GCE PHYSICS

S21-A420QS

Assessment Resource number 5

Newtonian Physics Resource E

1

(a) A fairground ride rotates at a rate of 8.20 revolutions per **minute**.

(i) Calculate:

I. the angular velocity in radians per second; [2]

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II. the time taken to travel an arc of length 10.0 m for a point P on the ride at 3.80 m from the central axis around which the ride is rotating; [2]

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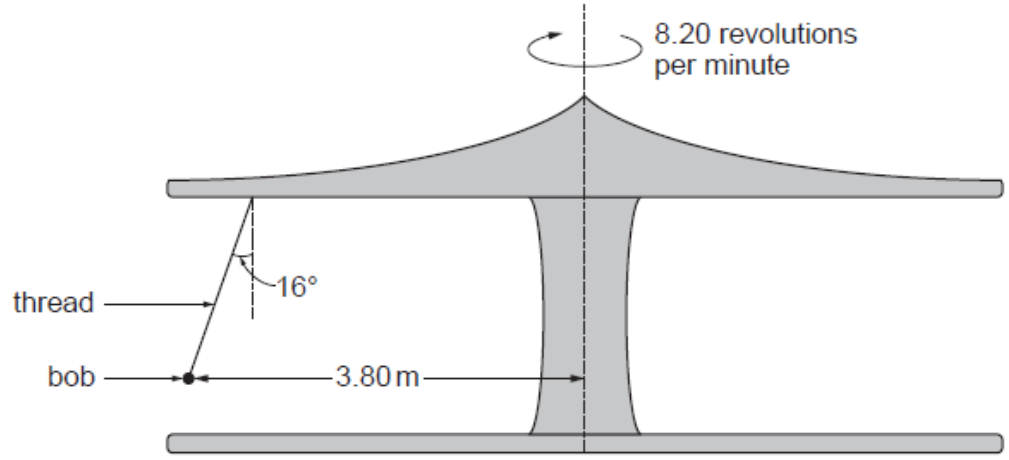
(ii) Annushka has been given permission to tie a simple pendulum from the ceiling of the rotating ride. She finds that, when the pendulum has stabilised, it hangs at 16° to the vertical, with its bob at 3.80 m from the central axis (see diagram).



I. The mass of the bob is 0.270 kg. By considering the **vertical** force components on the bob, calculate the tension in the thread. [2]

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II. State what provides the centripetal force on the bob and show clearly whether or not this is consistent with the acceleration calculated in *(a)*(i)III. [3]

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(b) Discuss **one** way in which our knowledge of the magnitude of centripetal force has been applied in the design of roads **or** railways **or** a domestic appliance. [3]

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2

(a) Define *simple harmonic motion*. [2]

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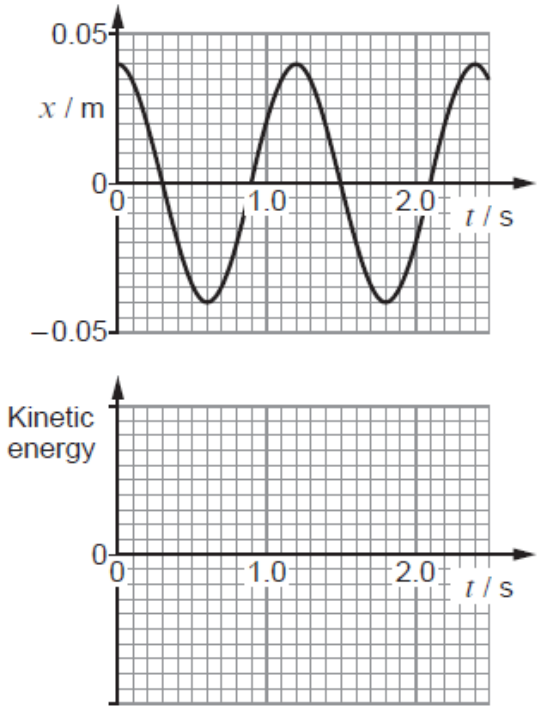
(b) A metal sphere of mass 0.175 kg hangs from a spring whose top end is clamped. The sphere is set oscillating up and down, and a displacement-time graph is plotted.



GRID FOR *(b)*(iii)

(i) Calculate the stiffness constant, k, of the spring. [3]

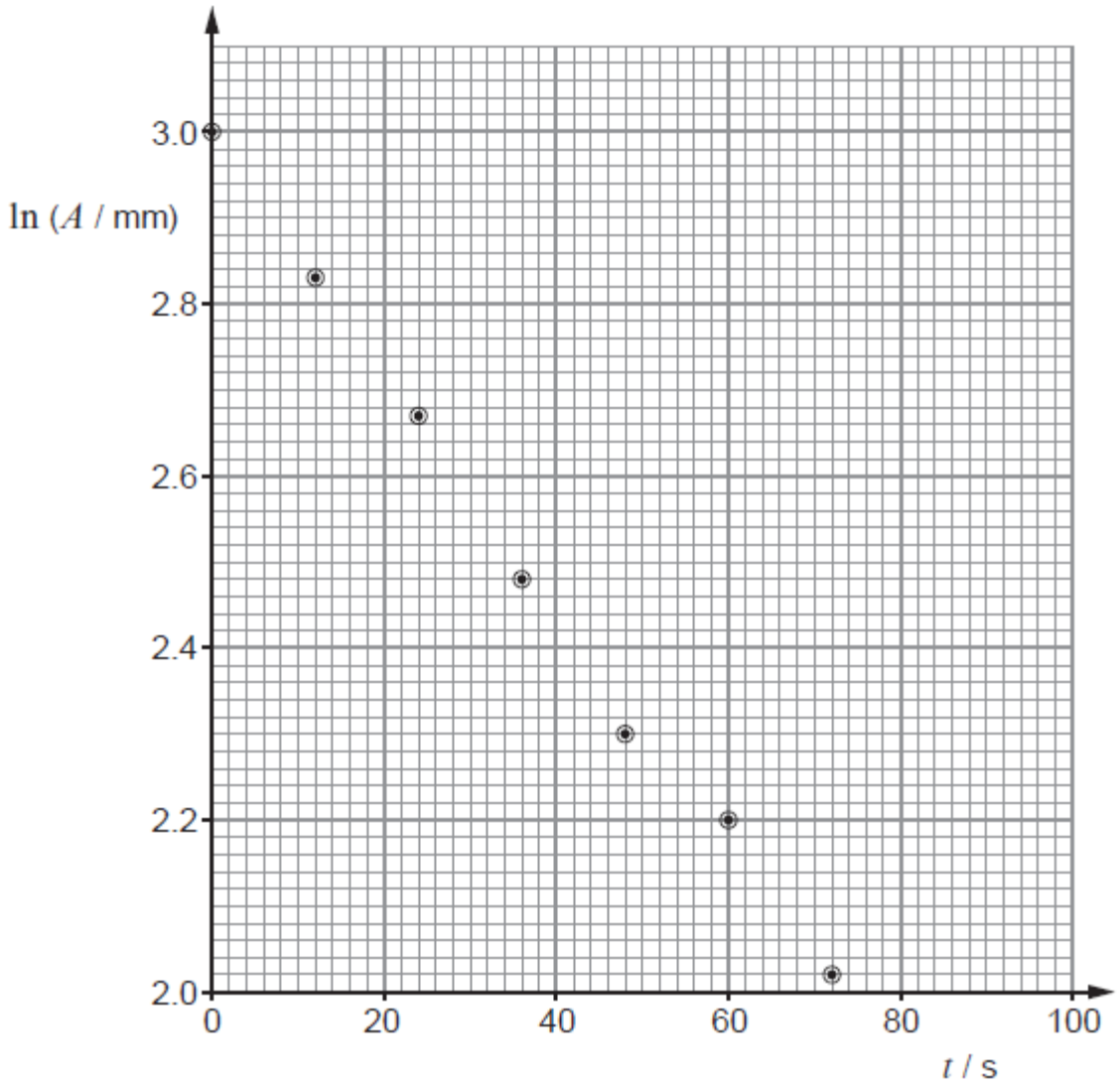
(ii) Calculate the maximum kinetic energy of the sphere. [3]

(iii) Carefully sketch a graph of the sphere's kinetic energy against time **on the axes provided on the opposite page**. A vertical scale is **not** needed. [3]

(c) Over several oscillations it is clear that the amplitude of the sphere's motion is decreasing. Evgeniya suspects that the amplitude is decreasing exponentially, according to the equation:

$$A = A_0 e^{-\lambda t}$$

To check this idea she uses readings of the amplitude, A, taken at regular intervals to plot $\ln (A / \text{mm})$ against time, t.



Evgeniya claims that the points she has plotted support the exponential decrease of amplitude. Justify her claim **and** determine a value for λ. [5]

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3

(a) State what is meant by the *heat*, Q, entering a system. [2]

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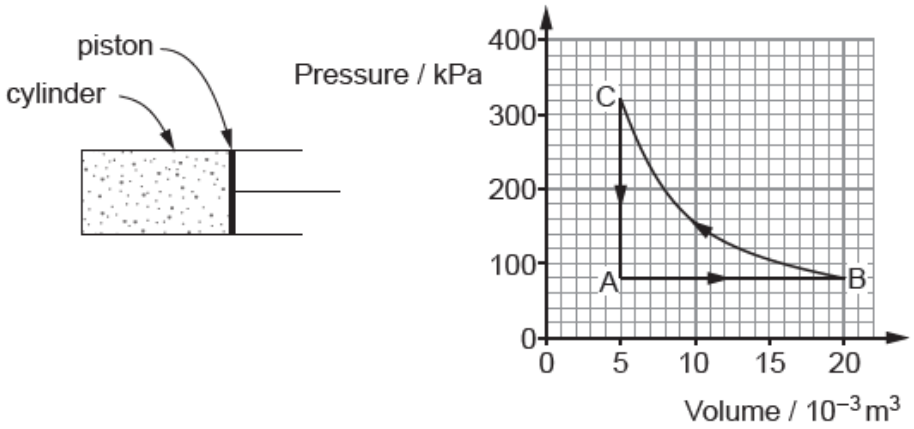
(b) A gas (assumed ideal) is contained in a cylinder with a moveable, leak-proof piston. The gas is taken through the cycle ABC shown on the graph. The stage BC takes place at constant temperature.



(i) Calculate the work done by the gas in the stage AB. [2]

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(ii) For each of the stages AB, BC and CA separately, **and** for the cycle as a whole, use the first law of thermodynamics to explain whether heat flows into the system or out of the system. Calculations are **not** required. [6 QER]

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