Oscillations

Mark Scheme 4

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Oscillations
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 4

Time Allowed: **56 minutes**

Score: **/46**

Percentage: **/100**

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

1 **(a) (i)** 8.0 cm A1 [1]

(ii) $2\pi f = 220$ C1
$f = 35$ (*condone unit*) A [2]

(iii) line drawn mid-way between AB and CD (*allow ±2 mm*) B [1]

(iv) $v = \omega a$ C1
$= 220 \times 4.0$
$= 880 \text{ cm s}^{-1}$ A1 [2]

(b) (i) **1.** line drawn 3 cm above AB (*allow ±2 mm*) B [1]
2. arrow pointing upwards B1 [1]

(ii) **1.** line drawn 3 cm above AB (*allow ±2 mm*) B [1]
2. arrow pointing downwards B1 [1]

(iii) $v = \omega\sqrt{(a^2 - x^2)}$
$= 220 \times \sqrt{(4.0^2 - 2.0^2)}$ C1
$= 760 \text{ cm s}^{-1}$ A1 [2]
(*incorrect value for x, 0/2 marks*)

2 **(a) (i)** to-and-fro / backward and forward motion (between two limits) B1 [1]

(ii) no energy loss or gain / no <u>external</u> force acting / constant energy / constant amplitude B1 [1]

(iii) acceleration directed towards a fixed point B1
acceleration proportional to <u>distance from the fixed point</u> / displacement B1 [2]

(b) acceleration is constant (magnitude) M1
so cannot be s.h.m. A1 [2]

3 **(a) (i)** reduction in energy (of the oscillations) (B1)
reduction in amplitude / energy of oscillations (B1)
due to force (always) opposing motion / resistive forces (B1) [2]
any two of the above, max 2

(ii) amplitude is decreasing (very) gradually / oscillations would continue (for a long time) /many oscillations M1
light damping A1 [2]

(b) (i) frequency = 1 / 0.3
= 3.3 Hz A1 [1]
allow points taken from time axis giving f = 3.45 Hz

(ii) energy = ½ mv^2 and $v = \omega a$ C1
= ½ × 0.065 × $(2\pi/0.3)^2$ × $(1.5 \times 10^{-2})^2$ M1
= 3.2 mJ A0 [2]

(c) amplitude reduces exponentially / does not decrease linearly M1
so will be not be 0.7 cm A1 [2]

4 (a) (i) amplitude = 0.2 mm ..... A1 [1]

(ii) period = 1.2 ms C1
frequency = 830 Hz ..... A1 [2]

(b) (any two of zero, 0.6 ms and 1.2 ms ..... A1 [1]

(ii) any two of 0.3 ms, 0.9 ms, 1.5 ms ..... A1 [1]

(c) *either* $v = \omega x_0 = 2\pi f x_0$
$= 2\pi \times 830 \times 0.2 \times 10^{-3} = 1.05$ m s^{-1}
or slope of graph = 1.0 m s^{-1} ……(allow ± 0.1 m s^{-1}) C1
$E_K = ½mv^2$
= ½ × 2.5 × 10^{-3} × 1.05^2 ..... C1
= 1.4 × 10^{-3} J ..... A1 [3]

(d) (large / maximum amplitude of vibration B1
when impressed frequency equals natural frequency of vibration ..... B1 [2]

(ii) e.g. metal panels on machinery vibrate / oscillate ..... (M1)
motor in machine impresses frequency on panel ..... (A1)
e.g. car suspension system vibrates / oscillates ..... (M1)
going over bumps would give large amplitude vibrations ..... (A1)
any feasible example, M1 + A1 ..... [2]

[Total: 12]

5 **(a)** straight line through origin B1
negative gradient ..... B1 [2]

(b) $a = -\omega^2 x$ and $\omega = 2\pi f$ C1
$750 = (2\pi f)^2 \times 0.3 \times 10^{-3}$ C1
$f = 250$ Hz ..... A1 [3]

(c) straight line between(-0.3,+190) and (+0.3,-190) ..... A2 [2]
(*allow 1 mark for end of line incorrect by one grid square or line does not extend to +/- 0.3 mm*)

[Total: 7]