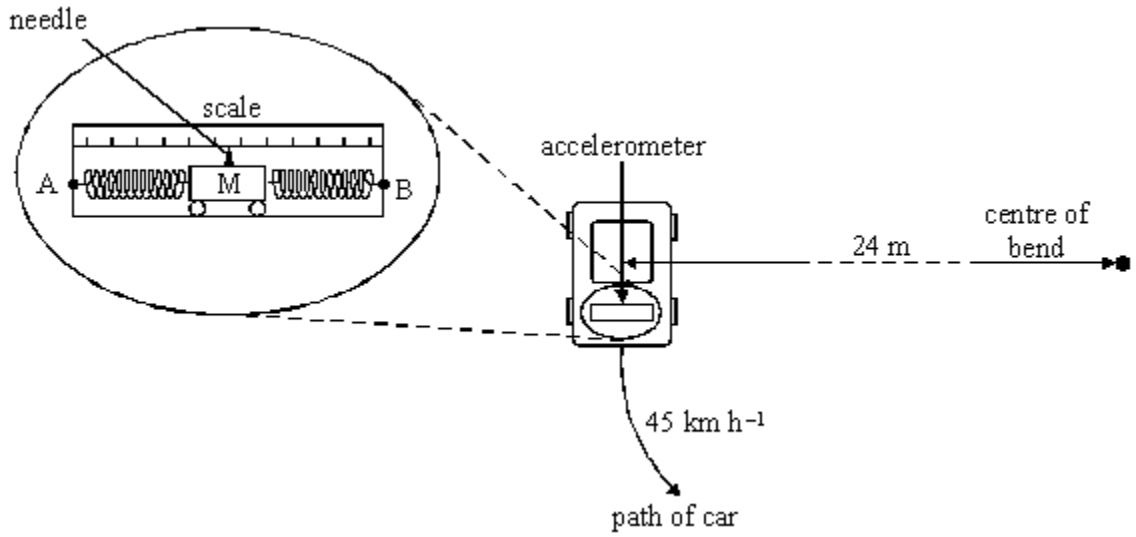
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

The diagram below shows a simple accelerometer designed to measure the centripetal acceleration of a car going round a bend following a circular path.



The two ends **A** and **B** are fixed to the car. The mass **M** is free to move between the two springs. The needle attached to the mass moves along a scale to indicate the acceleration.

In one instant a car travels round a bend of radius 24 m in the direction shown in the diagram above. The speed of the car is 45 km h^{-1}.

(a) State and explain the direction in which the pointer moves from its equilibrium position.

_____

_____

_____

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_____

(3)

(b) (i) Calculate the acceleration that would be recorded by the accelerometer.

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(2)

(ii) The mass **M** between the springs in the accelerometer is 0.35 kg. A test shows that a force of 0.75 N moves the pointer 27 mm.

Calculate the displacement of the needle from the equilibrium position when the car is travelling with the acceleration in part (i).

(2)

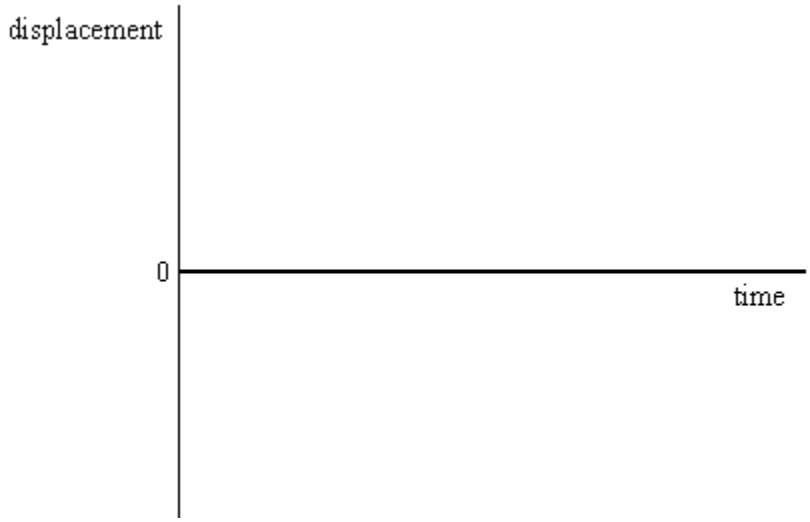
(c) When the car leaves the bend the accelerometer eventually returns to its zero reading after a few cycles of damped simple harmonic motion.

(i) Calculate the period of the oscillation of the mass **M**.

(3)

(ii) Sketch, on the axes below, a graph showing how the displacement of the mass varies with time from the instant the car leaves the bend. Include appropriate values on the axes of your graph.

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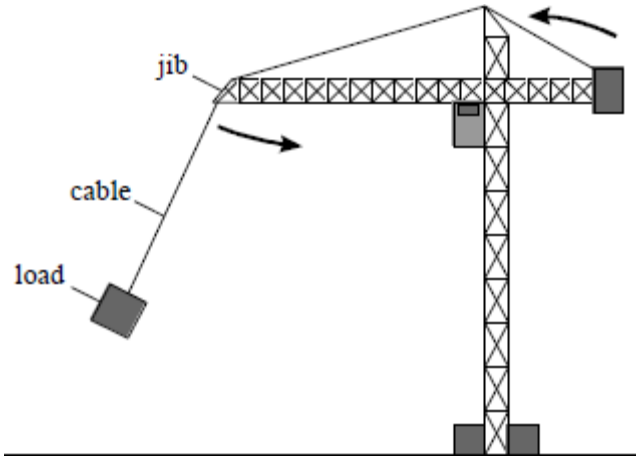
(2)

(Total 12 marks)

Q2.

The diagram below shows a crane moving a heavy load of mass 1.5×10^3 kg. The mass of the cable is negligible compared with the mass of the load. When the jib moves round and then stops the load swings and behaves like a simple pendulum, undergoing free oscillations. The oscillation has an amplitude of 5.0 m and period of 8.0 s.

the acceleration of free fall, $g = 9.8$ m s^{-2}



(a) (i) Explain briefly the difference between a free and a forced oscillation.

_____

_____

_____

_____

_____

_____

(2)

(ii) Calculate the length of the cable.

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(2)

(iii) Determine the maximum acceleration of the load as it swings.

(3)

(iv) Calculate the force on the load that produces this acceleration.

(2)

(b) The total energy of the oscillating load is approximately 12 kJ.

Sketch a graph showing how the **kinetic energy** of the load varies with **time** during one cycle of oscillation. Start your graph at a time when the displacement of the load from the equilibrium position is a maximum. Include appropriate scales on the axes of your graph.

(2)
(Total 11 marks)

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