# Unit 4 · Dynamics

WORKSHEET

Full marks 32

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 32

## 1 Key words [4]

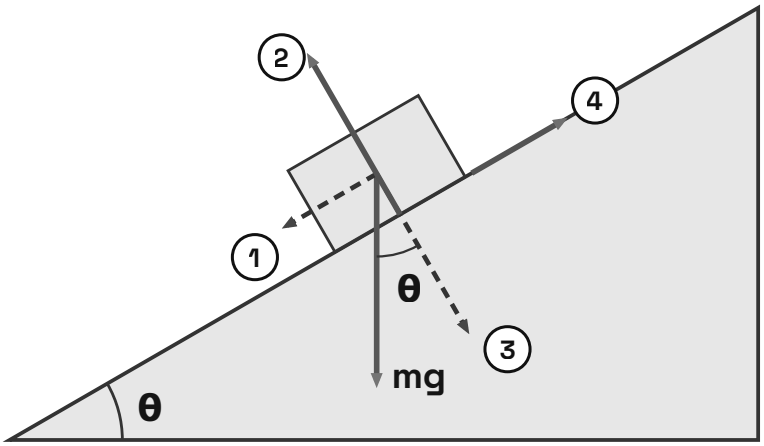
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

| angle of repose | couple | impulse | inertia | limiting friction | momentum | newton | power | torque | weight |
|---|---|---|---|---|---|---|---|---|---|

A body's resistance to any change in its state of rest or motion is its _____. The product of mass and velocity is _____, and the product of a force and the time it acts is _____. The force that gives a mass of 1 kg an acceleration of 1 $m/s^2$ is one _____. The turning effect of a force about an axis is its _____. Two equal and opposite parallel forces whose lines of action don't coincide form a _____. The greatest friction that can act before a body starts to slide is _____, and the steepest slope on which a body can rest without sliding is at the _____.

## 2 Label the diagram [2]

The diagram shows the forces on a block resting on a rough inclined plane. Name the force or component that belongs in place of 1 to 4. Each carries 0.5 mark.




1. _____ 2. _____

3. _____ 4. _____

## 3 Multiple choice [5]

Choose the correct option for each of the following questions.

**i.** The SI unit of impulse is: [1]

**a.** N s **b.** N/s

**c.** N m **d.** kg m/s$^2$

**ii.** A fielder pulls her hands back while catching a fast cricket ball. This: [1]

**a.** reduces the change in the ball's momentum

**b.** makes the stopping time longer, so the force is smaller

**c.** makes the stopping time shorter, so the force is smaller

**d.** reduces the ball's inertia

**iii.** A 4 kg gun fires a 20 g bullet at 400 m/s. The gun's recoil velocity is: [1]

**a.** 0.2 m/s **b.** 2 m/s

**c.** 20 m/s **d.** 80 m/s

**iv.** A 50 kg girl stands in a lift that accelerates downward at 2 m/s$^2$. Her apparent weight is (g = 9.8 m/s$^2$): [1]

**a.** 490 N **b.** 590 N

**c.** 390 N **d.** 100 N

**v.** A heavy box rests on a level floor, and nobody pushes it. The friction on it is: [1]

**a.** zero **b.** its limiting friction, $\mu_s R$

**c.** its kinetic friction, $\mu_k R$ **d.** equal to its weight

## 4 Short answers [7]

Write short answers to the following questions.

**a.** Action and reaction are equal and opposite. Why don't they cancel each other? [2]

**b.** Why is a door handle fixed at the edge farthest from the hinges? [2]

**c.** Sudarshan drags a 40 kg trunk across a floor at a steady speed. The coefficient of kinetic friction is 0.3. How hard must he pull, horizontally? What does "a steady speed" tell you about the forces on the trunk? ($g = 9.8\ m/s^2$) **[3]**

## 5 Long answer **[4]**

Write a long answer to the following question.

Two masses $m_1$ and $m_2$ ($m_1 > m_2$) hang from the ends of a light string passing over a smooth pulley. Derive expressions for their acceleration and the tension in the string. What happens when $m_1 = m_2$?

## 6 Numerical problems **[7]**

Solve the following problems. Show your working. Take $g = 9.8\ m/s^2$.

**a.** Kopila, of mass 45 kg, jumps down from a wall 1.0 m high. Find her speed as she reaches the ground. Then find the average upward force of the ground on her if she stops i. in 0.05 s, landing stiff-legged, and ii. in 0.40 s, bending her knees. **[4]**

**Answer:**

**b.** On a seesaw, Riya (30 kg) sits 2.0 m from the pivot. Where must Rohan (40 kg) sit to balance her? What upward force does the pivot then give? (Take the seesaw's own weight as acting at the pivot.) **[3]**

**Answer:** _____

## 7 Think **[3]**

Shishir is stuck in the middle of a frozen pond so smooth that there is no friction at all: he can't walk off. He has a heavy school bag. How can he reach the edge? Explain with a law of physics.

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## 8 Activity: The angle of repose (not marked)

Put an object on a hardcover book lying flat. Lift one end of the book slowly until the object just starts to slide. Measure the height h of the raised end and the length l of the book, and find the angle from $\sin\theta = h/l$. Then $\mu = \tan\theta$.

| Object | h (cm) | l (cm) | θ | μ = tan θ |
|---|---|---|---|---|
| eraser | | | | |
| coin | | | | |
| matchbox | | | | |
| matchbox on its narrow side | | | | |

Did the matchbox start to slide at the same angle on its wide and its narrow side? What does that tell you?

_____

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