IYGB GCE

Mathematics FM1

Advanced Level

Practice Paper N

Difficulty Rating: 3.2067/1.4320

Time: 1 hour 30 minutes

Candidates may use any calculator allowed by the regulations of this examination.

Information for Candidates

This practice paper follows closely the Pearson Edexcel Syllabus, suitable for first assessment Summer 2018.

The standard booklet "Mathematical Formulae and Statistical Tables" may be used.
Full marks may be obtained for answers to ALL questions.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
There are 7 questions in this question paper.
The total mark for this paper is 75.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.
Non exact answers should be given to an appropriate degree of accuracy.
The examiner may refuse to mark any parts of questions if deemed not to be legible.

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Question 1

A rail car A of mass $3m$ is moving with constant speed $4U$ on smooth straight horizontal rails. It collides directly with another rail car B of mass $7m$ which is moving with constant speed $6U$ in the opposite direction on the same rails.

The rail cars' couples join so that immediately after the collision they move together.

The rail cars are modelled as particles.

a) Find, in terms of U, the speed of the rail cars immediately after the collision.

(3)

b) Determine, in terms of m and U, the magnitude of the impulse exerted on A by B in the collision. **(3)**

Question 2

A light elastic string AB has natural length 1.25 m and modulus of elasticity 24.5 N. Another light elastic string CD has natural length 1.25 m and modulus of elasticity 26.95 N.

The two strings AB and CD are joined together with B attached to C forming a longer string AD whose end A is fixed to a horizontal ceiling.

A particle of mass 5 kg is attached to the free end of the string at D and hangs in equilibrium, without touching the ground.

(6)

a) Determine the length of AD in this configuration.

The strings are next joined together at their ends with A joined to C and with B joined to D. The "A to C" end is fixed to the horizontal ceiling.

A particle of mass 5 kg is attached to the "B to D" end, and hangs in equilibrium, without touching the ground.

(9)

b) Calculate the tension in each string.

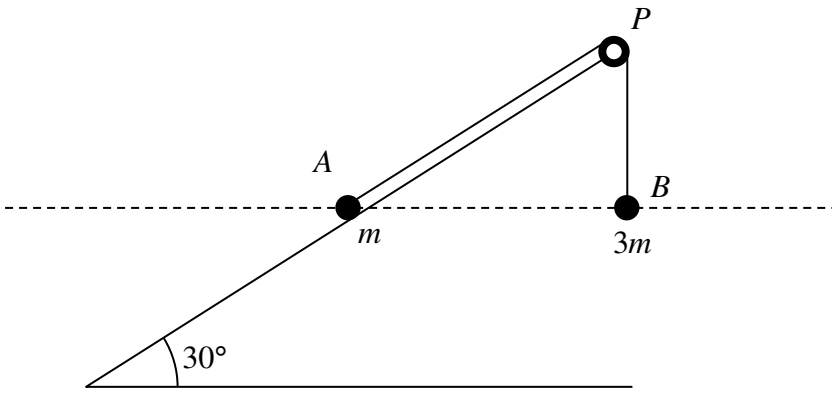
Question 3

A lorry, of mass 4000 kg, is travelling up the line of greatest slope of a hill inclined at an angle θ to the horizontal, where $\sin\theta = \frac{3}{49}$. The engine of the lorry is working at the constant rate of 90 kW.

The motion of the lorry is subject to a **constant** non gravitational resistance.

Determine the greatest speed of the lorry up the hill, given that at some instant during the climb the lorry is accelerating at 0.2 ms^{-2} and its speed is 14.4 ms^{-1}. **(10)**

Question 4



Two particles A and B, of mass m and $3m$ respectively, are attached to each of the ends of a light inextensible string. The string passes over a smooth pulley P, at the top of a fixed smooth plane, inclined at $30°$ to the horizontal.

Particle A is held at rest on the incline plane while B is hanging freely at the end of the incline plane vertically below P, as shown in the figure above. The two particles, the pulley and the string lie in a vertical plane parallel to the line of greatest slope of the incline plane.

The particles are released from rest, from the same horizontal level with the string taut. When B has fallen by a distance l, its speed is v, and A has not yet reach P.

By using energy considerations and ignoring air resistance, express v in terms of l. **(10)**

Question 5

A particle A, of mass 0.2 kg, is travelling in a straight line on a smooth horizontal surface, when it collides with a particle B, of mass 1.5 kg, which was moving on the same surface and in the same direction as A.

The respective speeds of A and B just before the collision are 15 ms^{-1} and 4 ms^{-1}.

The coefficient of restitution between the two particles, e, is such so that the two particles move in the same direction after the collision.

Show that $e < \frac{6}{11}$. **(10)**

Question 6

A light elastic string, of natural length 1.42 m, has each of its two ends attached to two fixed points, A and B, where AB is horizontal and $|AB| = 1.68$ m.

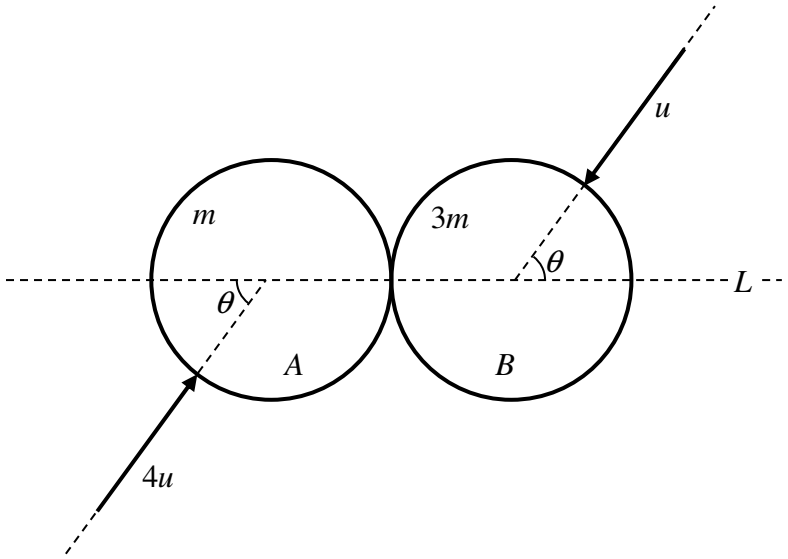
A particle, of mass 2 kg, is attached to the midpoint of the string, M.

The particle is hanging in a equilibrium at the point C, where MC is vertical and $|MC| = 0.35$ m.

The particle is then held at M and released from rest.

Calculate, correct to 2 decimal places, the speed of particle as it passes through C. **(13)**

Question 7



Two smooth uniform spheres A and B with equal radii have masses m and $3m$ respectively. The spheres are moving in opposite directions on a smooth horizontal surface, where they collide obliquely.

Immediately before the collision, A has speed $4u$ and its direction of motion forms an angle θ to the straight line L, joining the centres of the spheres on impact.

Immediately before the collision B has speed u with its direction of motion also forming an angle θ to L, as shown in the figure above.

Immediately after the collision, the speed of A is twice the speed of B.

Given further that the coefficient of restitution between A and B is 0.25, find the value of θ. **(11)**