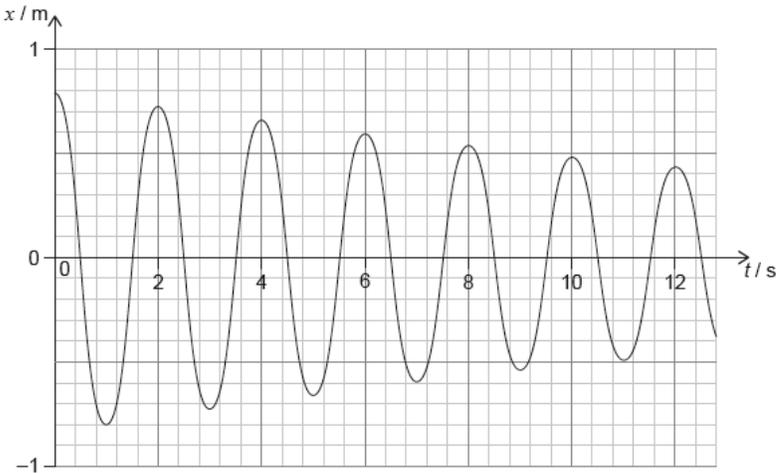


Resonance Practice Problems [21 marks]

The graph below represents the variation with time t of the horizontal displacement x of a mass attached to a vertical spring.



1a. Describe the motion of the spring-mass system. [1 mark]

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The total mass for the oscillating system is 30 kg. For this system

1b. determine the initial energy. [1 mark]

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1c. calculate the Q at the start of the motion. [2 marks]

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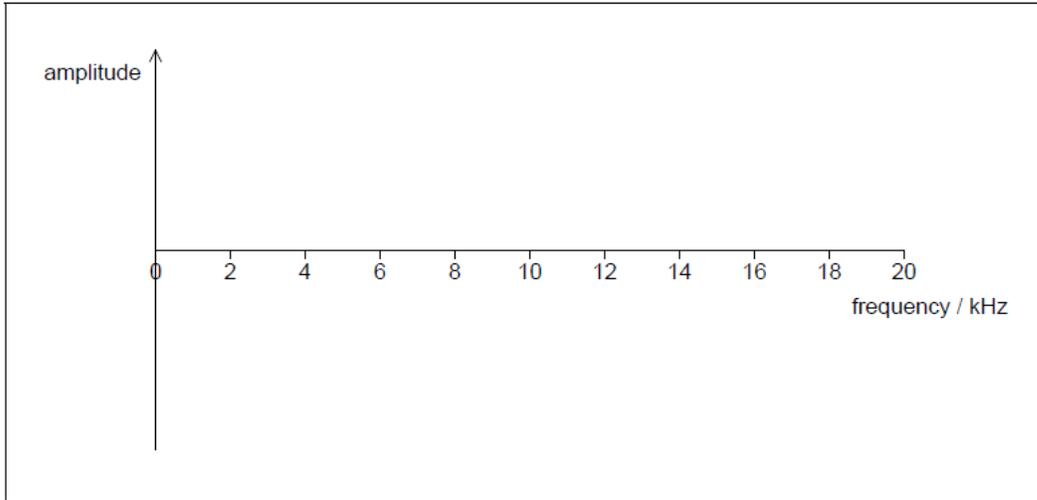
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The natural frequency of a driven oscillating system is 6 kHz. The frequency of the driver for the system is varied from zero to 20 kHz.

2a. Draw a graph to show the variation of amplitude of oscillation of the system with frequency.

[3 marks]



2b. The Q factor for the system is reduced significantly. Describe how the graph you drew in (a) changes.

[2 marks]

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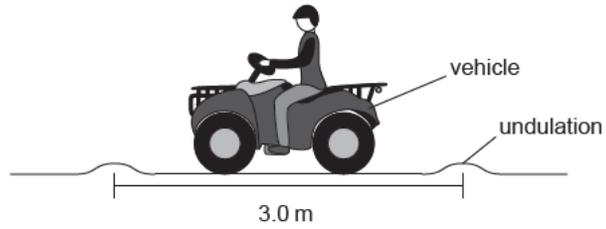
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A farmer is driving a vehicle across an uneven field in which there are undulations every 3.0 m.



The farmer's seat is mounted on a spring. The system, consisting of the mass of the farmer and the spring, has a natural frequency of vibration of 1.9 Hz.

3a. Explain why it would be uncomfortable for the farmer to drive the vehicle at a speed of 5.6 m s^{-1} . [3 marks]

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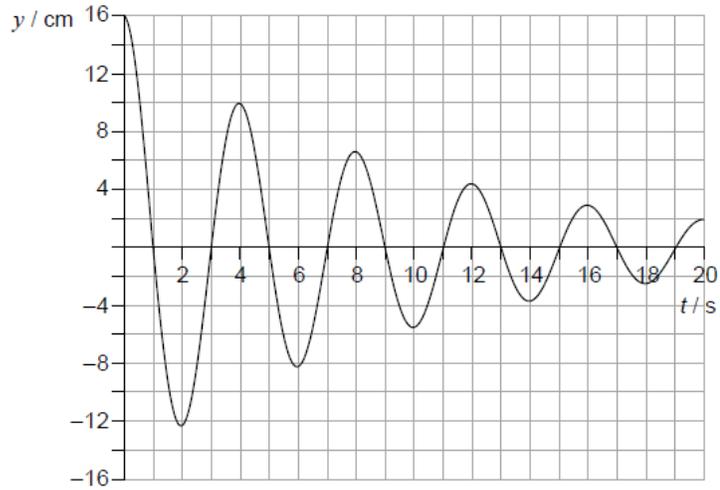
3b. Outline what change would be required to the value of Q for the mass–spring system in order for the drive to be more comfortable. [1 mark]

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The graph below shows the displacement y of an oscillating system as a function of time t .



4a. State what is meant by damping.

[1 mark]

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4b. Calculate the Q factor for the system.

[1 mark]

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4c. The Q factor of the system increases. State and explain the change to the graph.

[2 marks]

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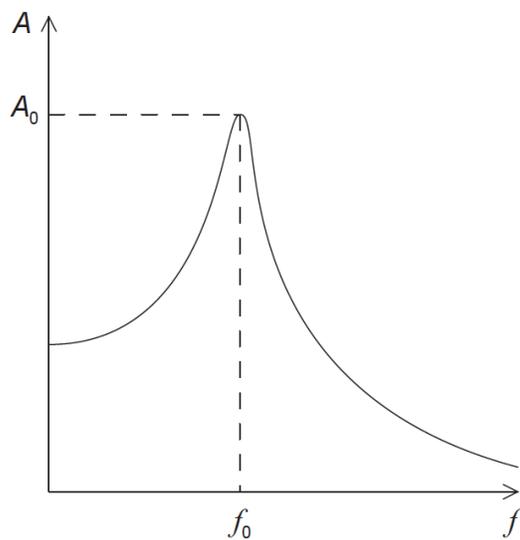
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5. The effects of resonance should be avoided in

[1 mark]

- A. quartz oscillators.
- B. vibrations in machinery.
- C. microwave generators.
- D. musical instruments.

6. In which of the following systems is it desirable that damping should be as small as possible? [1 mark]
- A. Suspension bridge
 - B. Quartz oscillator
 - C. Car suspension
 - D. Airplane/aeroplane wing
7. Microwave ovens cause the water molecules in food to resonate. Water molecules have a natural frequency of vibration f . In order to heat the food most effectively, the frequency of the microwaves should have a value [1 mark]
- A. less than f .
 - B. equal to f .
 - C. greater than f .
 - D. as large as possible.
8. A periodic driving force of frequency f acts on a system which undergoes forced oscillations of amplitude A . The graph below shows the variation with f of A . The maximum amplitude A_0 of the oscillations occurs at frequency f_0 . [1 mark]



The damping of the system is now increased.
Which describes the change in f_0 and the change in A_0 ?

	f_0	A_0
A.	decrease	increase
B.	decrease	decrease
C.	increase	increase
D.	increase	decrease