

# IYGB GCE

## Mathematics FM1

### Advanced Level

#### Practice Paper N

Difficulty Rating: 3.3533/1.5113

**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.

**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.
-

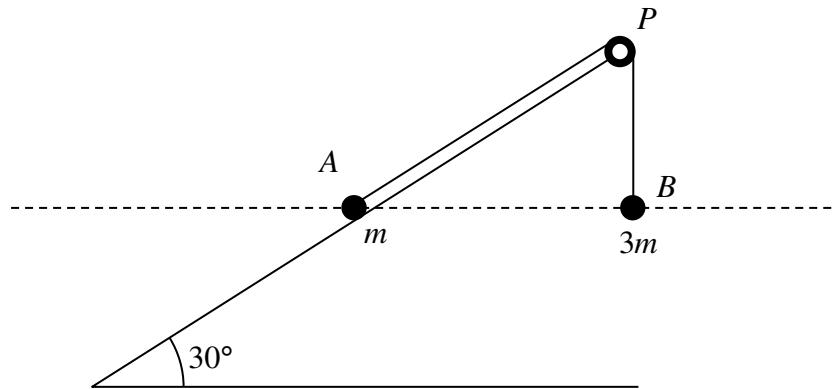
**Question 3**

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

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  $0.2 \text{ ms}^{-2}$  and its speed is  $14.4 \text{ ms}^{-1}$ . (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  $30^\circ$  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  $P$ .

Ignoring air resistance, express  $v$  in terms of  $g$  and  $l$ . (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  $15 \text{ ms}^{-1}$  and  $4 \text{ ms}^{-1}$ .

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

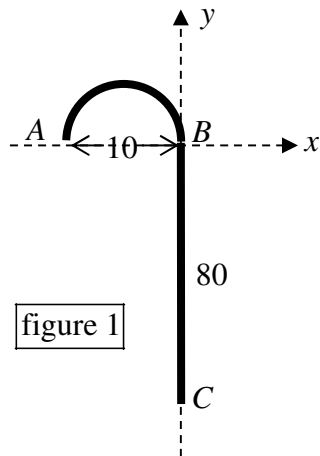


figure 1

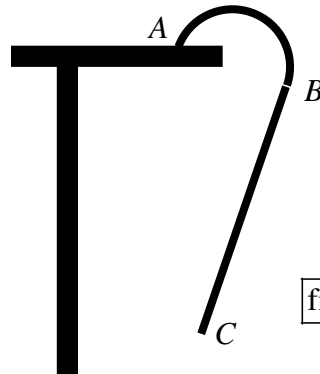


figure 2

Figure 1 shows a walking stick  $ABC$ , modelled as two uniform rods  $AB$  and  $BC$ . The straight section  $BC$  has length 80 cm and the section  $AB$  is a circular arc of diameter 10 cm. The semi-circular section of the walking stick is **four times** as dense as the straight section. A set of coordinate axes is defined with  $B$  as the origin as shown in figure 1.

- a) Find the coordinates of the centre of mass of the walking stick. (8)

The walking stick is placed with its end  $A$  at the end of a horizontal table and rests in equilibrium under its own weight as shown in figure 2, without touching any other object.

- b) Determine the size of the angle that  $BC$  makes with the vertical. (3)