WAVE REVIEW MARKSCHEME

1. B

[1]

2. D

[1]

3. B

[1]

4. C

[1]

5. A

[1]

6. B

[1]

7. D

[1]

8. D

[1]

9. B

[1]

10. B

[1]

11. C

[1]

12. D

[1]

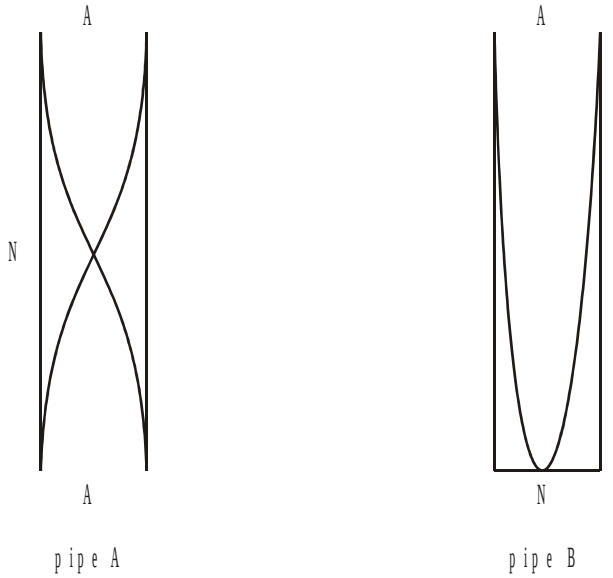
C

[1]

13. B

[1]

14. (a)



(i) correct wave shape for pipe A;
correct wave shape for pipe B; 2

(ii) correct marking of A and N for pipe A;
correct marking of A and N for Pipe B; 2

(b) (i) for pipe A, $\lambda = 2L$, where L is length of the pipe;
$c = f\lambda$ to give $L = \frac{c}{2f}$;
substitute to get $L = 0.317$ m; 3

(ii) for 32 Hz, the open pipe will have a length of about 5 m;
whereas the closed pipe will have half this length, so will not take up as much space as the open pipe / *OWTTE*; 2
*The argument does not have to be quantitative. Award **[1]** for recognition that low frequencies mean longer pipes and **[1]** for the same frequency, closed pipes will be half the length of open pipes. The fact they need less space can be implicit.*

[9]

15. (a) longitudinal; 1

(b) (i) wavelength = 0.5 m; 1

(ii) amplitude = 0.5 mm; 1

(iii) correct substitution into speed = frequency × wavelength;
to give $v = 660 \times 0.5 = 330$ m s^{-1}; 2 max

[5]

16. (a) (i) energy transfer;
no interruption in transfer / without mass motion of the medium; 2

Do not accept "continuous".

(ii) speed / rate at which energy / wavefronts are propagated; 1

(b) (i) frequency: number of oscillations/vibrations per unit time; 1

Do not accept specific units e.g. seconds.

(ii) wavelength: distance moved by wave during one oscillation of the source; 1

Accept distance between successive crests or troughs.

(c) (i) wave travels down tube and is reflected;
incident and reflected waves interfere to give standing wave; 2

(ii) air (column) in tube has natural frequency of vibration;
when fork frequency equals natural frequency;
maximum amplitude of vibration / maximum loudness;
when fork frequency not equal to natural frequency,
no resonance / loudness drops; 4

(iii) $\frac{1}{2}\lambda = 65$ cm;
speed = $0.65 \times 2 \times 256 = 330$ m s^{-1}; 2

*Award **[1 max]** for 660 m s^{-1}.*

(d) pressure = $\frac{\text{force}}{\text{area}}$

$= \frac{(4.0 \times 10^{-5})}{(30 \times 10^{-6})}$

= 1.3 Pa; 2

(e) (i) idea of using area under the line / $\frac{1}{2}kx^2$;
energy = $\frac{1}{2} \times 6 \times 10^{-5} \times 1.5 \times 10^{-2} \times 10^{-3}$ ***or*** 112.5 (±2.5) squares;
= 4.5×10^{-10} J; *(Allow ±0.1 × 10^{-10} if candidate counts squares.)* 3

(ii) period = 1.0 ms;
and energy is supplied in $\frac{1}{4}$period (= 0.25 ms);
power = $\frac{4.5 \times 10^{-10}}{0.25 \times 10^{-3}}$;
= 1.8×10^{-6} W; 4

(iii) strain energy / energy of deformation of eardrum / kinetic energy of eardrum / vibrational energy; 1

(f) (i) path difference is 2.5 λ;
wavelength = 0.20 m;
speed = $f\lambda = 1700 \times 0.2 = 340$ m s^{-1}; 3

(ii) at X: loudness increases;
waves not same amplitude at X so not complete destructive interference;
at P: loudness decreases;
because sum of amplitudes less than before; 4

*Award **[1]** for two correct statements without explanations.*
*Award **[0]** for statement with incorrect reasoning. Award **[1]** for correct statement with partially correct reasoning.*

[30]

17. Wave properties

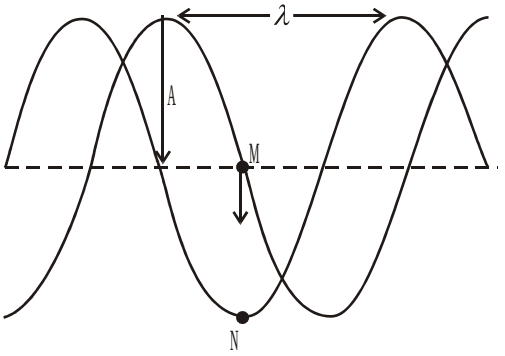
(a) (i)

1

(ii)

1

(b)



(i) downwards; 1

(ii) correct marking of A; 1

(iii) correct marking of λ; 1

(iv) +ve sine curve;
correct position of N; 2

Watch for ecf from (i).

(c) (i) $f = \frac{v}{\lambda}$ = to give 2.0 Hz; 1

(ii) T = 0.5 s;

$s = \frac{vT}{4}$ = 1.25 (1.3) cm;

or

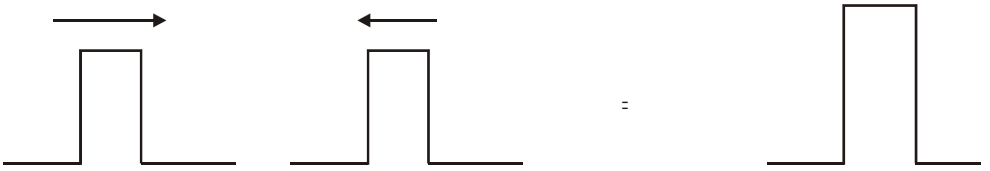
in $\frac{T}{4}$ wave moves forward $\frac{1}{4}$ λ;

$= \frac{5}{4}$ = 1.25 (1.3) cm; 2 max

(d) *Principle of superposition*:
when two or more waves overlap, the resultant displacement at any point;
is the sum of the displacements due to each wave separately / *OWTTE*;

*Award **[2 max]** for an answer that shows a clear understanding of the principle, **[1]** for a reasonable understanding and **[0]** for a weak answer.*

Explanation:



suitable diagram;
when two +ve pulses (or two wave crests) overlap, they reinforce / OWTTE; 4

Any situation where resultant displacement looks as though it is the sum of the individual displacements. Mark the description of the principle and the description of constructive interference together.

(e) (i) $S_2X = n\lambda$;
where $n = 0, 1, 2$; *(Accept "n is an integer")* 2

(ii) $\sin\theta \approx \theta$;
therefore $\theta = \frac{S_2X}{d}$; 2

(iii) $\phi = \frac{y_n}{D}$; 1

Award the small angle approximation mark anywhere in (i) or (ii).

(f) (i) $\theta = \frac{S_2X}{d} = \frac{n\lambda}{d}$ *so* $\lambda = \frac{d\theta}{n}$;
substitute to get $\lambda = 4.73 \times 10^{-7}$ m; 2

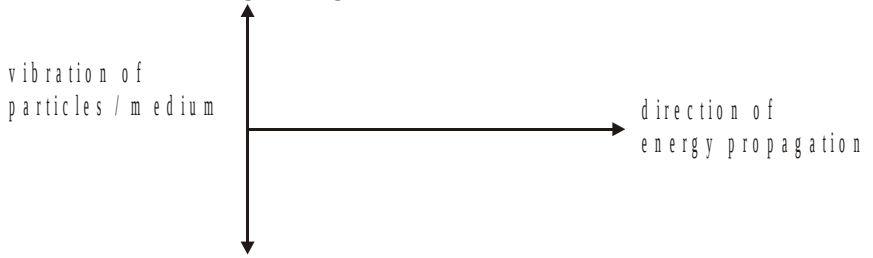
(ii) θ and ϕ are small;
therefore $\frac{\lambda}{d} = \frac{y}{D}$;
so $y = \frac{D\lambda}{d}$ = 0.510 mm; 3

[24]

18. (a) a wave in which the direction of energy propagation;
is at right angles to the direction of vibration of the particles of the medium through which the wave is travelling / *OWTTE*; 2

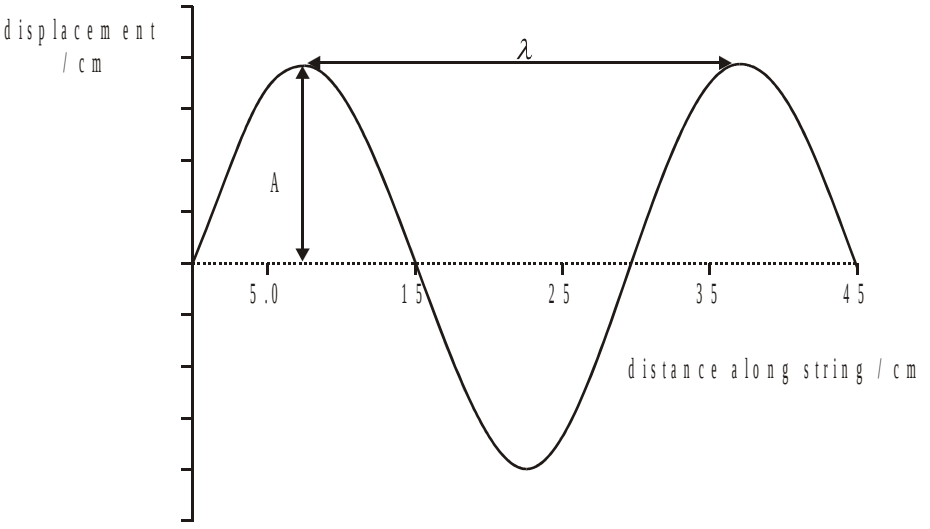
or

suitable labelled diagram e.g.



(b) any em wave / elastic waves in solids / accept water; 1

(c)



1

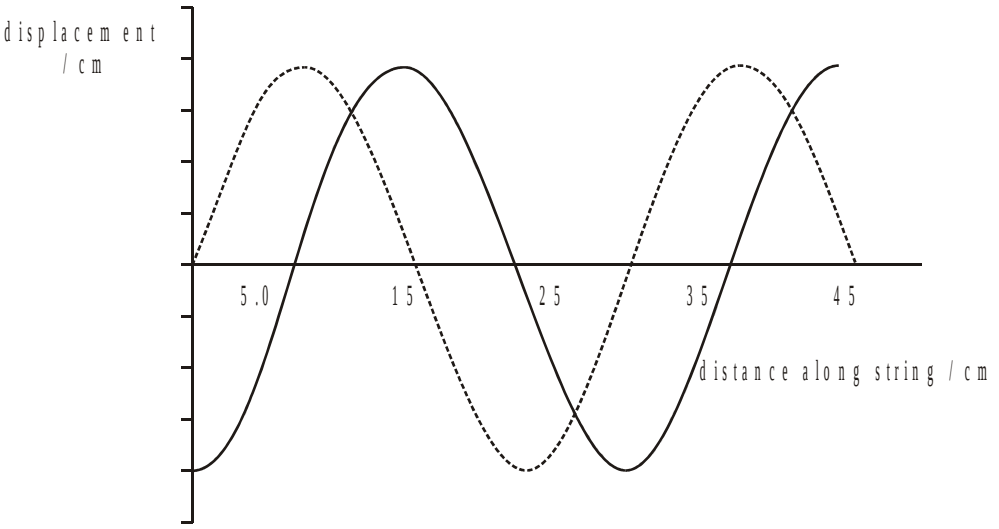
correct annotation

(i) A (4.0 cm); 1

(ii) λ (30.0 cm); 1

(d) $f = \frac{1}{T} = \frac{1}{1.2 \times 10^{-3}}$ = 830 Hz;
$c = f\lambda = 830 \times 0.30 = 250$ m s^{-1}; 2

(e)



troughs / peaks moved to the right;
by $\lambda/4$ (7.5 cm); *(judge by eye)*
wave continuous between $x = 0$ and $x = 45$ cm; 3

(f) a system resonates when a periodic force is applied to it;
and the frequency of the force is equal to the natural frequency of vibration of the system / *OWTTE*; 2

(g) the string could be clamped at one end and vibrated at the other end by a signal generator / tuning fork;
whose frequency is adjusted until one loop of vibration is observed / *OWTTE*;
or
string is clamped at both ends;
and plucked in the middle; 2

(h) $\lambda = 0.90$ m;

$f = \frac{c}{\lambda} = \frac{250}{0.90} = 280$ hz; 2

[16]