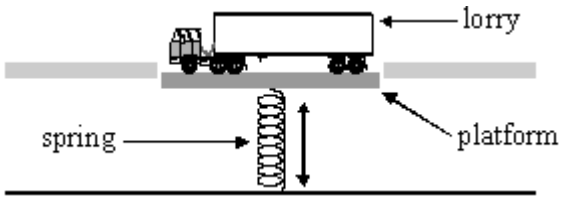
Name of the Student:_____
Max. Marks : 16 Marks **Time : 16 Minutes**

Q1.

The diagram below shows a way to measure the mass of a lorry. The vehicle and its contents are driven onto a platform mounted on a spring. The platform is then made to oscillate vertically and the mass is found from a measurement of the natural frequency of oscillation.



(a) (i) State whether the period of oscillation increases, decreases or remains unchanged when the amplitude of oscillation of the platform is reduced.

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(1)

(ii) The spring constant *k* of the supporting spring is increased to four times its original value.

State the value of the ratio $\frac{\text{new oscillation period}}{\text{oldo scillation period}}$.

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(1)

(iii) The time period of oscillation is *T* when a lorry is on the platform. The spring constant of the spring is *k*. Show that the total mass *M* of lorry and platform is given by

$$M = \frac{kT^2}{4\pi^2}$$

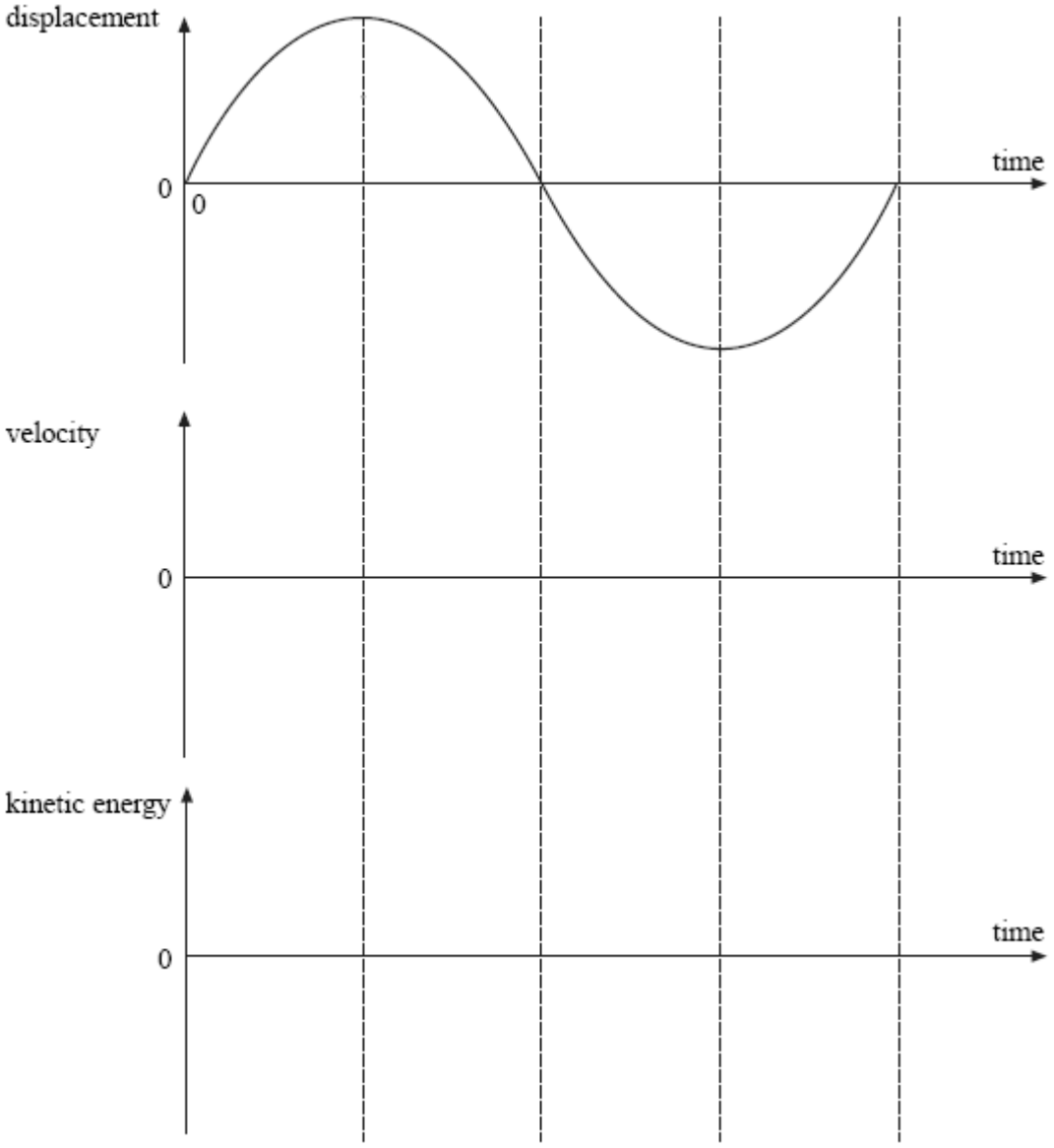
(2)

(iv) A lorry and its contents have a total mass of 5300 kg. The spring constant of the supporting spring *k* is 1.9×10^5 N m^{-1}. The frequency of oscillation of the platform with the lorry resting on it is 0.91 Hz.

Calculate the mass of the platform.

(3)

(b) The graph below shows how the displacement of the platform varies with time over one cycle. Sketch on the axes provided graphs of velocity against time and kinetic energy against time for the motion of the platform.



(5)

(c) The driver is required to turn off the vehicle engine whilst the measurement is taking place.

The driver of the lorry in part (a)(iv) fails to do this and slowly increases the frequency of vibration of his vehicle from 0.5 Hz to about 4 Hz whilst the measurement is in progress and the platform is free to move. Describe and explain how the amplitude and frequency of the platform vary as this frequency increase occurs. You should use a sketch graph to support your answer.

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(4)

(Total 16 marks)