

[3]

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

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

**[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.

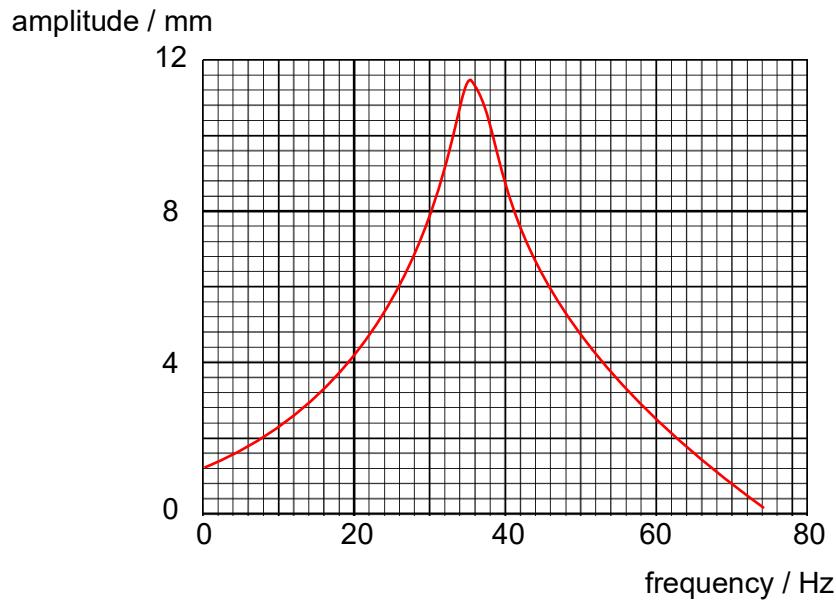


Fig. 3.1

- (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]**

