

ADVANCED SUBSIDIARY GCE
MATHEMATICS
Mechanics 1

4728

Candidates answer on the Answer Booklet

OCR Supplied Materials:

- 8 page Answer Booklet
- List of Formulae (MF1)

Other Materials Required:

None

Thursday 11 June 2009
Morning

Duration: 1 hour 30 minutes



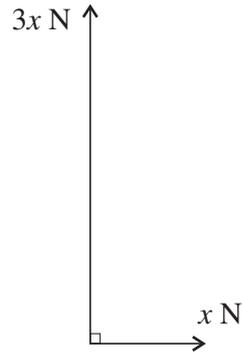
INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- 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 $g \text{ m s}^{-2}$. Unless otherwise instructed, when a numerical value is needed, use $g = 9.8$.
- You are permitted to use a graphical calculator in this paper.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- **You are reminded of the need for clear presentation in your answers.**
- The total number of marks for this paper is **72**.
- This document consists of **4** pages. Any blank pages are indicated.

1



Two perpendicular forces have magnitudes x N and $3x$ N (see diagram). Their resultant has magnitude 6 N.

(i) Calculate x . [3]

(ii) Find the angle the resultant makes with the smaller force. [3]

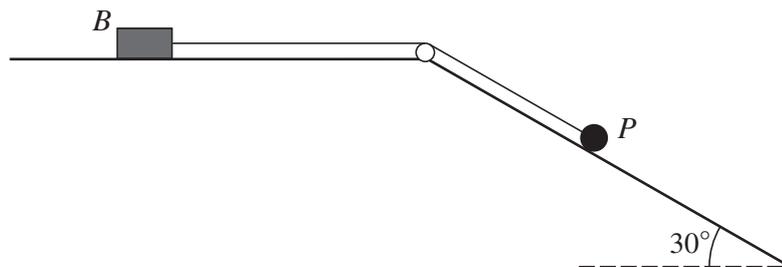
2 The driver of a car accelerating uniformly from rest sees an obstruction. She brakes immediately bringing the car to rest with constant deceleration at a distance of 6 m from its starting point. The car travels in a straight line and is in motion for 3 seconds.

(i) Sketch the (t, v) graph for the car's motion. [2]

(ii) Calculate the maximum speed of the car during its motion. [3]

(iii) Hence, given that the acceleration of the car is 2.4 m s^{-2} , calculate its deceleration. [4]

3



The diagram shows a small block B , of mass 3 kg, and a particle P , of mass 0.8 kg, which are attached to the ends of a light inextensible string. The string is taut and passes over a small smooth pulley. B is held at rest on a horizontal surface, and P lies on a smooth plane inclined at 30° to the horizontal. When B is released from rest it accelerates at 0.2 m s^{-2} towards the pulley.

(i) By considering the motion of P , show that the tension in the string is 3.76 N. [4]

(ii) Calculate the coefficient of friction between B and the horizontal surface. [5]

- 4 An object is projected vertically upwards with speed 7 m s^{-1} . Calculate
- (i) the speed of the object when it is 2.1 m above the point of projection, [3]
- (ii) the greatest height above the point of projection reached by the object, [3]
- (iii) the time after projection when the object is travelling downwards with speed 5.7 m s^{-1} . [3]
- 5 (i)

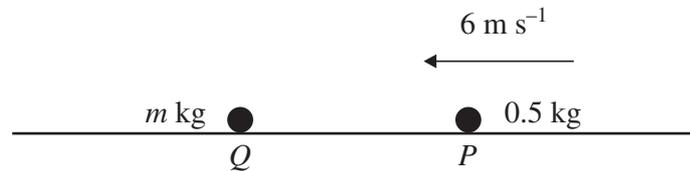


Fig. 1

A particle P of mass 0.5 kg is projected with speed 6 m s^{-1} on a smooth horizontal surface towards a stationary particle Q of mass $m \text{ kg}$ (see Fig. 1). After the particles collide, P has speed $v \text{ m s}^{-1}$ in its original direction of motion, and Q has speed 1 m s^{-1} more than P . Show that $v(m + 0.5) = -m + 3$. [3]

(ii)

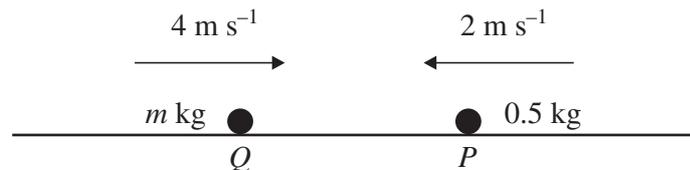


Fig. 2

Q and P are now projected towards each other with speeds 4 m s^{-1} and 2 m s^{-1} respectively (see Fig. 2). Immediately after the collision the speed of Q is $v \text{ m s}^{-1}$ with its direction of motion unchanged and P has speed 1 m s^{-1} more than Q . Find another relationship between m and v in the form $v(m + 0.5) = am + b$, where a and b are constants. [4]

- (iii) By solving these two simultaneous equations show that $m = 0.9$, and hence find v . [4]

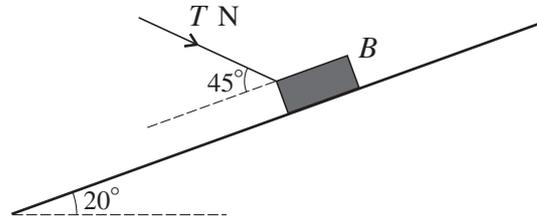
[Questions 6 and 7 are printed overleaf.]

6 A block B of weight 10 N is projected down a line of greatest slope of a plane inclined at an angle of 20° to the horizontal. B travels down the plane at constant speed.

(i) (a) Find the components perpendicular and parallel to the plane of the contact force between B and the plane. [2]

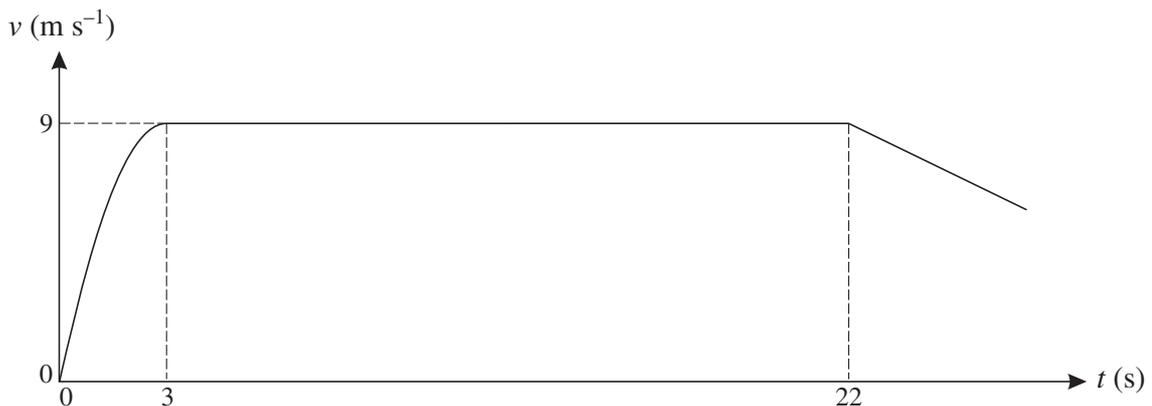
(b) Hence show that the coefficient of friction is 0.364 , correct to 3 significant figures. [2]

(ii)



B is in limiting equilibrium when acted on by a force of $T\text{ N}$ directed towards the plane at an angle of 45° to a line perpendicular to the plane (see diagram). Given that the frictional force on B acts down the plane, find T . [7]

7



A sprinter S starts from rest at time $t = 0$, where t is in seconds, and runs in a straight line. For $0 \leq t \leq 3$, S has velocity $(6t - t^2)\text{ m s}^{-1}$. For $3 < t \leq 22$, S runs at a constant speed of 9 m s^{-1} . For $t > 22$, S decelerates at 0.6 m s^{-2} (see diagram).

(i) Express the acceleration of S during the first 3 seconds in terms of t . [2]

(ii) Show that S runs 18 m in the first 3 seconds of motion. [5]

(iii) Calculate the time S takes to run 100 m . [3]

(iv) Calculate the time S takes to run 200 m . [7]

Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations, is given to all schools that receive assessment material and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1PB.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.