3.

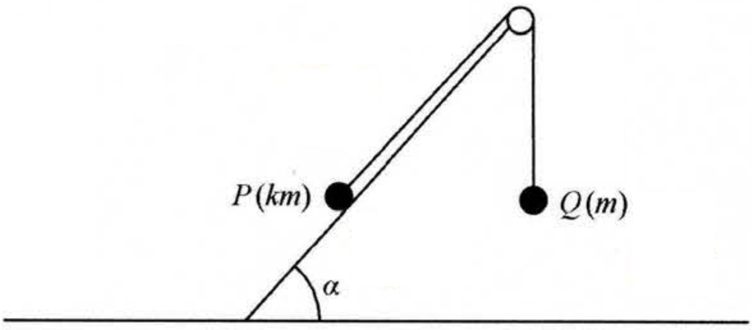

Figure 1

One end of a light inextensible string is attached to a particle P of mass km, where $k > 1.25$
The other end of the string is attached to a particle Q of mass m.
The string passes over a small smooth light pulley that is fixed at the top of a plane.

The plane is inclined to the horizontal at an angle α, where $\tan\alpha = \frac{4}{3}$

Particle P is held at rest on the plane and particle Q hangs at rest with the string taut, as shown in Figure 1.

The part of the string from P to the pulley lies along a line of greatest slope of the plane.
The two particles and the pulley all lie in the same vertical plane.
The particle P is released from rest.

In an initial model,

- the plane is modelled as being smooth
- P slides down the plane with acceleration $\frac{1}{5}g$

Using this model,

(a) write down an equation of motion for P

(2)

(b) find the value of k.

(4)

In a second model,

- the plane is modelled as being rough
- the coefficient of friction between P and the plane is μ
- P remains at rest but is on the point of slipping down the plane

Using this model,

(c) find, in terms of k, m and g, the magnitude of the normal reaction exerted by the plane on P.

(2)

(d) find, in terms of k, the value of μ.

(6)