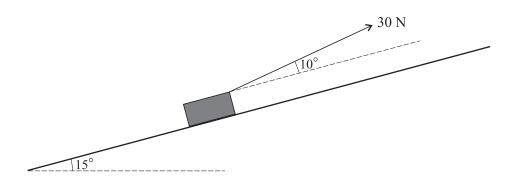
UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS General Certificate of Education Advanced Subsidiary Level and Advanced Level				
MATHEMATICS		9709/04		
Paper 4 Mechani	cs 1 (M1)	October/November 2006		
Additional Materials:	Answer Booklet/Pape Graph paper List of Formulae (MFS			
 Write your Centre number, of Write in dark blue or black prevention of the provided o	nswer Booklet, follow the candidate number and re- ben on both sides of the or any diagrams or graph lips, highlighters, glue of nswers correct to 3 sign at level of accuracy is sp r the acceleration due to culator is expected, while d for clear presentation en in brackets [] at the or this paper is 50. numbers of marks are plate paper.	hs. by correction fluid. ificant figures, or 1 decimal place in the case of angles becified in the question. b gravity is needed, use $10 \mathrm{ms^{-2}}$. ere appropriate. in your answers. end of each question or part question. rinted earlier in the paper, and questions carrying larger		

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[Turn over



A box of mass 8 kg is pulled, at constant speed, up a straight path which is inclined at an angle of 15° to the horizontal. The pulling force is constant, of magnitude 30 N, and acts upwards at an angle of 10° from the path (see diagram). The box passes through the points *A* and *B*, where AB = 20 m and *B* is above the level of *A*. For the motion from *A* to *B*, find

(i) the work done by the pulling force,	[2]
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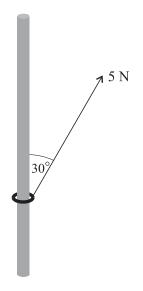
(ii) the gain in potential energy of the box, [2]

[1]

(iii) the work done against the resistance to motion of the box.



1



A small ring of mass 0.6 kg is threaded on a rough rod which is fixed vertically. The ring is in equilibrium, acted on by a force of magnitude 5 N pulling upwards at 30° to the vertical (see diagram).

- (i) Show that the frictional force acting on the ring has magnitude 1.67 N, correct to 3 significant figures. [2]
- (ii) The ring is on the point of sliding down the rod. Find the coefficient of friction between the ring and the rod.

- 3 A cyclist travels along a straight road working at a constant rate of 420 W. The total mass of the cyclist and her cycle is 75 kg. Ignoring any resistance to motion, find the acceleration of the cyclist at an instant when she is travelling at 5 m s^{-1} ,
 - (i) given that the road is horizontal,
 - (ii) given instead that the road is inclined at 1.5° to the horizontal and the cyclist is travelling up the slope.

[5]

[2]

[2]

[2]

- 4 The velocity of a particle t s after it starts from rest is $v \text{ m s}^{-1}$, where $v = 1.25t 0.05t^2$. Find
 - (i) the initial acceleration of the particle,
 - (ii) the displacement of the particle from its starting point at the instant when its acceleration is $0.05 \,\mathrm{m\,s}^{-2}$. [5]

2.45 m 1.2 mM

The diagram shows the vertical cross-section LMN of a fixed smooth surface. M is the lowest point of the cross-section. L is 2.45 m above the level of M, and N is 1.2 m above the level of M. A particle of mass 0.5 kg is released from rest at L and moves on the surface until it leaves it at N. Find

(i) the greatest speed of the particle,	[3]
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(ii) the kinetic energy of the particle at N.

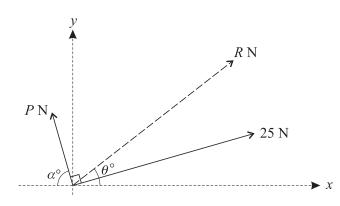
The particle is now projected from N, with speed $v \,\mathrm{m \, s^{-1}}$, along the surface towards M.

(iii) Find the least value of v for which the particle will reach L.

https://xtremepape.rs/

5





Forces of magnitudes *P*N and 25 N act at right angles to each other. The resultant of the two forces has magnitude *R*N and makes an angle of θ° with the *x*-axis (see diagram). The force of magnitude *P*N has components -2.8 N and 9.6 N in the *x*-direction and the *y*-direction respectively, and makes an angle of α° with the negative *x*-axis.

(i)	Find the values of <i>P</i> and <i>R</i> .	[3]

[4]

[3]

(ii) Find the value of α , and hence find the components of the force of magnitude 25 N in

(b) the y-direction.

(iii) Find the value of θ .

7 A particle of mass $m \, \text{kg}$ moves up a line of greatest slope of a rough plane inclined at 21° to the horizontal. The frictional and normal components of the contact force on the particle have magnitudes $F \,\text{N}$ and $R \,\text{N}$ respectively. The particle passes through the point P with speed 10 m s⁻¹, and 2 s later it reaches its highest point on the plane.

(i) Show that $R = 9.336m$ and $F = 1.416m$, each correct to 4 significant figures.	[5]
(ii) Find the coefficient of friction between the particle and the plane.	[1]
After the particle reaches its highest point it starts to move down the plane.	

(iii) Find the speed with which the particle returns to *P*. [5]

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