_1} = 1.5$; } *this marking point is not necessary to award full credit.*

$\theta_2 = \left[\sin^{-1} 0.75\right] = 49$; *[3]*

(ii)



any two lines as shown bending in the correct direction; *[1]*

B2. Part 1 Water waves

(a) (i) 1.0 mm; *[1]*

(ii) 6.0 mm; *[1]*

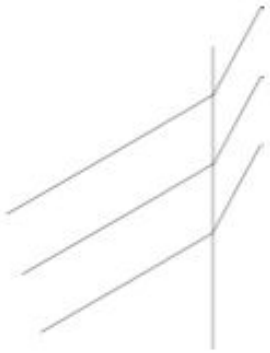
(iii) 37 Hz; *[1]*

(iv) $0.22\,m\,s^{-1}$; *[1]*

(b) (i) ray: direction in which energy travels;
wavefront: line connecting points with same phase/displacement; *[2]*

(ii) $\sin r \quad \frac{\sin 60}{1.4}$;
$r \quad 38$; *[2]*

(iii) wavefronts continuous at boundary and parallel;
wavefronts closer together and equally spaced by eye and in the correct direction; *[2]*



(c) (i) reference to superposition/interference;
waves (almost) cancel to give zero/small displacement;
where waves arrive out of phase/180 out/π out; *[3]*

(ii) position of any one minimum closer to centre / minima closer together;
frequency increased so wavelength decreased / correct explanation in terms of double-slit equation; *[2]*

B2. Part 1 Simple harmonic motion and waves

(a) displacement is proportional to acceleration / *vice versa*;
because graph is straight-line through origin;
displacement and acceleration in opposite directions / acceleration always directed towards origin;
because negative gradient; *[4]*

(b) use of $\omega^2 = (-)\frac{a}{x}$;

$\omega^2 = \frac{2900}{0.60\times 10^{-3}}$;

$\omega = 2\pi f$;

$f = \frac{1}{2\pi}\sqrt{\frac{2900}{0.60\times 10^{-3}}}$;

(to give $f = 350\,\text{Hz}$) *[4]*

(c) 0.60 mm; *[1]*

(d) (i) transfer of energy by means of vibrations/oscillations;
vibrations all in one direction parallel to direction of energy transfer; *[2]*

(ii) $\frac{330}{350}$ *or* use of $c = f\lambda$;
0.94 m; *[2]*
Award [2] for bald correct answer.