

[3]

- (i) Moon A rotates with an angular speed  $1.7 \times 10^{-4} \text{ rad s}^{-1}$  about the planet.  
Determine the orbital speed of moon B.

$$v_B = \dots\dots\dots \text{ m s}^{-1} \text{ [2]}$$

**[Total: 10]**

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(b) State what is meant by

(i) *free* oscillations,

.....  
..... [1]

(ii) *damped* oscillations, and

.....  
..... [1]

(iii) *forced* oscillations.

.....  
..... [1]

(c) Passenger cars consist of many components attached to a main chassis. A particular component of mass 0.046 kg rattles when the car is in operation. Fig. 3.1 shows the variation of the amplitude of the rattle with external frequency.

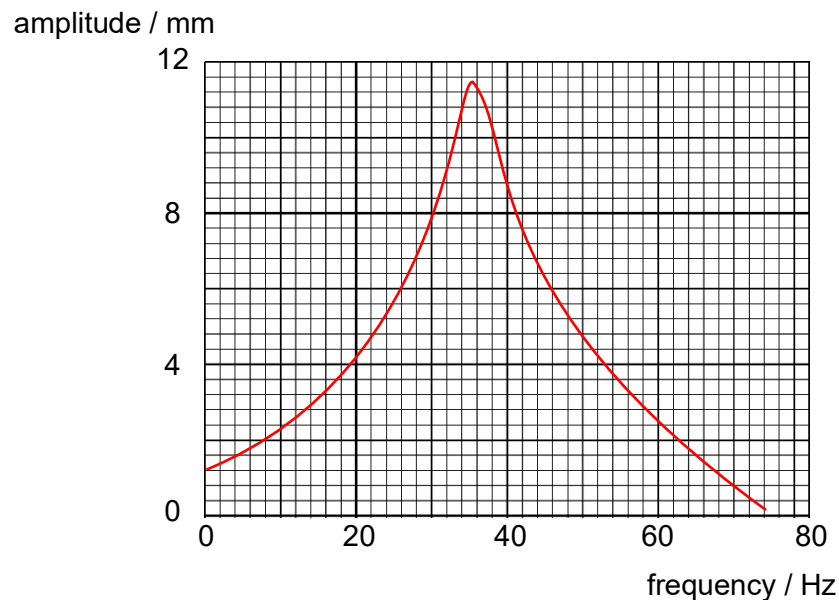


Fig. 3.1

(i) Explain why there is a *resonance* peak at 35 Hz frequency.

.....

.....  
.....[2]

- (ii) Determine the maximum kinetic energy of the component when it is rattling at 35 Hz frequency.

Maximum kinetic energy = ..... J [2]

- (iii) On Fig. 3.1, sketch the variation of the amplitude of rattle with frequency if the component is attached to the main car chassis through a rubber mount. Label your sketch P. [1]

(d)

- (i) Modern vehicles deploy suspension systems to reduce the discomfort experienced by passengers as the vehicles drive over vertical irregularities on the road. The suspension systems typically provide near-critical damping.

Explain what is meant by *critical damping*.

.....  
..... [1]

- (ii) Sketch a graph to show the variation with time of the displacement of a critically-damped oscillation.

[1]

[Total: 10]

