GCE PHYSICS

S21-A420QS

Assessment Resource number 1

Newtonian Physics Resource A

1.

(a) (i) Define the angular velocity, ω, for a body moving in a circle. [1]

(ii) Two equations giving the acceleration of a body moving at constant speed in a circle are:

$$a = \frac{v^2}{r} \quad \text{and} \quad a = r\omega^2.$$

Show clearly that the equations are equivalent. [2]

(b) A moon called *Deimos* orbits Mars in a circular path of radius 23 500 km. Astronomers have calculated the mass of Deimos to be 1.48×10^{15} kg, and the force exerted on it by Mars to be 1.15×10^{14} N.

(i) Calculate the speed of Deimos around Mars. [2]

(ii) Explain whether or not a moon of twice the mass of Deimos, but in a circular orbit of the same radius about Mars, would have the same speed as Deimos. [2]

2

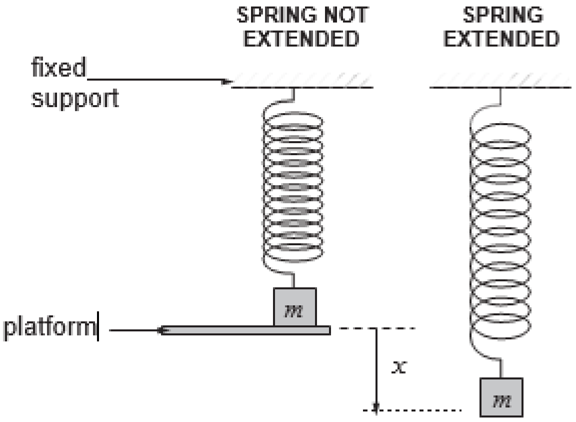
(a) State the *principle of conservation of energy*. [2]

....

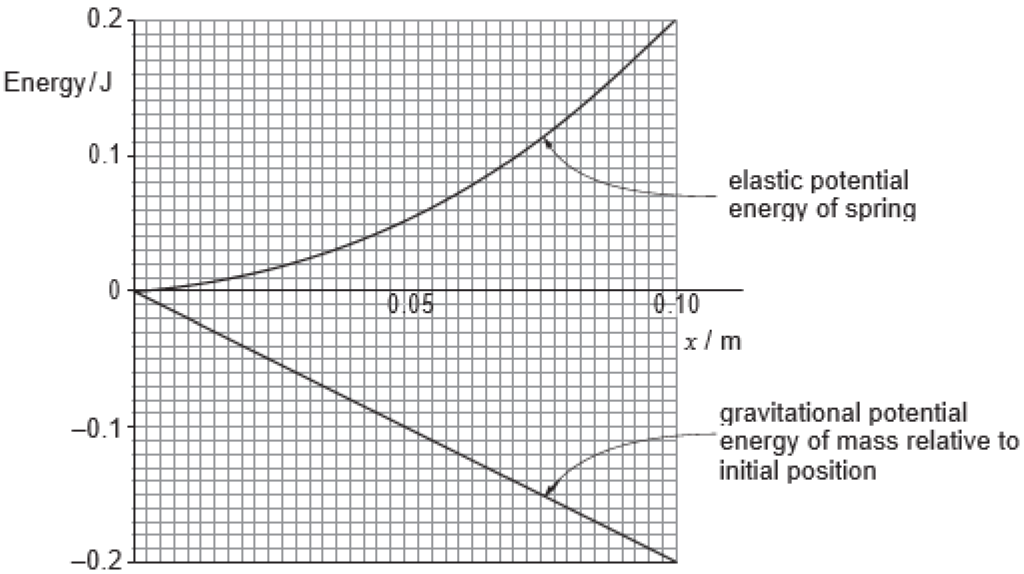
....

....

(b) A mass, m, is attached to a light spring whose top end is held firmly. Initially the mass is supported by a platform with the spring unextended. The platform is suddenly removed so the mass falls.



The graphs show how the elastic potential energy of the spring and the gravitational potential energy of the mass vary with the distance, x, of the mass below the platform (see diagrams).



(i) Assuming that resistive forces are negligible, use data from the graphs to calculate:

I. the spring constant, k; [3]

....

....

....

II. the mass, m; [2]

....

....

....

III. the kinetic energy of m when $x = 0.050$ m. [2]

....

....

....

(ii) Sketch a graph of the kinetic energy of the mass, m, against x **on the same grid as the other graphs**. [2]

(c) In the arrangement described in *(b)*, the furthest distance, x_{max}, that m falls is 0.10 m. However, a larger mass would fall further. In theory, x_{max} is directly proportional to the mass, m. Describe briefly how you would verify this relationship by experiment. [4]

....

3

(a) Rachel investigates a simple pendulum consisting of a small metal sphere suspended by a thread. She determines its period to be 2.40 s.

(i) Calculate the length of the pendulum. [2]

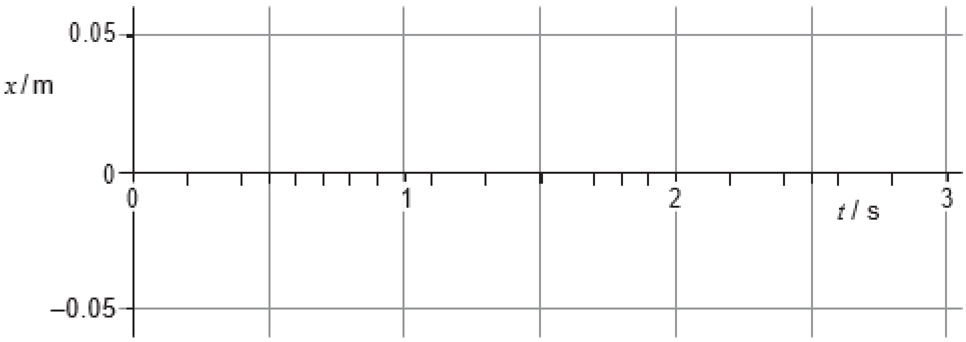
....

....

....

....

(ii) Rachel now displaces the sphere by 0.050 m to one side of its equilibrium position and releases it at time $t = 0$.



I. Sketch a graph of displacement, x, against time, t, for the sphere between $t = 0$ and $t = 3.00$ s **on the grid provided**. Take the initial value of x to be positive. [2]

II. Use an appropriate equation to calculate the sphere's displacement at $t = 1.60$ s. [2]

....

....

....

III. Calculate the sphere's velocity at $t = 1.60$ s. [2]

....

....

....

IV. State the next time at which the sphere has the same velocity. [1]

....

(b) Explain what is meant by *resonance*, and how its effects can be reduced in a particular case where resonance should be avoided. [6 QER]