



Cambridge International AS & A Level

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MATHEMATICS

9709/42

Paper 4 Mechanics

May/June 2022

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 m 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.

1 Small smooth spheres A and B , of equal radii and of masses 5 kg and 3 kg respectively, lie on a smooth horizontal plane. Initially B is at rest and A is moving towards B with speed 8.5 m s^{-1} . The spheres collide and after the collision A continues to move in the same direction but with a quarter of the speed of B .

(a) Find the speed of B after the collision. [3]

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(b) Find the loss of kinetic energy of the system due to the collision. [2]

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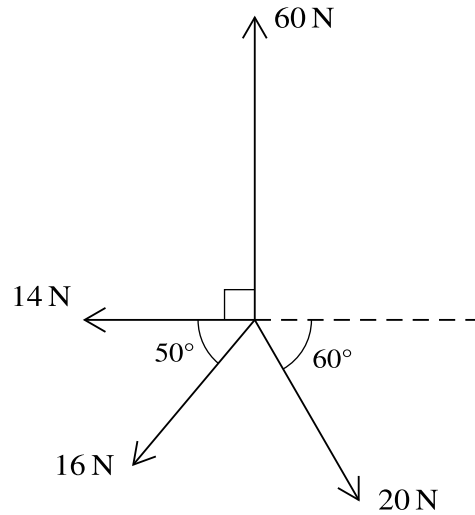
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Coplanar forces of magnitudes 60 N, 20 N, 16 N and 14 N act at a point in the directions shown in the diagram.

Find the magnitude and direction of the resultant force. [6]

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(b) Find the greatest height of B above the plane. [3]

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4 A particle *A*, moving along a straight horizontal track with constant speed 8 m s^{-1} , passes a fixed point *O*. Four seconds later, another particle *B* passes *O*, moving along a parallel track in the same direction as *A*. Particle *B* has speed 20 m s^{-1} when it passes *O* and has a constant deceleration of 2 m s^{-2} . *B* comes to rest when it returns to *O*.

(a) Find expressions, in terms of *t*, for the displacement from *O* of each particle *t* seconds after *B* passes *O*. [3]

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- (b) Find the values of t when the particles are the same distance from O . [3]

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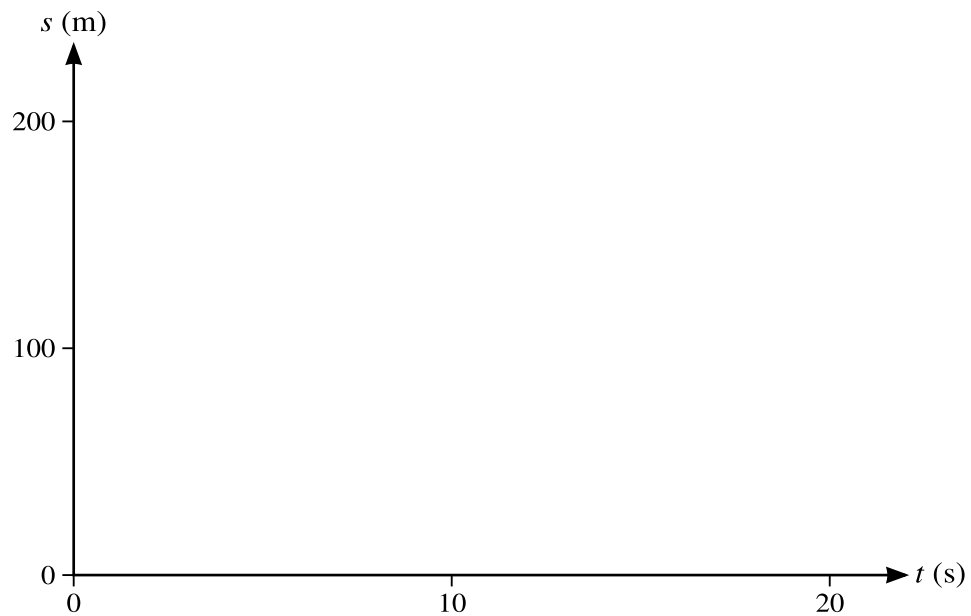
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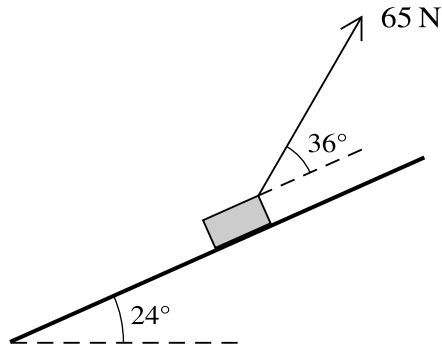
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- (c) On the given axes, sketch the displacement-time graphs for both particles, for values of t from 0 to 20. [3]



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A block of mass 12 kg is placed on a plane which is inclined at an angle of 24° to the horizontal. A light string, making an angle of 36° above a line of greatest slope, is attached to the block. The tension in the string is 65 N (see diagram). The coefficient of friction between the block and plane is μ . The block is in limiting equilibrium and is on the point of sliding up the plane.

Find μ .

[6]

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