

Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

Mark Schemes

Q1.

- (a) acceleration is proportional to displacement **(1)**
 acceleration is in opposite direction to displacement, or
 towards a fixed point, or towards the centre of oscillation **(1)**

2

(b) (i) $f = \frac{25}{23} = 1.1 \text{ Hz (or s}^{-1}\text{) (1)}$ (1.09 Hz)

- (ii) (use of $a = (2\pi f)^2 A$ gives)
 $a = (2\pi \times 1.09)^2 \times 76 \times 10^{-3} \text{ (1)}$
 $= 3.6 \text{ m s}^{-2} \text{ (1)}$ (3.56 m s⁻²)
 (use of $f = 1.1 \text{ Hz}$ gives $a = 3.63 \text{ m s}^{-2}$)
 (allow C.E. for incorrect value of f from (i))

- (iii) (use of $x = A \cos(2\pi ft)$ gives)
 $x = 76 \times 10^{-3} \cos(2\pi \times 1.09 \times 0.60) \text{ (1)}$
 $= (-)4.3(1) \times 10^{-2} \text{ m (1)}$ (43 mm)
 (use of $f = 1.1 \text{ Hz}$ gives
 $x = (-)4.0(7) \times 10^{-2} \text{ m (41 mm)}$
 direction: above equilibrium position or upwards **(1)**

6

- (c) (i) graph to show:
 correct shape, i.e. cos curve **(1)**
 correct phase i.e. $-(\cos)$ **(1)**
- (ii) graph to show:
 two cycles per oscillation **(1)**
 correct shape (even if phase is wrong) **(1)**
 correct starting point (i.e. full amplitude) **(1)**

max 4

[12]

Q2.

- (a) (i) system made to oscillate by a periodic external force / energy source
or system made to oscillate by another oscillator it is connected to
or another oscillator forcing the system to vibrate
or an oscillator forcing another oscillator to vibrate
 due to its own vibrations

A1

(1)

not made to oscillate by an external force
not when its vibrations are not at its natural frequency
not when it is made to oscillate by another system

- (ii) frequency of wheel (motor) = natural frequency of system
 condone 'fundamental or resonant frequency' of the system
 or rotating wheel rotates at the resonant / fundamental
 frequency of the system

must be reference to the wheel or motor or driver oscillator
not just when it vibrates at its natural frequency

B1
 (3)

- (b) $T = 1.25 \text{ s}$

B1

$T = 2\pi(m/k)^{1/2}$ **or** numerical substitution

C1

0.36 kg
 allow e.c.f. for T ; 0.6 s gives 0.82 kg

A1
 (1)

- (c) (i) correct process using ratios
 (eg times to halve marked on the graph)

B1

three amplitudes read correctly
 or
 two times to halve read correctly

B1

ratios determined and conclusion drawn that it is exponential
or
 a clear statement that the time to halve is the same for points indicated and
 conclusion that it is exponential

B1
 (3)

- (ii) amplitude correct for 25 s, i.e. 4 to 4.2 cm
or energy proportional to A^2 (allow $0.5 kA^2$ or $0.5 kx^2$)

C1

allow e.c.f. from (b); $T = 0.6 \text{ s}$ leads to amplitude = 6.8 cm ; ratio = 0.46

0.16-0.19 or 17/100 (2 s.f. only)

A1
 (3)

[10]