IYGB GCE

Mathematics FM1

Advanced Level

Practice Paper M

Difficulty Rating: 3.3067/1.4851

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 8 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.

Question 1

A car of mass 1600 kg is travelling up a straight road inclined at an angle θ to the horizontal, where $\sin\theta = \frac{1}{40}$.

The car is modelled as a particle travelling at constant speed of 25 ms^{-1} and the resistance to its motion due to non-gravitational forces has a constant magnitude of 500 N.

The car travels between two points on the road, A and B in 20 s.

Determine the work done by the engine of the car, as the car moves from A to B. **(7)**

Question 2

A light elastic string AB has natural length $2L$ m and modulus of elasticity λ N.

A different light elastic string CD has natural length $3L$ m and modulus of elasticity $\frac{1}{4}\lambda$ N.

The two strings are joined together at their ends, with A joined to C and with B joined to D. The "A to C" end is fixed to a horizontal ceiling. A particle of weight 65 N is attached to the "B to D" end, and hangs in equilibrium, without touching the ground.

Given that when the particle hangs in equilibrium the length of the string AB is twice is natural length, determine the value of λ. **(6)**

Question 3

Two smooth spheres of equal radius, A and B, of mass 3 kg and m kg respectively, are moving in the same direction, along a straight line on a smooth horizontal plane.

The spheres collide and the magnitude of impulse exerted on B by A is 15 Ns.

Before the collision, the respective speeds of A and B are 8 ms^{-1} and 2 ms^{-1}.

After the collision B is moving with speed 2 ms^{-1} **relative** to A.

Determine the value of m and the speed of B, after the collision. **(7)**

Question 4

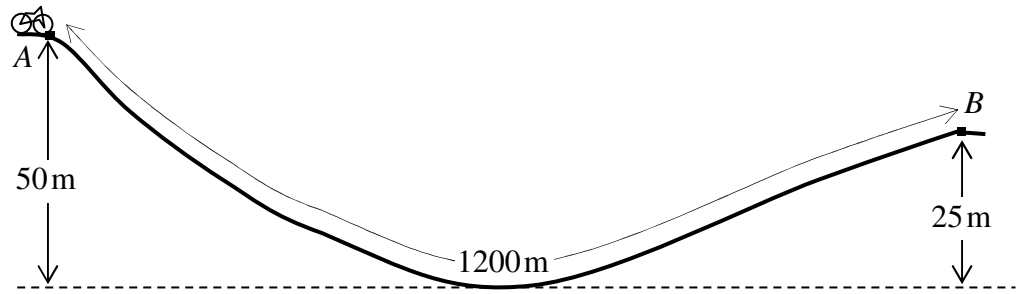
A light elastic spring AB, of natural length 2 m, has its end A attached to a fixed point on a horizontal ceiling and a particle, of mass 3 kg, is attached to the other end of the spring, B, with the particle hanging in equilibrium.

The modulus of elasticity of the spring is $100g$ N

The particle is then pulled vertically downwards, so that $|AB| = 2.15$ m, and released from rest.

Determine the length of AB when the particle first comes to instantaneous rest. **(12)**

Question 5



The figure above shows the path of a cyclist on a section of a road from A to B, where the distance AB is 1200 m.

The cyclist leaves point A at the top of a hill with a speed V ms^{-1} and descends a vertical distance of 50 m to the bottom of the hill. He then ascends a vertical distance of 25 m to the top of another hill at point B.

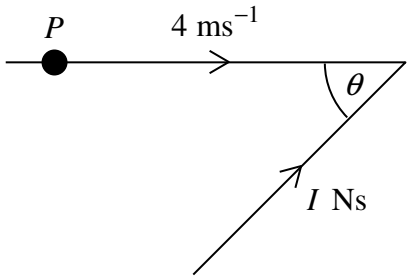
The cyclist takes 110 s to travel from A to B and is assumed to be working at the constant rate of 40 W, throughout the motion.

The combined mass of the cyclist and his bike is 80 kg.

The cyclist and his bike are modelled as a single particle subject to a constant non gravitational resistance of 20 N, throughout the motion.

Show that speed of the cyclist at B is V ms^{-1}. **(10)**

Question 6



A particle P of mass 0.5 kg is moving in a straight line with speed 4 ms^{-1}.

An impulse of magnitude I Ns is applied to P, acting at an acute angle θ to the direction of motion of P, as shown in the figure above.

After the impulse was applied, P is moving with speed 8 ms^{-1} in a direction which is inclined by an acute angle α to its original direction of motion.

Given that $\sin\alpha = \frac{3}{5}$, determine the value of I and the value of θ. **(9)**

Question 7

Three small smooth spheres A, B and C, are resting on a straight line, and in that order, on a horizontal surface.

The respective masses of A, B and C, are m, $3m$ and $7m$.

A is project towards B with speed u and a direct collision takes place.

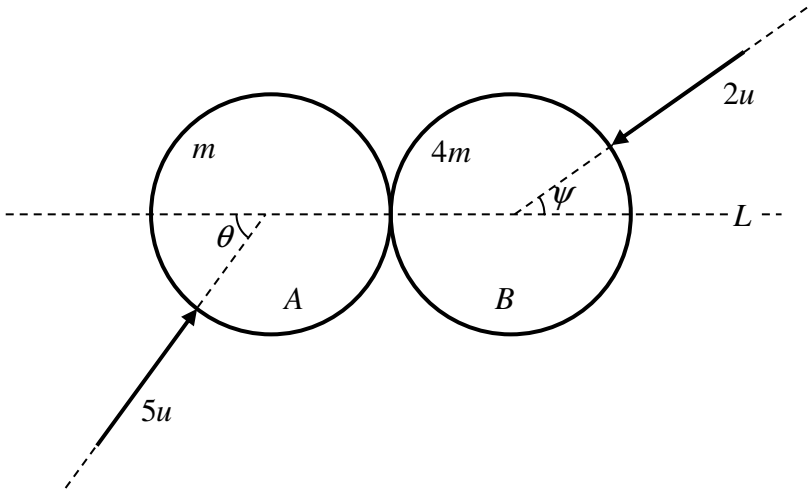
The coefficient of restitution between A and B is 0.5.

The coefficient of restitution between B and C is e.

If there is a second collision between A and B, find the range of possible values of e.

(14)

Question 8



Two smooth uniform spheres A and B have equal radii, and their respective masses are m and $4m$. The spheres are moving on a smooth horizontal plane when they collide obliquely, with their centres at impact defining the straight line L, as shown in the figure above.

Immediately before the collision, A is moving with speed $5u$ at an acute angle θ to L and B is moving with speed $2u$ at an acute angle ψ to L.

It is further given that $\cos\theta = 0.2$, $\cos\psi = 0.75$ and the coefficient of restitution between the two spheres is 0.5.

a) Determine, in terms of m and u, the magnitude of the impulse on A due to the collision. **(7)**

b) Express the kinetic energy **gained** by A in the collision, as a percentage of its initial kinetic energy. **(3)**