Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number | Candidate Number

AS and A level Further Mathematics
Further Mechanics 1

Practice Paper
Work, energy and power (part 2)

You must have:
Mathematical Formulae and Statistical Tables (Pink)

Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all the questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 80.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1.

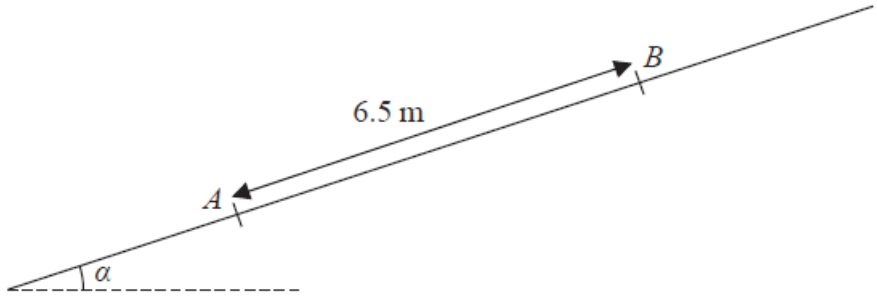

Figure 2

A particle P of mass 10 kg is projected from a point A up a line of greatest slope AB of a fixed rough plane. The plane is inclined at angle α to the horizontal, where $\tan \alpha = \frac{5}{12}$ and $AB = 6.5$ m, as shown in Figure 2. The coefficient of friction between P and the plane is μ. The work done against friction as P moves from A to B is 245 J.

(*a*) Find the value of μ.

(5)

The particle is projected from A with speed 11.5 m s^{-1}. By using the work-energy principle,

(*b*) find the speed of the particle as it passes through B.

(4)

(Total 9 marks)

2.

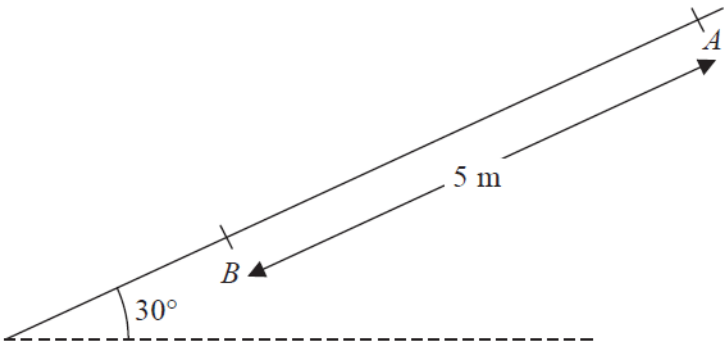

Figure 2

A particle P of mass 2 kg is released from rest at a point A on a rough inclined plane and slides down a line of greatest slope. The plane is inclined at 30° to the horizontal. The point B is 5 m from A on the line of greatest slope through A, as shown in Figure 2.

(*a*) Find the potential energy lost by P as it moves from A to B.

(2)

The speed of P as it reaches B is 4 m s^{-1}.

(*b*) (i) Use the work-energy principle to find the magnitude of the constant frictional force acting on P as it moves from A to B.

(ii) Find the coefficient of friction between P and the plane.

(7)

The particle P is now placed at A and projected down the plane towards B with speed 3 m s^{-1}. Given that the frictional force remains constant,

(*c*) find the speed of P as it reaches B.

(4)

(Total 13 marks)

3.

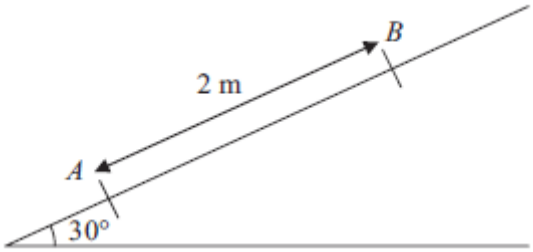

Figure 3

A particle P of mass 0.5 kg is projected from a point A up a line of greatest slope AB of a fixed plane. The plane is inclined at 30° to the horizontal and $AB = 2$ m with B above A, as shown in Figure 32. The particle P passes through B with speed 5 m s^{-1}. The plane is smooth from A to B.

(a) Find the speed of projection.

(4)

The particle P comes to instantaneous rest at the point C on the plane, where C is above B and $BC = 1.5$ m. From B to C the plane is rough and the coefficient of friction between P and the plane is μ.

By using the work-energy principle,

(b) find the value of μ.

(6)

(Total 10 marks)

4. The point A lies on a rough plane inclined at an angle θ to the horizontal, where $\sin\theta = \frac{24}{25}$. A particle P is projected from A, up a line of greatest slope of the plane, with speed U m s^{-1}. The mass of P is 2 kg and the coefficient of friction between P and the plane is $\frac{5}{12}$. The particle comes to instantaneous rest at the point B on the plane, where AB =1.5 m. It then moves back down the plane to A.

(*a*) Find the work done against friction as P moves from A to B.

(4)

(*b*) Use the work-energy principle to find the value of U.

(4)

(*c*) Find the speed of P when it returns to A.

(3)

(Total 11 marks)

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5. A car of mass 1200 kg pulls a trailer of mass 400 kg up a straight road which is inclined to the horizontal at an angle α, where $\sin\alpha = \frac{1}{14}$. The trailer is attached to the car by a light inextensible towbar which is parallel to the road. The car's engine works at a constant rate of 60 kW. The non-gravitational resistances to motion are constant and of magnitude 1000 N on the car and 200 N on the trailer.

At a given instant, the car is moving at 10 m s^{-1}. Find

(*a*) the acceleration of the car at this instant,

(5)

(*b*) the tension in the towbar at this instant.

(4)

The towbar breaks when the car is moving at 12 m s^{-1}.

(*c*) Find, using the work-energy principle, the further distance that the trailer travels before coming instantaneously to rest.

(5)

(Total 14 marks)

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6. Two particles A and B, of masses $3m$ and $4m$ respectively, lie at rest on a smooth horizontal surface. Particle B lies between A and a smooth vertical wall which is perpendicular to the line joining A and B. Particle B is projected with speed $5u$ in a direction perpendicular to the wall and collides with the wall. The coefficient of restitution between B and the wall is $\frac{3}{5}$.

(*a*) Find the magnitude of the impulse received by B in the collision with the wall.

(3)

After the collision with the wall, B rebounds from the wall and collides directly with A. The coefficient of restitution between A and B is e.

(*b*) Show that, immediately after they collide, A and B are both moving in the same direction.

(7)

The kinetic energy of B immediately after it collides with A is one quarter of the kinetic energy of B immediately before it collides with A.

(*c*) Find the value of e.

(4)

(Total 14 marks)

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7. The points A and B are 10 m apart on a line of greatest slope of a fixed rough inclined plane, with A above B. The plane is inclined at 25° to the horizontal. A particle P of mass 5 kg is released from rest at A and slides down the slope. As P passes B, it is moving with speed 7 m s^{-1}.

(*a*) Find, using the work-energy principle, the work done against friction as P moves from A to B.

(4)

(*b*) Find the coefficient of friction between the particle and the plane.

(5)

(Total 9 marks)

TOTAL FOR PAPER: 80 MARKS