OCR
RECOGNISING ACHIEVEMENT

Friday 25 January 2013 – 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 in the centre of 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 bar codes.
- 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 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 **16** 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.

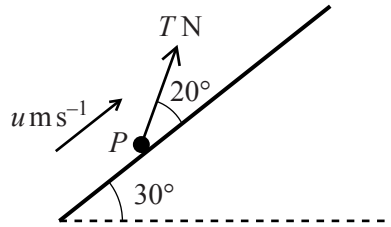
1 Three horizontal forces, acting at a single point, have magnitudes 12 N, 14 N and 5 N and act along bearings 000°, 090° and 270° respectively. Find the magnitude and bearing of their resultant. **[5]**

2 A particle P moves in a straight line. The displacement of P from a fixed point on the line is $(t^4 - 2t^3 + 5)$ m, where t is the time in seconds. Show that, when $t = 1.5$,

(i) P is at instantaneous rest, **[3]**

(ii) the acceleration of P is $9\,\text{m s}^{-2}$. **[3]**

3



A particle P of mass 0.25 kg moves upwards with constant speed $u\,\text{m s}^{-1}$ along a line of greatest slope on a smooth plane inclined at 30° to the horizontal. The pulling force acting on P has magnitude T N and acts at an angle of 20° to the line of greatest slope (see diagram). Calculate

(i) the value of T, **[3]**

(ii) the magnitude of the contact force exerted on P by the plane. **[3]**

The pulling force T N acting on P is suddenly removed, and P comes to instantaneous rest 0.4 s later.

(iii) Calculate u. **[4]**

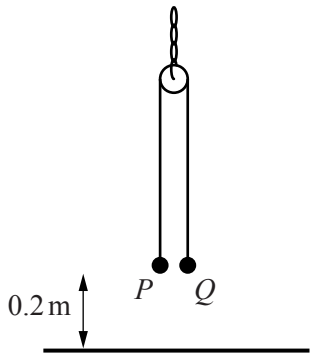
4 The acceleration of a particle P moving in a straight line is $(t^2 - 9t + 18)\,\text{m s}^{-2}$, where t is the time in seconds.

(i) Find the values of t for which the acceleration is zero. **[2]**

(ii) It is given that when $t = 3$ the velocity of P is $9\,\text{m s}^{-1}$. Find the velocity of P when $t = 0$. **[4]**

(iii) Show that the direction of motion of P changes before $t = 1$. **[2]**

5



A small smooth pulley is suspended from a fixed point by a light chain. A light inextensible string passes over the pulley. Particles P and Q, of masses 0.3 kg and m kg respectively, are attached to the opposite ends of the string. The particles are released from rest at a height of 0.2 m above horizontal ground with the string taut; the portions of the string not in contact with the pulley are vertical (see diagram). P strikes the ground with speed $1.4\,\text{m s}^{-1}$. Subsequently P remains on the ground, and Q does not reach the pulley.

(i) Calculate the acceleration of P while it is in motion and the corresponding tension in the string. **[4]**

(ii) Find the value of m. **[3]**

(iii) Calculate the greatest height of Q above the ground. **[4]**

(iv) It is given that the mass of the pulley is 0.5 kg. State the magnitude of the tension in the chain which supports the pulley

(a) when P is in motion, **[2]**

(b) when P is at rest on the ground and Q is moving upwards. **[1]**

6 Particle P of mass 0.3 kg and particle Q of mass 0.2 kg are 3.6 m apart on a smooth horizontal surface. P and Q are simultaneously projected directly towards each other along a straight line. Before the particles collide P has speed $4\,\text{m s}^{-1}$ and Q has speed $5\,\text{m s}^{-1}$.

(i) Given that the particles coalesce in the collision, calculate their common speed after they collide. **[3]**

(ii) It is given instead that one particle is at rest immediately after the collision.

(a) State which particle is in motion after the collision and find the speed of this particle. **[4]**

(b) Find the time taken after the collision for the moving particle to return to its initial position. **[4]**

(c) On a single diagram sketch the (t, v) graphs for the two particles, with $t = 0$ as the instant of their initial projection. **[4]**

7 A and B are two points on a line of greatest slope of a plane inclined at 45° to the horizontal and $AB = 2\,\text{m}$. A particle P of mass $0.4\,\text{kg}$ is projected from A towards B with speed $5\,\text{m}\,\text{s}^{-1}$. The coefficient of friction between the plane and P is 0.2.

(i) Given that the level of A is above the level of B, calculate the speed of P when it passes through the point B, and the time taken to travel from A to B. **[7]**

(ii) Given instead that the level of A is below the level of B,

(a) show that P does not reach B, **[3]**

(b) calculate the difference in the momentum of P for the two occasions when it is at A. **[4]**