Question 1

A small brick of mass $0.5\,kg$ is placed on a rough plane which is inclined to the horizontal at an angle θ, where $\tan\theta = \frac{4}{3}$, and released from rest. The coefficient of friction between the brick and the plane is $\frac{1}{3}$. Find the acceleration of the brick.

QUestion 2

A particle P of mass 6 kg is projected up a line of greatest slope inclined at an angle of $\alpha = 20$ degrees to the horizontal. The coefficient of friction between P and the plane is 0.3. The initial speed of P is 7 m/s. Find
(a) the frictional force acting on P as it moves up the plane,
(b) the distance moved by P up the plane before P comes to instantaneous rest.

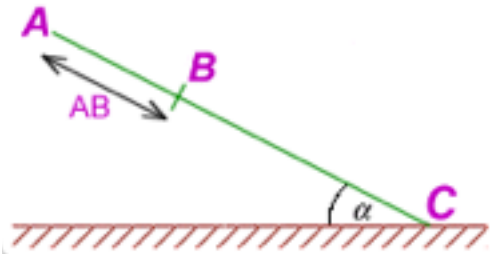
Question 3

The following is based on a typical examination question.

Parcels are often damaged when loaded onto a trolley, so a ramp is constructed down which parcels can slide onto the trolley. The ramp makes an angle of $\theta = 58°$ to the vertical, the distance $AB = 2.9\,m$ and the coefficient of friction between the ramp and a parcel is 0.2. A parcel of mass $2.5\,kg$ is released from rest at the top of the ramp (see diagram). Calculate the speed of the parcel after sliding down the ramp.

Question 4

The following is based on a typical examination question.



A suitcase of mass 9 kg slides down a ramp which is inclined at an angle of $\alpha = 21$ degrees to the horizontal. The suitcase is modelled as a particle and the ramp as a rough plane. The top of the plane is A. The bottom of the plane is C and AC is the line of greatest slope. The point B is on AC with AB = 5 m. The suitcase leaves A with a speed of is 9 m/s and passes B with a speed of 7 m/s. Find

(a) the deceleration of the suitcase,

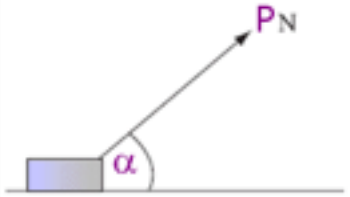
(b) the coefficient of friction between the suitcase and the ramp.

The suitcase reaches the bottom of the ramp.

(c) Find the greatest possible length of AC.

Question 5

The following is based on a typical examination question.



The diagram shows a block, of mass 23 kg, being pulled along a rough horizontal surface by a rope inclined at an angle of $\alpha = 27°$ to the horizontal. The coefficient of friction between the block and the surface is μ. Model the block as a particle which slides on the surface.

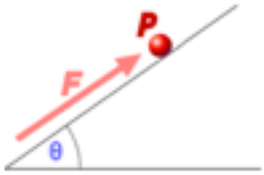
If the tension, P, in the rope is 61 newtons, the block moves at a constant speed.

(a) Show that the magnitude of the normal reaction force acting on the block is 166 N.

(b) Find μ.

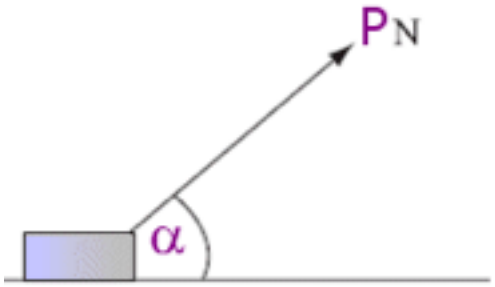
(c) If the rope remains at the same angle and the block accelerates at 0.8 ms^{-2}, find the tension in the rope.

Question 6



A particle P of mass $0.6\,kg$ is on a rough plane inclined at an angle θ to the horizontal, where $\tan\theta = \frac{3}{4}$. The particle is held at rest on the plane by the action of a force of magnitude $6\,N$ acting up the plane in a direction parallel to a line of greatest slope of the plane, as shown. The particle is on the point of slipping up the plane.
(a) Find the coefficient of friction between P and the plane.
The force of magnitude $6\,N$ is removed.
(b) Find the acceleration of P down the plane.

Question 7



A box of mass $31\,kg$ is being pulled along rough horizontal ground at a constant speed using a rope. The rope makes an angle of $\alpha = 24°$ with the ground. The coefficient of friction between the box and the ground is 0.2.
The box is modelled as a particle and the rope as a light inextensible string. The tension in the rope is P newtons.

(a) Find the value of P.

The tension in the rope is now increased to $130N$.

(b) Find the acceleration of the box.

Question 8

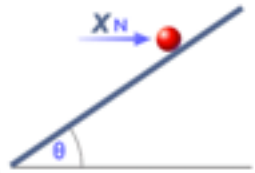
An object, of mass $6.2\,kg$, moves on a slope inclined at an angle α to the horizontal, where $\sin\alpha = \frac{5}{13}$. The coefficient of friction between the object and the slope is $\frac{1}{4}$.

(a) The object is sliding freely down a line of greatest slope. Find the magnitude of the acceleration of the object.

(b) The object is being pulled up the slope at a constant speed by means of a rope parallel to a line of greatest slope. Find the tension in the rope.

Question 9

The following is based on a typical examination question.



A particle of mass $0.7\,kg$ is held at rest on a rough plane. The plane is inclined at 29° to the horizontal. The particle is released from rest and slides down a line of greatest slope of the plane. The particle moves 2.2 m during the first 2 seconds of its motion. Find

(a) the acceleration of the particle,

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

The particle is now held on the same rough plane by a horizontal force of magnitude X newtons, acting in a plane containing a line of greatest slope of the plane, as shown. The particle is in equilibrium and on the point of moving up the plane.

(c) Find the value of X.