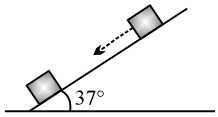
Illustration 2

A block of mass 4 kg slides down a plane inclined at 37° with the horizontal. The length of plane is 3 m. The coefficient of sliding friction between the block and the plane is 0.2. Find the work done by the gravity, the frictional force and the normal reaction between the block and the plane.

Solution

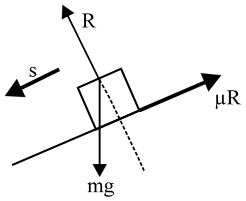
As the normal reaction is perpendicular to the displacement,
work done by the normal reaction R

= R s cos 90° = 0



The magnitude of displacement = s = 3 m and the angle between force of gravity (mg) and displacement is equal to (90° – 37°)
work done by the gravity = mgs cos (90° – 37°)

mg sin 37° = 4 × 9.8 × 3 × 3/5 = 70.56 J



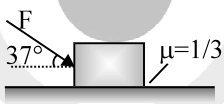
⇒ work done by friction

= – (μR)s = – (μ mg cos 37°) s

= – 0.2 × 4 × 9.8 × 4/5 × 3 = – 18.816 J

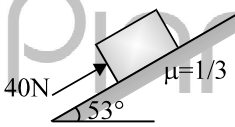
Practice Problems # 1

Q.1 A block of mass M = 9 kg is moving with uniform velocity of 2 m/s on a rough horizontal surface under the action of constant force F. The force acts at an angle 37° to the horizontal. Find work done by the force F during an interval of 4 s of motion.



(A) 400 J (B) 300 J (C) 320 J (D) 100 J

Q.2 A block of mass 10 kg is acted upon by a force of 40 N parallel to the inclined plane as shown. Find work done by applied force during first 10 s of its motion. Initially block was at rest.



(A) – 4000 J (B) 4000 J (C) –8000 J (D) 8000 J

Q.3 In the previous problem, find work done by frictional force on the block

(A) – 3000 J (B) –2000 J (C) –4000 J (D) –6000 J

Q.4 In the previous problem work done by gravity is

(A) – 8000 J (B) – 4000 J (C) 8000 J (D) 4000 J

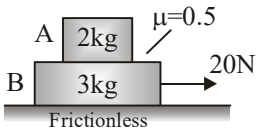
Q.5 Two constant force $\vec{F}_1$ and $\vec{F}_2$ acts on a body of mass 8 kg. These forces displaces the body from point P(1, –2, 3) to Q (2, 3, 7) in 2s starting from rest. Force $\vec{F}_1$ is of magnitude 9 N and is acting along vector $(2\hat{i} - 2\hat{j} + \hat{k})$. The positions are in meter. Find work done by $\vec{F}_1$.

(A) – 12 J (B) + 12 J (C) 36 J (D) – 36 J

Q.6 In the previous question work done by the force $\vec{F}_2$ is

(A) 80 J (B) – 80 J (C) – 180 J (D) 180 J

Q.7 Two blocks A and B are placed one over other. Block B is acted upon by a force of 20 N which displaces it through 5 m. Find work done by frictional force on block A



(A) –40 J (B) – 50 J (C) 40 J (D) 50 J