Class 9-12 Physics

Physics Numericals

Practice pack: 3 levels, with full answers

The 5-step method

1. Write what is given and what you must find, with units.
2. Pick the formula that links them.
3. Convert every unit to SI (m, kg, s, A).
4. Substitute the numbers and calculate.
5. Check the unit, the sign and whether the size makes sense.

Motion

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

speed = distance / time

Force and momentum

$F = ma$

$p = mv$

$W = mg$ (weight)

$F \times t$ = change in p

Work, energy, power

$W = F \times s$

$KE = \frac{1}{2}mv^2$

$PE = mgh$

$P = W / t$

Pressure and density

$\rho = m / V$

$P = F / A$

$P = \rho gh$

Electricity

$V = IR$

$P = VI = I^2R$

Series: $R = R_1 + R_2$

Parallel: $1/R = 1/R_1 + 1/R_2$

Energy: $E = P \times t$

Light

Mirror: $1/v + 1/u = 1/f$

Lens: $1/v - 1/u = 1/f$

$m = -v/u$ (mirror), $m = v/u$ (lens)

Power of lens: $P = 1/f$ (f in m)

Convert first

km/h to m/s: multiply by 5/18. g to kg: divide by 1000. cm to m: divide by 100.
Minutes to s: multiply by 60. 1 kWh = 3.6×10^6 J = 1 unit of electricity.
Take g = 10 m/s² in this pack for easy arithmetic. Use 9.8 m/s² if your teacher asks for it.
Sign convention: distances measured against the incident light are negative.

Level 1: One Formula

Pick the formula and substitute

1. A car covers 150 km in 2.5 hours. Find its average speed in km/h and in m/s.

2. A car starts from rest and accelerates at 3 m/s^2 for 8 s. Find its final speed.

3. Find the force needed to give a 5 kg trolley an acceleration of 4 m/s^2.

4. A metal block has mass 540 g and volume 200 cm^3. Find its density in g/cm^3.

5. A force of 600 N acts on an area of 0.3 m^2. Find the pressure.

6. A force of 50 N moves a box 6 m in the direction of the force. Find the work done.

7. A machine does 600 J of work in 12 s. Find its power.

8. A 12 V battery is connected across a 4 Ω resistor. Find the current.

9. A lens has a focal length of 25 cm. Find its power in dioptres.

10. Find the weight of a 60 kg student. Use g = 10 m/s^2.

Level 2: Two Steps

Combine formulas to reach the answer

1. A car moving at 20 m/s brakes uniformly and stops in 5 s. Find its acceleration and the distance it travels before stopping.

2. A stone is dropped from the top of an 80 m tower. How long does it take to reach the ground, and how fast is it moving just before it lands?

3. A 2 kg block on a rough table is pulled by a 12 N force. Friction is 4 N. Find the acceleration and the speed after 3 s from rest.

4. A 0.5 kg ball hits a wall at 10 m/s and rebounds at 6 m/s. The contact lasts 0.02 s. Find the change in momentum and the average force.

5. A 2 kg object is lifted 5 m. Find its gain in potential energy. If it is then dropped, find its speed just before it reaches the ground.

6. A 6 Ω and a 3 Ω resistor are in series across an 18 V battery. Find the current and the voltage across the 3 Ω resistor.

7. The same 6 Ω and 3 Ω resistors are in parallel across a 12 V battery. Find the equivalent resistance, the total current and the current in each resistor.

8. An object is placed 30 cm in front of a concave mirror of focal length 20 cm. Find the image distance and the magnification. Describe the image.

Level 3: Challenge

Multi-stage and exam-style problems

1. A train starts from rest and accelerates at 0.5 m/s^2 for 40 s. It then moves at constant speed for 60 s, and finally brakes uniformly at 2 m/s^2 to a stop. Find the total distance travelled and the total time.

2. A ball is thrown at 20 m/s at 30° above the horizontal. Find the time of flight, the maximum height and the range.

3. A 4 kg block slides from rest down a smooth incline of angle 30°. Find its acceleration and its speed after it has slid 10 m.

4. A 1000 kg car moving at 20 m/s collides with a stationary 500 kg car and the two stick together. Find their common speed and the kinetic energy lost.

5. A cell of emf 12 V and internal resistance 1 Ω is connected to a 5 Ω resistor. Find the current, the terminal voltage and the power dissipated in the 5 Ω resistor.

6. A convex lens of focal length 15 cm forms a real image on a screen 45 cm from the lens. Find the object distance and the magnification.

Stuck? Split multi-stage problems into stages. Final speed of one stage = initial speed of the next. In collisions, momentum is conserved. Kinetic energy is not, unless the collision is elastic.

Worked Examples

The 5-step method in action

Level 1: A cyclist speeds up from 4 m/s to 12 m/s in 8 s. Find the acceleration and the distance.

Given	u = 4 m/s, v = 12 m/s, t = 8 s
Find	a and s
Formula	a = (v − u) / t and s = (u + v) × t / 2
Solve	a = (12 − 4) / 8 = 1 m/s^2. s = (4 + 12) × 8 / 2 = 64 m.
Check	s = ut + ½at^2 = 32 + 32 = 64 m. It matches.

Level 2: A 2 kW heater runs 3 hours every day. Find the monthly cost (30 days) at Rs 8 per unit.

Given	P = 2 kW, t = 3 h per day, rate = Rs 8 per kWh
Find	Energy used and cost
Formula	E = P × t, and 1 kWh = 1 unit
Solve	Per day: 2 × 3 = 6 kWh. In 30 days: 180 kWh. Cost = 180 × 8 = Rs 1,440.
Check	Power is already in kW and time in hours, so no conversion is needed.

Level 3: A convex mirror has f = 10 cm. An object is 20 cm in front of it. Find the image position and magnification.

Given	f = +10 cm (convex), u = −20 cm
Find	v and m
Formula	1/v + 1/u = 1/f and m = −v/u
Solve	1/v = 1/10 + 1/20 = 3/20, so v = +6.67 cm. m = −(6.67) / (−20) = +0.33.
Check	A convex mirror always gives a virtual, erect, smaller image behind the mirror. It matches.

Five mistakes to avoid

1. Forgetting to convert units (km/h, g, cm, minutes) before substituting.
2. Wrong signs in mirror and lens problems. Check the sign convention first.
3. Mixing up mass (kg) and weight (newton). Weight = mass × g.
4. Using g = 10 in one step and 9.8 in the next. Pick one and keep it.
5. Not checking the final unit and whether the size of the answer is sensible.

Answer Key

Check your work

Level 1

1. 60 km/h, which is 16.7 m/s
2. 24 m/s
3. 20 N
4. 2.7 g/cm³
5. 2000 Pa
6. 300 J
7. 50 W
8. 3 A
9. +4 D (convex lens)
10. 600 N

Level 2

1. a = −4 m/s² (it slows down), s = 50 m
2. t = 4 s, v = 40 m/s
3. a = 4 m/s², v = 12 m/s
4. Change in momentum = 8 kg m/s, force = 400 N
5. PE = 100 J, v = 10 m/s
6. I = 2 A, V = 6 V
7. R = 2 Ω, total I = 6 A, branches 2 A (6 Ω) and 4 A (3 Ω)
8. v = −60 cm, m = −2. Real, inverted, twice the size, 60 cm in front of the mirror

Level 3

1. Stage 1: 400 m. Stage 2: 1200 m. Stage 3: 100 m. Total 1700 m in 110 s
2. Time 2 s, max height 5 m, range 34.6 m
3. a = g sin 30° = 5 m/s², v = 10 m/s
4. v = 13.3 m/s, kinetic energy lost about 66.7 kJ (66,667 J)
5. I = 2 A, terminal voltage 10 V, power 20 W
6. u = −22.5 cm, m = −2 (real, inverted, twice the size)

Pin it on the noticeboard

Page 7 is a one-page poster. Print it and pin it up in your classroom or lab.

Scan for more practice.

The Practise Ground

Classes 9-12 Physics

Solve Any Numerical

The 5-step method for physics problems

1 Write what is given

Step 1: list the knowns and the unknown

Include the unit with every number

2 Pick the formula

Step 2: find the equation that links them

Use the quantity that is not given or asked for as a guide

3 Convert to SI units

Step 3: metre, kilogram, second, ampere

km/h to m/s: ×5/18. g to kg: ÷1000. cm to m: ÷100

4 Substitute and solve

Step 4: put in the numbers, then calculate

Keep the units in every line of working

5 Check the answer

Step 5: unit, sign and size

Is a car's speed 5000 m/s? Then something is wrong

Formulas to remember

$F = ma$, $v = u + at$, $P = W/t$

$V = IR$, $\rho = m/V$, $P = F/A$

Quick example

A 5 kg trolley accelerates at 4 m/s^2.

$F = ma = 5 \times 4 = 20$ N

Think you've got it? Test yourself.

Scan for the free practice pack with answers.

thepractiseground.in

Print it. Pin it on your classroom noticeboard. Free for every class.