Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

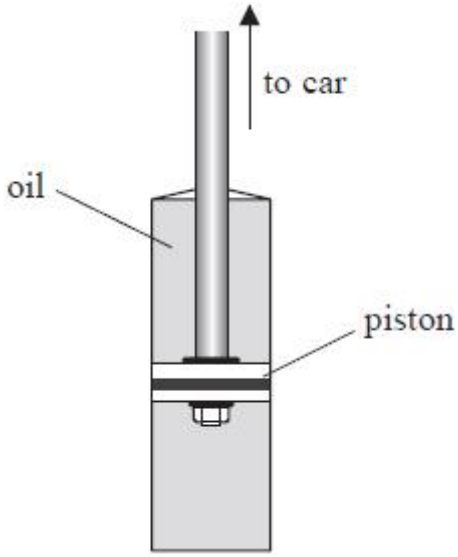
Q1.

The suspension system in a car includes a spring attached to each wheel as shown.



(Source: © Macrovector/Shutterstock)

The oscillations are heavily damped by a piston in the suspension system. The piston moves within a cylinder filled with oil, as shown. The oil has a high viscosity.



Explain why using oil of high viscosity will produce heavy damping.

(3)

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(Total for question = 3 marks)

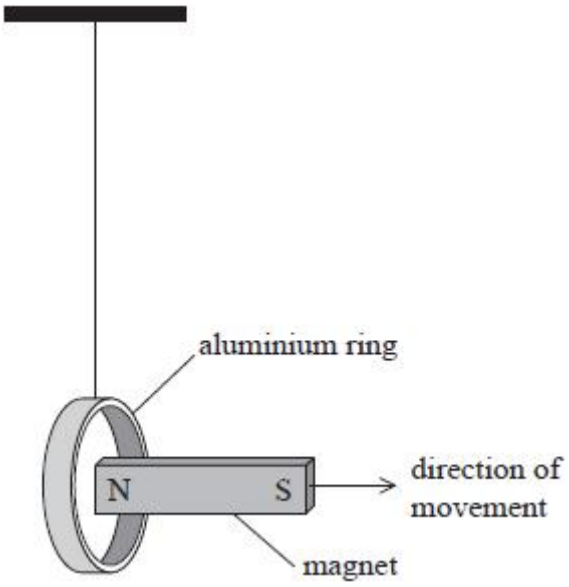
Q2.

The Shanghai Maglev Train is the first commercially operated high-speed magnetic levitation train in the world, connecting the airport and central Shanghai.



* A linear induction motor provides the force to accelerate the train forwards. A current flows in sequence through coils of wire mounted in the track. The train is dragged along as the magnetic field progresses along the coils of wire in the track. This is similar to moving a permanent magnetic field away from a conductor.

A teacher demonstrates this effect by quickly removing one end of a bar magnet from a suspended aluminum ring.



When the magnet is removed from the ring, the ring moves in the same direction as the magnet.

Explain, using the laws of electromagnetic induction, why the ring moves in the direction of the magnet.

(6)

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(Total for question = 6 marks)

Q3.

The Shanghai Maglev Train is the first commercially operated high-speed magnetic levitation train in the world, connecting the airport and central Shanghai.



Electromagnetic forces enable the train to levitate above a steel rail.

Explain why magnetic levitation is an advantage for a high-speed transport system.

(2)

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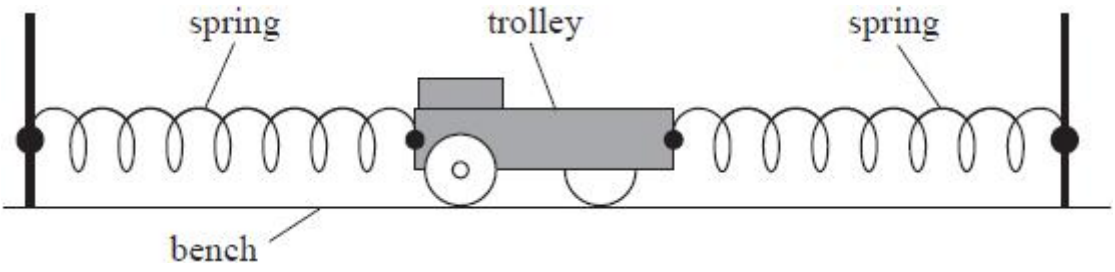
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(Total for question = 2 marks)

Q4.

A trolley is attached to the ends of two springs as shown. When displaced from its equilibrium position, the trolley moves with simple harmonic motion.



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The student displaces the trolley a greater distance from the equilibrium position, so the amplitude of oscillation is doubled. The trolley still moves with simple harmonic motion.

Explain how the maximum kinetic energy of the trolley will change.

(3)

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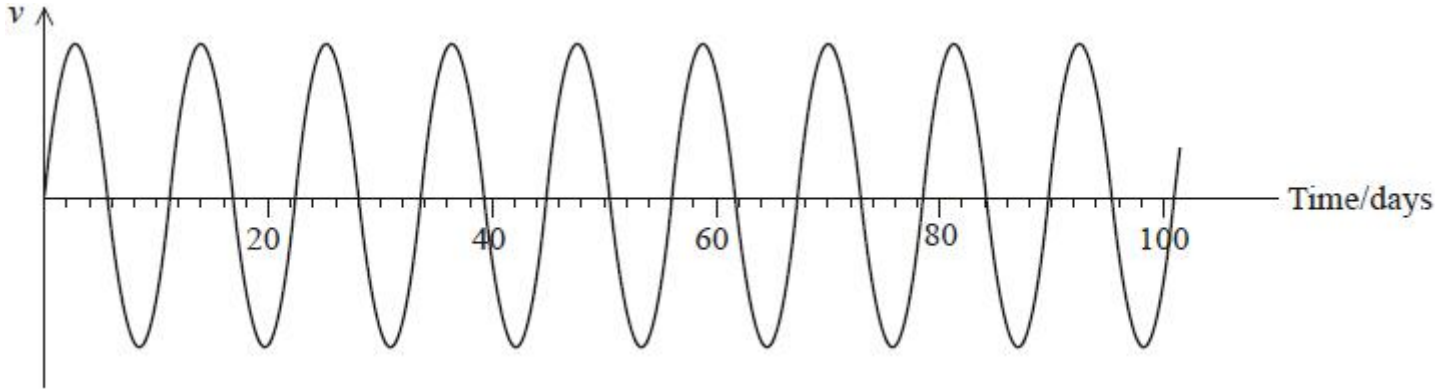
(Total for question = 3 marks)

Q5.

In 2016 astronomers announced the discovery of an Earth-like planet orbiting Proxima Centauri, the closest star to the Sun.

The planet was detected because of the small movement of the star as the planet orbited. The movement was detected using the Doppler shift in the frequency of light travelling to the Earth.

The graph shows how the component of the star's velocity *v* towards the Earth varied over time.



(i) Use the graph to show that the angular velocity of the planet is about 6×10^{-6} radian s^{-1}.

(3)

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(ii) The mass of Proxima Centauri is 0.12 times the mass of the Sun.

Determine the distance of the planet from Proxima Centauri.
mass of Sun = 1.99×10^{30} kg

(3)

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Distance = ...

(Total for question = 6 marks)

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