* 0000800000001 *

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 6 6 5 4 4 6 3 2 1 1 *

MATHEMATICS **9709/43**

Paper 4 Mechanics **October/November 2024**

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

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 [ ].

Kambridge Math & Physics
kambridgemp.com

This document has **12** pages. Any blank pages are indicated.

© UCLES 2024

BLANK PAGE

Kambridge Math & Physics
kambridgemp.com

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

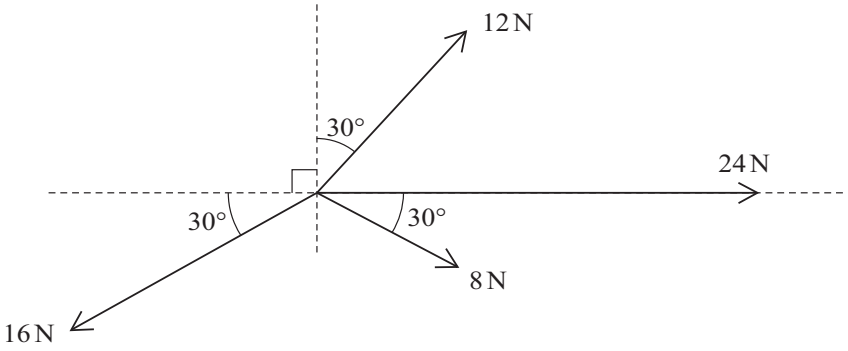
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

1 An athlete has mass m kg. The athlete runs along a horizontal road against a constant resistance force of magnitude 24 N. The total work done by the athlete in increasing his speed from $5\,\text{m}\,\text{s}^{-1}$ to $6\,\text{m}\,\text{s}^{-1}$ while running a distance of 50 metres is 1541 J.

Find the value of m. [4]

Kambridge Math & Physics
kambridgemp.com

2



Coplanar forces of magnitudes 16 N, 12 N, 24 N and 8 N act at a point in the directions shown in the diagram.

Find the magnitude and direction of the single additional force acting at the same point which will produce equilibrium. [6]

Kambridge Math & Physics
kambridgemp.com

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

3 A car of mass 1600 kg travels up a slope inclined at an angle of $\sin^{-1} 0.08$ to the horizontal. There is a constant resistance of magnitude 240 N acting on the car.

(a) It is given that the car travels at a constant speed of $32\,\text{m}\,\text{s}^{-1}$.

Find the power of the engine of the car. [3]

.....

.....

.....

.....

.....

.....

.....

.....

(b) Find the acceleration of the car when its speed is $24\,\text{m}\,\text{s}^{-1}$ and the engine is working at 95% of the power found in **(a)**. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

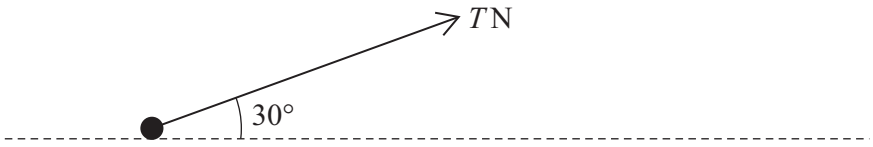
4 Two particles, A and B, of masses 3 kg and 6 kg respectively, lie on a smooth horizontal plane. Initially, B is at rest and A is moving towards B with speed $8\,\text{m}\,\text{s}^{-1}$. After A and B collide, A moves with speed $2\,\text{m}\,\text{s}^{-1}$.

Find the greater of the two possible total losses of kinetic energy due to the collision. [6]

Kambridge Math & Physics
kambridgemp.com

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

5



A particle of mass 12 kg is going to be pulled across a rough horizontal plane by a light inextensible string. The string is at an angle of 30° above the plane and has tension T N (see diagram). The coefficient of friction between the particle and the plane is 0.5 .

(a) Given that the particle is on the point of moving, find the value of T. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Given instead that the particle is accelerating at $0.2\,\text{m}\,\text{s}^{-2}$, find the value of T. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

6 A particle moves in a straight line. It starts from rest, at time $t = 0$, and accelerates at $0.6t\,\text{m s}^{-2}$ for 4 s, reaching a speed of $V\,\text{m s}^{-1}$. The particle then travels at $V\,\text{m s}^{-1}$ for 11 s, and finally slows down, with constant deceleration, stopping after a further 5 s.

(a) Show that $V = 4.8$. [1]

.....

.....

.....

.....

.....

(b) Sketch a velocity-time graph for the motion. [3]

Kambridge Math & Physics
kambridgemp.com

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

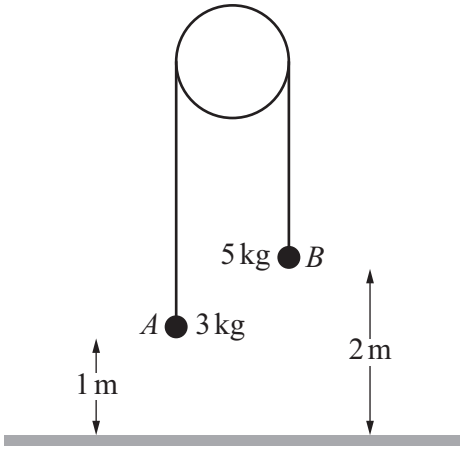
(c) Find an expression, in terms of t, for the velocity of the particle for $15 \leqslant t \leqslant 20$. [2]

(d) Find the total distance travelled by the particle. [4]

Kambridge Math & Physics
kambridgemp.com

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

7



Two particles, A and B, of masses 3 kg and 5 kg respectively, are connected by a light inextensible string that passes over a fixed smooth pulley. The particles are held with the string taut and its straight parts vertical. Particle A is 1 m above a horizontal plane, and particle B is 2 m above the plane (see diagram).

The particles are released from rest. In the subsequent motion, A does not reach the pulley, and after B reaches the plane it remains in contact with the plane.

(a) Find the tension in the string and the time taken for B to reach the plane. [6]

Kambridge Math & Physics
kambridgemp.com

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

.....

.....

.....

.....

.....

.....

(b) Find the time for which A is at least 3.25 m above the plane. [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Kambridge Math & Physics
kambridgemp.com

Additional page

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

Kambridge Math & Physics
kambridgemp.com

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

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.