

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 $g \text{ ms}^{-2}$. 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

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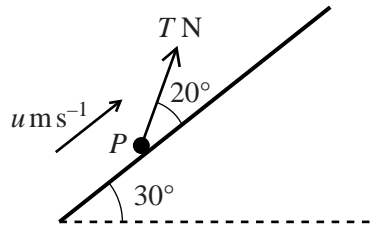
1 Three horizontal forces, acting at a single point, have magnitudes 12 N, 14 N and 5 N and act along bearings 000° , 090° and 270° respectively. Find the magnitude and bearing of their resultant. [5]

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 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 $T \text{ N}$ 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 $T \text{ N}$ acting on P is suddenly removed, and P comes to instantaneous rest 0.4 s later.

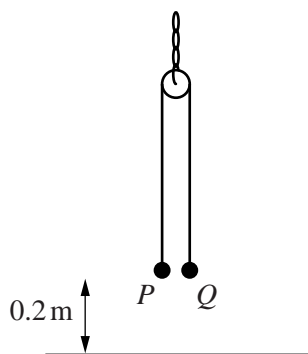
(iii) Calculate u . [4]

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 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]



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 $m\text{ kg}$ 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 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 m s^{-1} and Q has speed 5 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 $AB = 2$ m. A particle P of mass 0.4 kg is projected from A towards B with speed 5 m 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]

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