Question 1:

A particle P of mass 3 kg moves from point A to point B up a line of greatest slope of a fixed rough plane. The plane is inclined at $20°$ to the horizontal. The coefficient of friction between P and the plane is 0.4.

$AB = 15$ m and the speed of P at A is 20 ms^{-1}.

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

[3]

(b) Find the speed of P at B.

[4]

Question 2:

A block of mass 10 kg is pulled along a straight horizontal road by a constant horizontal force of magnitude 70 N in the direction of the road. The block moves in a straight line passing through two points A and B on the road, where $AB = 50$ m. The block is modelled as a particle and the road is modelled as a rough plane. The coefficient of friction between the block and the road is $\frac{4}{7}$.

(a) Calculate the work done against friction in moving the block from A to B.

[4]

The block passes through A with a speed of 2 ms^{-1}.

(b) Find the speed of the block at B.

[4]

Question 3:

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 ms^{-1}.

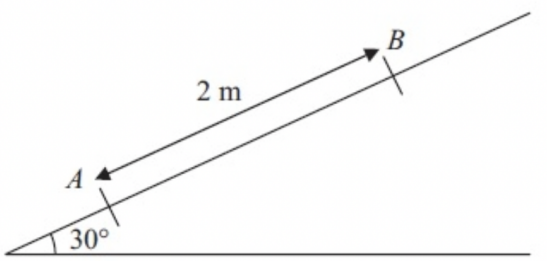
(a) Find, using the work-energy principle, the work done against friction as P moves from A to B.

[4]

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

[5]

Question 4:



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. The particle P passes through B with speed 5 ms^{-1}. The plane is smooth from A to B.

(a) Find the speed of projection.

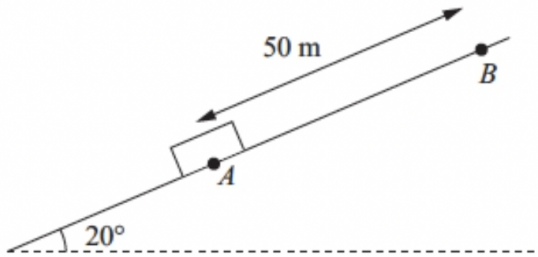
[4]

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.

(b) By using the work-energy principle, find the value of μ.

[6]

Question 5:



A box of mass 30 kg is held at rest at point A on a rough inclined plane. The plane is inclined at 20° to the horizontal. Point B is 50 m from A up a line of greatest slope of the plane. The box is dragged from A to B by a force acting parallel to AB and then held at rest at B. The coefficient of friction between the box and the plane is $\frac{1}{4}$. Friction is the only non-gravitational resistive force acting on the box.

(a) Find the work done in dragging the box from A to B.

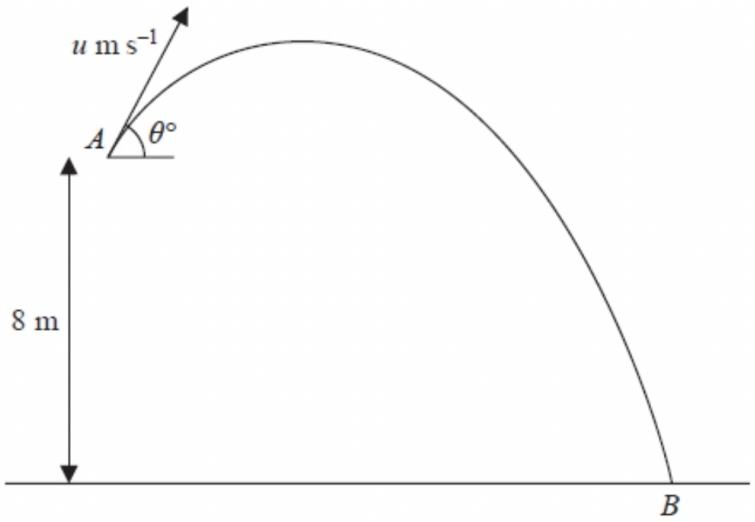
[6]

The box is released from rest at the point B and slides down the slope.

(b) Using the work-energy principle, or otherwise, find the speed of the box as it reaches A.

[5]

Question 6:



A ball is projected from a point A which is 8 m above horizontal ground. The ball is projected with speed u ms^{-1} at an angle of $\theta°$ above the horizontal. The ball moves freely under gravity and hits the ground at the point B. The speed of the ball immediately before it hits the ground is $2u$ ms^{-1}.

(a) By considering energy, find the value of u.

[5]

The time taken for the ball to move from A to B is 2 seconds.

(b) Find the value of θ.

[4]

(c) Find the minimum speed of the ball on its path from A to B.

[2]

Numerical Answers:

(1) (a) 166 J
    (b) 13.7 ms^{-1}

(2) (a) 2800 J
    (b) 12 ms^{-1}

(3) (a) 85 J
    (b) 0.19

(4) (a) 6.7 ms^{-1}
    (b) 0.40

(5) (a) 8480 J
    (b) 10.2 ms^{-1}

(6) (a) 7.2
    (b) 53.3°
    (c) 4.3 ms^{-1}