Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

6670018231

MATHEMATICS **9709/43**

Paper 4 Mechanics **October/November 2022**

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

Cambridge Math & Physics
kambridgemp.com

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- Where a numerical value for the acceleration due to gravity (g) is needed, use $10\,\text{m}\,\text{s}^{-2}$.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

© UCLES 2022

BLANK PAGE

Kambridge Math & Physics
kambridgemp.com

1 A particle P is projected vertically upwards with speed $u\,\text{m s}^{-1}$ from a point on the ground. P reaches its greatest height after 3 s.

(a) Find u. [1]

.....

.....

.....

.....

.....

.....

.....

.....

(b) Find the greatest height of P above the ground. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

2 A box of mass 5 kg is pulled at a constant speed of $1.8\,m\,s^{-1}$ for 15 s up a rough plane inclined at an angle of 20° to the horizontal. The box moves along a line of greatest slope against a frictional force of 40 N. The force pulling the box is parallel to the line of greatest slope.

(a) Find the change in gravitational potential energy of the box. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Find the work done by the pulling force. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

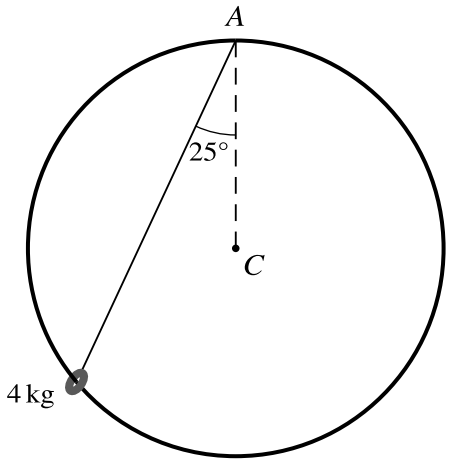
.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

3



A ring of mass 4 kg is threaded on a smooth circular rigid wire with centre C. The wire is fixed in a vertical plane and the ring is kept at rest by a light string connected to A, the highest point of the circle. The string makes an angle of 25° to the vertical (see diagram).

Find the tension in the string and the magnitude of the normal reaction of the wire on the ring. [6]

Kambridge Math & Physics
kambridgemp.com

4 A particle P travels in the positive direction along a straight line with constant acceleration. P travels a distance of 52 m during the 2nd second of its motion and a distance of 64 m during the 4th second of its motion.

(a) Find the initial speed and the acceleration of P. [5]

Kambridge Math & Physics
kambridgemp.com

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Find the distance travelled by P during the first 10 seconds of its motion. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

5 Particles X and Y move in a straight line through points A and B. Particle X starts from rest at A and moves towards B. At the same instant, Y starts from rest at B.

At time t seconds after the particles start moving

- the acceleration of X in the direction AB is given by $(12t + 12)\,\text{m s}^{-2}$,
- the acceleration of Y in the direction AB is given by $(24t - 8)\,\text{m s}^{-2}$.

(a) It is given that the velocities of X and Y are equal when they collide.

Calculate the distance AB. [6]

Kambridge Math & Physics
kambridgemp.com

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) It is given instead that $AB = 36\,\text{m}$.

Verify that X and Y collide after 3 s. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

6 A car of mass 1750 kg is pulling a caravan of mass 500 kg. The car and the caravan are connected by a light rigid tow-bar. The resistances to the motion of the car and caravan are 650 N and 150 N respectively.

(a) The car and caravan are moving along a straight horizontal road at a constant speed of $24\,m\,s^{-1}$.

(i) Find the power of the car's engine. [2]

.....

.....

.....

.....

.....

.....

.....

(ii) The engine's power is now suddenly increased to 40 kW.

Find the instantaneous acceleration of the car and caravan and find the tension in the tow-bar. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) The car and caravan now travel up a straight hill, inclined at an angle $\sin^{-1} 0.14$ to the horizontal, at a constant speed of $v\,\text{m}\,\text{s}^{-1}$. The car's engine is working at 31 kW. The resistances to the motion of the car and caravan are unchanged.

Find v. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

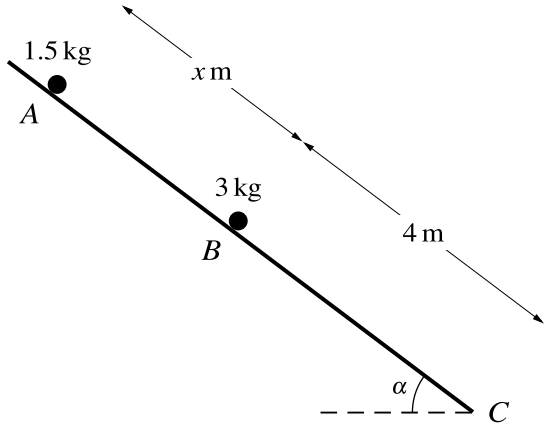
.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

7



Particles of masses 1.5 kg and 3 kg lie on a plane which is inclined at an angle of α to the horizontal, where $\tan\alpha = \frac{3}{4}$. The section of the plane from A to B is smooth and the section of the plane from B to C is rough. The 1.5 kg particle is held at rest at A and the 3 kg particle is in limiting equilibrium at B. The distance AB is x m and the distance BC is 4 m (see diagram).

(a) Show that the coefficient of friction between the particle at B and the plane is 0.75. [3]

Kambridge Math & Physics
kambridgemp.com

The 1.5 kg particle is released from rest. In the subsequent motion the two particles collide and coalesce. The time taken for the combined particle to travel from B to C is 2 s. The coefficient of friction between the combined particle and the plane is still 0.75.

(b) Find x. [6]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

(c) Find the total loss of energy of the particles from the time the 1.5 kg particle is released until the combined particle reaches C. [3]

.....

.....

.....

.....

.....

.....

.....

Additional Page

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

Kambridge Math & Physics
kambridgemp.com

BLANK PAGE

Kambridge Math & Physics
kambridgemp.com

BLANK PAGE

Kambridge Math & Physics
kambridgemp.com

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.