OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS 4728

Mechanics 1

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
- Printed answer book 4728
- List of Formulae (MF1)

Other materials required:
- Scientific or graphical calculator

Monday 24 January 2011
Morning

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. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- 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 **12** pages. The question paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

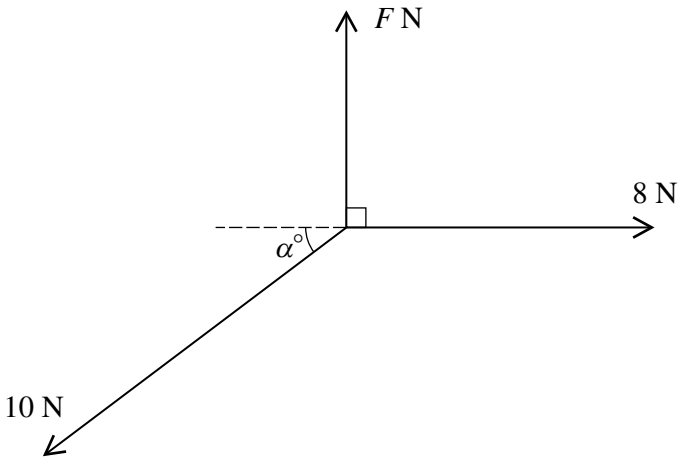
- Do not send this question paper for marking; it should be retained in the centre or destroyed.

1 Two particles P and Q are projected directly towards each other on a smooth horizontal surface. P has mass 0.5 kg and initial speed $2.4\,\text{m s}^{-1}$, and Q has mass 0.8 kg and initial speed $1.5\,\text{m s}^{-1}$. After a collision between P and Q, the speed of P is $0.2\,\text{m s}^{-1}$ and the direction of its motion is reversed. Calculate

(i) the change in the momentum of P, **[2]**

(ii) the speed of Q after the collision. **[4]**

2



Three horizontal forces of magnitudes F N, 8 N and 10 N act at a point and are in equilibrium. The F N and 8 N forces are perpendicular to each other, and the 10 N force acts at an obtuse angle $(90 + \alpha)^\circ$ to the F N force (see diagram). Calculate

(i) α, **[3]**

(ii) F. **[3]**

3 A particle is projected vertically upwards with velocity $5\,\text{m s}^{-1}$ from a point 2.5 m above the ground.

(i) Calculate the speed of the particle when it strikes the ground. **[3]**

(ii) Calculate the time after projection when the particle reaches the ground. **[3]**

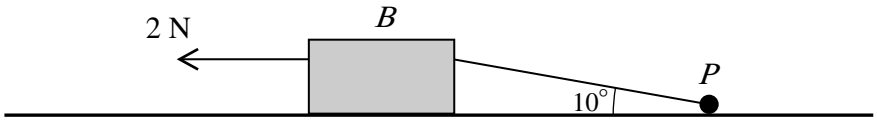
(iii) Sketch on separate diagrams

(a) the (t, v) graph,

(b) the (t, x) graph,

representing the motion of the particle. **[4]**

4

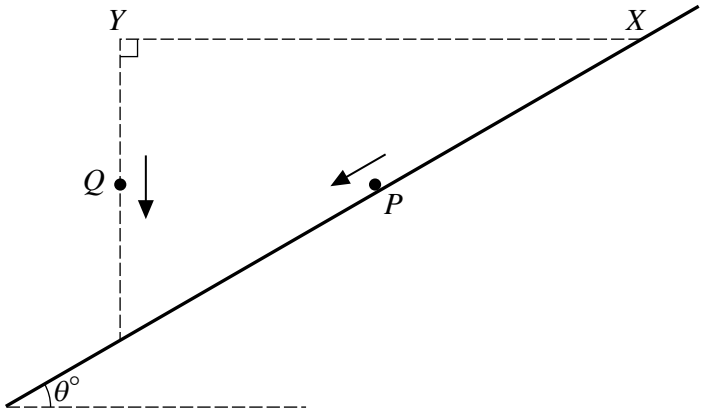


A block B of mass 0.8 kg and a particle P of mass 0.3 kg are connected by a light inextensible string inclined at 10° to the horizontal. They are pulled across a horizontal surface with acceleration $0.2\,\text{m s}^{-2}$, by a horizontal force of 2 N applied to B (see diagram).

(i) Given that contact between B and the surface is smooth, calculate the tension in the string. **[3]**

(ii) Calculate the coefficient of friction between P and the surface. **[7]**

5



X is a point on a smooth plane inclined at $\theta°$ to the horizontal. Y is a point directly above the line of greatest slope passing through X, and XY is horizontal. A particle P is projected from X with initial speed $4.9\,\text{m s}^{-1}$ down the line of greatest slope, and simultaneously a particle Q is released from rest at Y. P moves with acceleration $4.9\,\text{m s}^{-2}$, and Q descends freely under gravity (see diagram). The two particles collide at the point on the plane directly below Y at time T s after being set in motion.

(i) (a) Express in terms of T the distances travelled by the particles before the collision. **[3]**

(b) Calculate θ. **[2]**

(c) Using the answers to parts **(a)** and **(b)**, show that $T = \frac{2}{3}$. **[3]**

(ii) Calculate the speeds of the particles immediately before they collide. **[3]**

6 The velocity $v\,\text{m s}^{-1}$ of a particle at time t s is given by $v = t^2 - 9$. The particle travels in a straight line and passes through a fixed point O when $t = 2$.

(i) Find the displacement of the particle from O when $t = 0$. **[4]**

(ii) Calculate the distance the particle travels from its position at $t = 0$ until it changes its direction of motion. **[6]**

(iii) Calculate the distance of the particle from O when the acceleration of the particle is $10\,\text{m s}^{-2}$. **[5]**

[Question 7 is printed overleaf.]

7 A particle P of mass 0.6 kg is projected up a line of greatest slope of a plane inclined at 30° to the horizontal. P moves with deceleration $10\,\mathrm{m\,s^{-2}}$ and comes to rest before reaching the top of the plane.

(i) Calculate the frictional force acting on P, and the coefficient of friction between P and the plane. **[7]**

(ii) Find the magnitude of the contact force exerted on P by the plane and the angle between the contact force and the upward direction of the line of greatest slope,

(a) when P is in motion, **[5]**

(b) when P is at rest. **[2]**

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* 4 7 2 8 *

Candidate forename		Candidate surname	

Centre number						Candidate number				

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1 (i)	
1 (ii)	

2 (i)	
2 (ii)	
3 (i)	

3 (ii)	
3(iii)(a)	
3(iii)(b)	
4 (i)	

4 (i)	**(continued)**
4 (ii)	

5(i)(a)	
5(i)(b)	

5 (i) (c)	
5 (ii)	

6 (i)

6 (ii)

6 (ii)	**(continued)**
6 (iii)	

7 (i)	

7(ii)(a)	

7 (ii) (b)	