OCR
Oxford Cambridge and RSA

Friday 15 June 2018 – Afternoon

AS GCE MATHEMATICS

4728/01 Mechanics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4728/01
- List of Formulae (MF1)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found inside the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do **not** write in the barcodes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.
- The acceleration due to gravity is denoted by $g\,\mathrm{m\,s^{-2}}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Answer **all** the questions.

1 A small object moves with constant acceleration along a straight line from A to B. Its speed at A is $0.4\,\mathrm{m\,s^{-1}}$ and its speed at B is $6.9\,\mathrm{m\,s^{-1}}$. The object takes 2.5 s to travel from A to B.

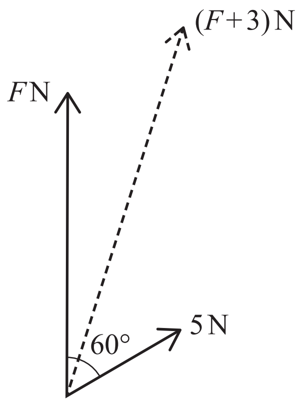
(i) Show that the acceleration of the object is $2.6\,\mathrm{m\,s^{-2}}$. **[2]**

(ii) Find the distance from A to B. **[2]**

(iii) Find the distance travelled by the object in the first 0.2 s of the motion. **[2]**

(iv) Find the distance travelled by the object in the final 0.2 s of the motion. **[2]**

2



Two horizontal forces of magnitudes F N and 5 N act on bearings 000° and 060° respectively. The resultant of these two forces has magnitude $(F + 3)$ N, as shown in the diagram.

(i) Show by calculation that $F = 16$. **[4]**

(ii) Calculate the bearing of the line of action of the resultant. **[4]**

3 A particle P of mass 0.2 kg rests in limiting equilibrium on a plane inclined at $\theta°$ to the horizontal. The coefficient of friction is 0.3.

(i) State in terms of θ

(a) the magnitude of the component of the weight of P parallel to the plane, **[1]**

(b) the magnitude of the frictional force acting on P. **[2]**

(ii) Calculate θ. **[3]**

P is now projected with initial speed $4\,\mathrm{m\,s^{-1}}$ up the plane along a line of greatest slope.

(iii) Calculate the time for which P moves up the plane. **[4]**

4

Two particles A and B move on the same straight line on a smooth horizontal table. A has speed $6\,\mathrm{m\,s^{-1}}$ and is moving towards B. The speed of B is $2\,\mathrm{m\,s^{-1}}$ and B is moving in the opposite direction to A (see diagram). After A and B collide the speed of A is $3\,\mathrm{m\,s^{-1}}$ in its original direction of motion. The particles A and B have masses 0.5 kg and m kg respectively.

(i) It is given that $m = 0.2$. Find the distance between A and B at time 2 s after the collision. **[4]**

(ii) It is given instead that B moves with its least possible speed after the collision. State this speed, and hence find the value of m. **[5]**

5 Two particles of masses 0.3 kg and 0.2 kg are attached to opposite ends of a taut light inextensible string which passes over a small smooth pulley. The particles are released from rest and move vertically.

(i) For the time while both particles are in motion, calculate the magnitude of the acceleration of the particles, and find the magnitude of the force exerted on the pulley by the string. **[7]**

After the particles have been moving for 1.5 s, the particle of mass 0.3 kg reaches the ground and remains at rest. The particle of mass 0.2 kg subsequently comes to instantaneous rest at a point A below the pulley.

(ii) Draw the (t, v) graphs for the motion of the two particles from the instant of initial release from rest until the 0.2 kg particle reaches A. Show clearly all necessary calculations. **[5]**

6 A particle P moves in a straight line on a horizontal surface. At time t s the velocity of P is $v\,\mathrm{m\,s^{-1}}$ and the displacement of P from a fixed point O on the line is x m. For $0 \leqslant t \leqslant 3$ it is given that $v = 2 + t^2$. The particle is at O when $t = 0$.

(i) Find x when $t = 3$. **[3]**

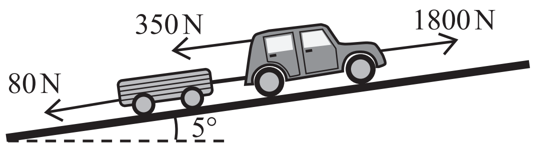
For $t \geqslant 3$ it is given that $x = a + bt + ct^4$, where a, b and c are constants.

(ii) Find expressions for the acceleration of P for each of the cases $0 \leqslant t \leqslant 3$ and $t \geqslant 3$. Hence, by considering the acceleration at $t = 3$, show that $c = \frac{1}{18}$. **[5]**

(iii) Find the values of a and b. **[4]**

(iv) Calculate the value of t for which $v = 25$. **[2]**

7



A car and a trailer are moving together along a straight road up a hill inclined at 5° to the horizontal. The car has a driving force of magnitude 1800 N and a resistance to motion of 350 N. The trailer has a resistance to motion of 80 N. A light rigid tow-bar parallel to the road joins the trailer to the car (see diagram). The mass of the car is 1250 kg and the mass of the trailer is 150 kg.

(i) **(a)** Calculate the acceleration of the car and trailer. **[4]**

(b) Find the magnitude of the force in the tow-bar. **[3]**

On another occasion an object of weight W N is in the trailer when the car and trailer again move up the hill. The magnitudes of the driving force and resistance to motion of the car are unaltered. The resistance to motion of the trailer is increased by $0.05W$ N.

(ii) Calculate the value of W for which the car and trailer move at constant speed. **[4]**

END OF QUESTION PAPER