Lesson 3

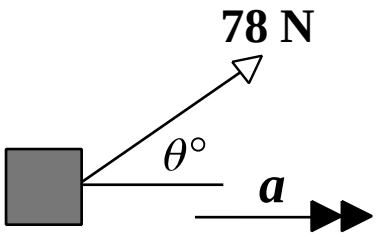
A-Level Applied Mathematics
Mechanics : Dynamics II : Year 2

3.1 Practice Questions on Resolving Forces

Question 1

A 7 kg box is dragged along rough ground by a rope inclined at $\theta°$ to the horizontal as shown below.

The tension in the rope is 78 N, $\mu = 0.65$, and $\tan\theta = \frac{5}{12}$

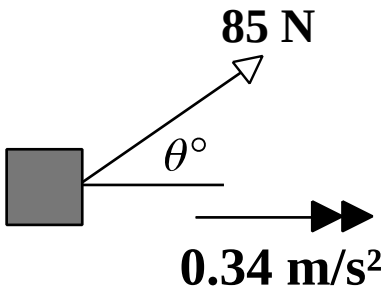


Find the acceleration of the box.

Question 2

A force of 85 N is pulling a 29 kg crate over rough ground.
The force acts at an angle of $\theta°$ to the horizontal.

The crate is uniformly accelerating at 0.34 m s^{-2} and $tan\ \theta = \frac{8}{15}$

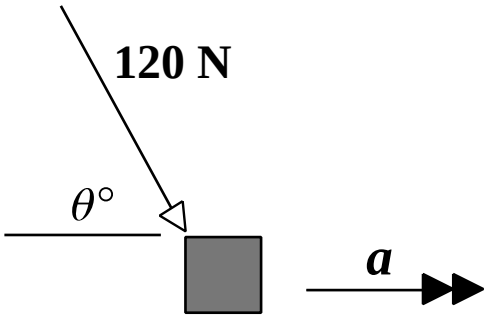


Find the coefficient of friction between the ground and the crate.

Question 3

A force of 120 N is pushing a water tank along rough ground.

The force acts at an angle of $\theta°$ to the horizontal, as shown, where $tan\ \theta = \frac{4}{3}$

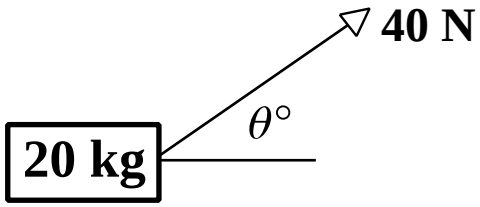


The coefficient of friction, μ, between the water tank and the ground is 0.25

Given that the tank has a mass of 15 kg, find the acceleration, a.

Question 4

A-Level Mathematics (Mechanics) Examination Question from June 2018, Q7



A wooden crate of mass 20 kg is pulled in a straight line along a rough horizontal floor using a handle attached to the crate.

The handle is inclined at an angle θ to the floor, where $tan\ \theta = \frac{3}{4}$

The tension in the handle is 40 N.

The coefficient of friction between the crate and the floor is 0.14.

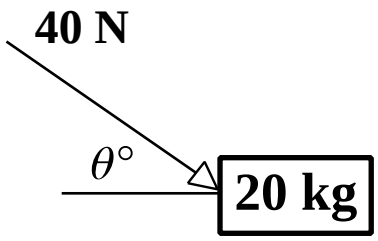
The crate is modelled as a particle and the handle is modelled as a light rod.

Using the model,

(a) find the acceleration of the crate.

[6 marks]

The crate is now pushed along the same floor using the handle. The handle is again inclined at the same angle θ to the floor, and the thrust in the handle is 40 N.

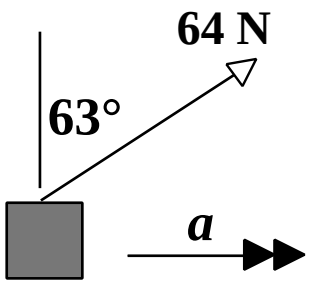


(b) Explain briefly why the acceleration of the crate would now be less than the acceleration of the crate found in part (a)

[2 marks]

Question 5

A box of mass M kg is being pulled along a rough but level surface for which the coefficient of friction, μ, is 0.42. The pulling force has a magnitude of 64 N and acts at an angle of 63° to the vertical as shown below.



The box has an acceleration, a, of 1.7 ms^{-2}.

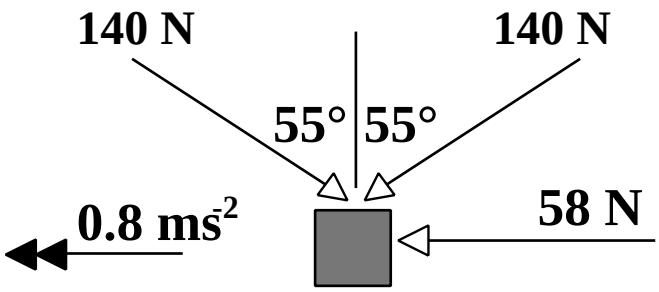
(i) Show that the frictional resistance to motion, F_r , is given approximately by;

$$F_r = 4.1M - 12.2$$

(ii) Determine the value, in kg, of M.

Question 6

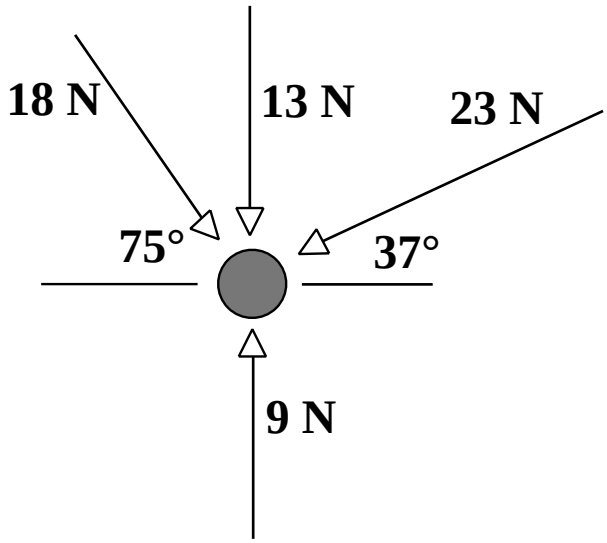
A crate of mass *M* kg has forces of magnitudes 140 N, 140 N and 58 N acting on it as shown below. The crate is being accelerated along rough, level ground.



The crate is accelerating at 0.8 ms^{-2}.
The coefficient of friction for the interface between crate and ground is 0.2.

Determine the mass of the crate.

Question 7



Four forces act upon an airborne dust particle of negligible mass as shown in the diagram above.
What single force could replace the four forces shown.
State both its magnitude and the direction in which it acts.