LOGIC BLOOM · JEE PHYSICS

Conversion of Units *from One System to Another*

Chapter 1 · **Units & Dimensions** · Class 11 Physics

Frequently-asked JEE Main & Advanced questions

10 MCQs | Main + Advanced | Full Solutions

THE MASTER FORMULA

$$n_2 = n_1 \left(M_1/M_2\right)^a \left(L_1/L_2\right)^b \left(T_1/T_2\right)^c$$

Logic Bloom
logicbloom.co.in

Understand through games.
Score through practice.

PART I · QUESTIONS

Unit-System Conversion — 10 MCQs

Single correct answer. Each tagged JEE Main or JEE Advanced by difficulty pattern.

THE ONE METHOD BEHIND EVERY QUESTION

$$n_2 = n_1 \cdot (M_1/M_2)^a \, (L_1/L_2)^b \, (T_1/T_2)^c$$

Write the dimensional formula $[M^a L^b T^c]$ of the quantity, plug the ratio of old-to-new base units, and raise each to its exponent. The numerical value n is inversely related to the unit size u (since nu = constant): a larger unit always gives a smaller number.

Q1 JEE MAIN

The value of 1 newton in the CGS system (dyne) is:

(A) 10^3 dyne

(B) 10^5 dyne

(C) 10^{-5} dyne

(D) 10^7 dyne

Q2 JEE MAIN

The value of 1 joule of energy in the CGS system (erg) is:

(A) 10^5 erg

(B) 10^7 erg

(C) 10^{-7} erg

(D) 10^4 erg

Q3 JEE MAIN

The density of a substance is 8 g cm^{-3}. Its value in SI units (kg m^{-3}) is:

A 8×10^{3} kg m^{-3}

B 8×10^{-3} kg m^{-3}

C 800 kg m^{-3}

D 8×10^{6} kg m^{-3}

Q4 JEE MAIN

Young's modulus of a material is 19×10^{10} N m^{-2}. Its value in dyne cm^{-2} is:

A 19×10^{10}

B 1.9×10^{12}

C 19×10^{8}

D 1.9×10^{10}

Q5 JEE MAIN

The universal gravitational constant G = 6.67×10^{-11} N m^2 kg^{-2} in SI. Its value in CGS units (dyne cm^2 g^{-2}) is:

A 6.67×10^{-8}

B 6.67×10^{-14}

C 6.67×10^{8}

D 6.67×10^{-11}

Q6 JEE ADVANCED

A calorie is a unit of heat and equals 4.2 J, where 1 J = 1 kg m^2 s^{-2}. In a new system the unit of mass is α kg, the unit of length is β m, and the unit of time is γ s. The magnitude of a calorie in the new units is:

(A) $4.2\ \alpha\ \beta^2\ \gamma^{-2}$

(B) $4.2\ \alpha^{-1}\ \beta^{-2}\ \gamma^2$

(C) $4.2\ \alpha^{-1}\ \beta^{-2}\ \gamma^{-2}$

(D) $\alpha^{-1}\ \beta^{-2}\ \gamma^2$

Q7 JEE ADVANCED

Suppose a new system of units takes the unit of mass as 100 kg, the unit of length as 1 km, and the unit of time as 100 s. The magnitude of 1 joule of energy in this new system is:

(A) 10^{-4}

(B) 10^4

(C) 10^{-2}

(D) 10^2

Q8 JEE ADVANCED

In a hypothetical system, the unit of force is 2 N, the unit of length is 4 m, and the unit of velocity is 6 m s^{-1}. The unit of mass in this system is:

(A) 1/9 kg

(B) 2/9 kg

(C) 9/2 kg

(D) 9 kg

Q9 JEE ADVANCED

If the unit of length is doubled and the unit of time is halved, while the unit of mass is unchanged, then the numerical value of a given force (in the new units) becomes:

A Half the original

B Twice the original

C One-eighth the original

D Eight times the original

Q10 JEE MAIN

The speed of light is $c = 3 \times 10^8$ m s^{-1}. Its value in km h^{-1} is:

A 1.08×10^6

B 1.08×10^9

C 3×10^5

D 1.08×10^{12}

PART II · ANSWER KEY & SOLUTIONS

Detailed Solutions

Quick-check grid first, then full working for every question.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
B	B	A	B	A	B	A	B	C	B

Q1 **Correct: B** *10^5 dyne*

Force has dimensions [M L T^{-2}], so a=1, b=1, c=−2. Using $n_2 = n_1(M_1/M_2)^a(L_1/L_2)^b(T_1/T_2)^c$ with SI→CGS: M_1/M_2 = 1 kg / 1 g = 10^3, L_1/L_2 = 1 m / 1 cm = 10^2, T_1/T_2 = 1. So $n_2 = 1 \times (10^3)^1(10^2)^1(1)^{-2} = 10^5$. Hence **1 N = 10^5 dyne** — the single most asked conversion in this chapter.

Q2 **Correct: B** *10^7 erg*

Energy has dimensions [M L^2 T^{-2}], so a=1, b=2, c=−2. With SI→CGS: $n_2 = 1 \times (10^3)^1(10^2)^2(1)^{-2} = 10^3 \times 10^4 = 10^7$. Therefore **1 J = 10^7 erg**. Note the length exponent is 2 here (energy ∝ L^2), which is exactly what separates this from the newton conversion.

Q3 **Correct: A** *8×10^3 kg m^{-3}*

Density has dimensions [M L^{-3}], so a=1, b=−3, c=0. Going CGS→SI: M_1/M_2 = 1 g / 1 kg = 10^{-3}, L_1/L_2 = 1 cm / 1 m = 10^{-2}. So $n_2 = 8 \times (10^{-3})^1(10^{-2})^{-3} = 8 \times 10^{-3} \times 10^6 = 8 \times 10^3$. Thus **8 g cm^{-3} = 8000 kg m^{-3}**. Watch the sign: the negative length exponent flips 10^{-2} into 10^{+6}.

Q4 **Correct: B** *1.9×10^{12}*

Young's modulus (stress) has the dimensions of pressure: [M L^{-1} T^{-2}], so a=1, b=−1, c=−2. Converting SI→CGS: $n_2 = 19\times10^{10} \times (10^3)^1(10^2)^{-1}(1)^{-2} = 19\times10^{10} \times 10^3 \times 10^{-2} = 19\times10^{11}$ = **1.9×10^{12} dyne cm^{-2}**. A staple JEE Main numerical — the b = −1 from the L^{-1} in pressure is the step students drop.

Q5 **Correct: A** *6.67×10^{-8}*

From $F = Gm_1m_2/r^2$, G has dimensions [M^{-1} L^3 T^{-2}], so a=−1, b=3, c=−2. Converting SI→CGS: $n_2 = 6.67\times10^{-11} \times (10^3)^{-1}(10^2)^3(1)^{-2} = 6.67\times10^{-11} \times 10^{-3} \times 10^6$ = **6.67×10^{-8} dyne cm^2 g^{-2}**. The negative mass exponent (a = −1) is the trap; it makes the mass factor 10^{-3}, not 10^3.

Q6 **Correct: B** *$4.2\ \alpha^{-1}\ \beta^{-2}\ \gamma^{2}$*

This is the classic NCERT / JEE problem. Energy is $[M\ L^2\ T^{-2}]$, so a=1, b=2, c=−2. Each base unit scales: 1 kg = (1/α) new mass units, 1 m = (1/β) new length units, 1 s = (1/γ) new time units. So $n_2 = 4.2 \times (1/\alpha)^1(1/\beta)^2(1/\gamma)^{-2} = \mathbf{4.2\ \alpha^{-1}\ \beta^{-2}\ \gamma^{2}}$. The most common slip is the time term: with c = −2, $(1/\gamma)^{-2} = \gamma^{+2}$, so γ ends up with a *positive* power.

Q7 **Correct: A** *10^{-4}*

Energy $[M\ L^2\ T^{-2}]$ → a=1, b=2, c=−2. Ratios (SI → new): M_1/M_2 = 1 kg / 100 kg = 10^{-2}; L_1/L_2 = 1 m / 1000 m = 10^{-3}; T_1/T_2 = 1 s / 100 s = 10^{-2}. So $n_2 = 1 \times (10^{-2})^1(10^{-3})^2(10^{-2})^{-2} = 10^{-2} \times 10^{-6} \times 10^{4} = \mathbf{10^{-4}}$. So 1 J = 10^{-4} new units. Be careful to take the SI value as n_1 and the new unit as the target.

Q8 **Correct: B** *2/9 kg*

Express mass through the given units. Force = mass × acceleration, and acceleration = velocity / time, with time = length / velocity. So [F] = [M][v]/[t] = [M][v]²/[L], giving M = F·L / v^2. Substituting the unit magnitudes: M = (2 × 4) / 6^2 = 8/36 = **2/9 kg**. This 'find the derived fundamental unit' twist is a favourite JEE Advanced inversion of the standard conversion problem.

Q9 **Correct: C** *One-eighth the original*

Force is $[M\ L\ T^{-2}]$: a=1, b=1, c=−2. The numerical value scales as $n_2 = n_1(M_1/M_2)^1(L_1/L_2)^1(T_1/T_2)^{-2}$. Mass unchanged ⇒ M_1/M_2=1. Length doubled ⇒ L_2=2L_1 ⇒ L_1/L_2=1/2. Time halved ⇒ T_2=T_1/2 ⇒ T_1/T_2=2. So $n_2 = n_1 \times 1 \times (1/2) \times (2)^{-2} = n_1 \times (1/2) \times (1/4) = \mathbf{n_1/8}$. A larger unit gives a smaller numerical value — the inverse relation n ∝ 1/u is the whole idea being tested.

Q10 **Correct: B** *1.08×10^{9}*

Speed is $[L\ T^{-1}]$: a=0, b=1, c=−1. Converting m s^{-1} → km h^{-1}: L_1/L_2 = 1 m / 1 km = 10^{-3}; T_1/T_2 = 1 s / 3600 s. So $n_2 = 3{\times}10^8 \times (10^{-3})^1 \times (1/3600)^{-1} = 3{\times}10^8 \times 10^{-3} \times 3600 = \mathbf{1.08 \times 10^9\ km\ h^{-1}}$. Equivalently, multiply by 18/5: $3{\times}10^8 \times 18/5 = 1.08{\times}10^9$.

KEEP GOING · ON THE APP

Don't just solve 10.
Master the whole chapter.

You've worked the core conversion problems on paper. On the Logic Bloom app, every question you attempt is tracked, so you fix the exact steps you keep slipping on — the sign of an exponent, the wrong base-unit ratio — and turn practice into marks.

- **Mistake Book** — every wrong answer auto-saved with the concept you missed, so revision is targeted, not random.
- **In-depth analysis** — topic-wise accuracy, speed, and weak-area breakdown after every session.
- **Play the chapter** — Units & Dimensions turned into games that make dimensional formulae stick.
- **Unlimited JEE PYQs** — practice by topic with traps and predictions you won't find anywhere else.

Practice on the app →

logicbloom.co.in

Understand through games. Score through practice.

Logic Bloom

Understand through games. Score through practice.

logicbloom.co.in