

Name of the Student: \_\_\_\_\_

Max. Marks : 17 Marks

Time : 17 Minutes

**Q1.**

- (a) State the conditions necessary for a body to execute simple harmonic motion.

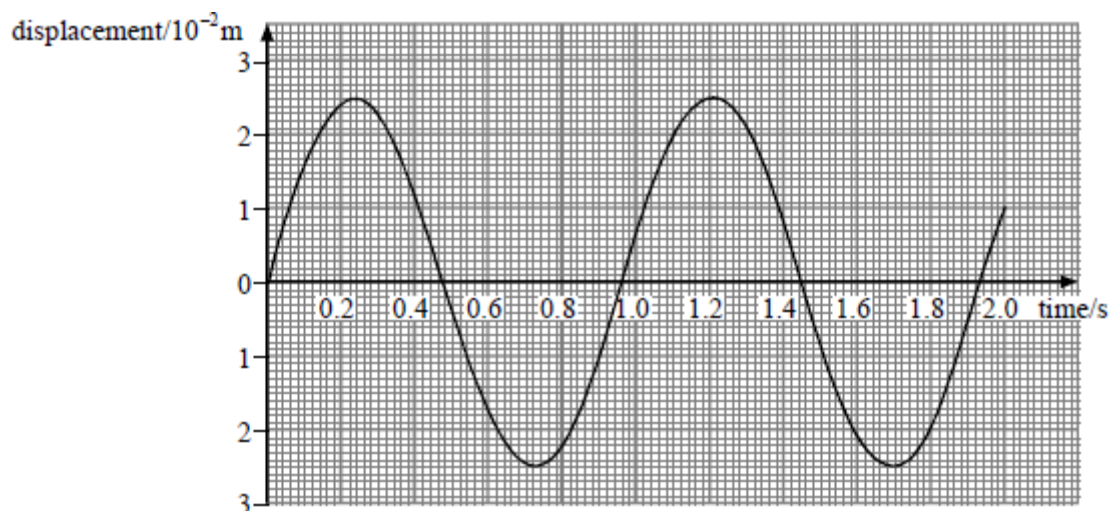
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(2)

- (b) The front wheel of a motorcycle is attached to the frame via a combination of springs which has a spring constant of  $4.2 \times 10^3 \text{ N m}^{-1}$ . You may consider this suspension system to be undamped. **Figure 1** shows the variation of displacement with time for the system when it is caused to oscillate after the wheel passes over a bump in the road.



**Figure 1**

- (i) State the periodic time for the oscillation of the system.

\_\_\_\_\_

(1)

- (ii) Calculate the frequency of oscillation of the system.

(1)

- (iii) Calculate the effective mass which is attached to the suspension system.

(2)

- (iv) Calculate the maximum acceleration of the wheel relative to the frame when the system oscillates as shown in **Figure 1**.

(2)

- (c) When approaching a roundabout at a speed of  $7.0 \text{ m s}^{-1}$ , the motorcycle moves over raised road markings separated by a distance of  $1.2 \text{ m}$ . By making a suitable calculation, decide whether the front wheel system of the motorcycle is likely to experience resonance when it crosses the road markings. Explain your answer.

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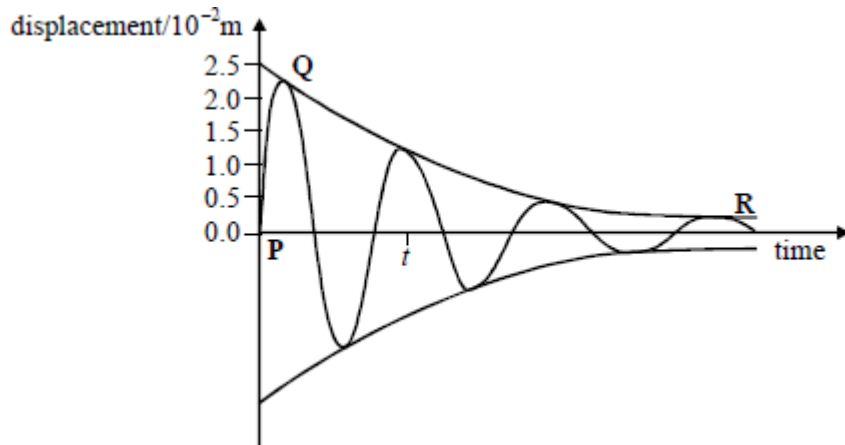
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(3)

- (d) In practice, the system is damped by a shock absorber. **Figure 2** shows the oscillation of the damped system after the wheel goes over a bump in the road.



**Figure 2**

- (i) Describe the energy changes that occur during the time covered by **Figure 2**, making reference to the types of energy involved at **P**, **Q** and **R**.

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(3)

- (ii) Use the graph to estimate the fraction of the energy absorbed by the shock absorbers by

the time  $t$ .

**(3)**  
**(Total 17 marks)**