CHAPTER

08 Gravitation

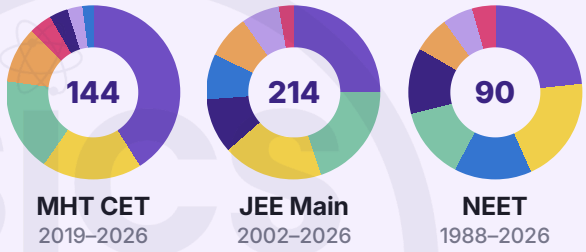
MHT CET · JEE · NEET Physics

PHYSICS CIRCLE

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EXAM WEIGHTAGE



	CET	JEE	NEET
Acceleration Due to Gravity	59 41%	53 25%	21 23%
Escape Velocity	27 19%	40 19%	18 20%
Satellites - Orbital Velocity & Period	25 17%	43 20%	12 13%
Gravitational Potential & Energy	5 3%	22 10%	11 12%
Satellite Energy & Weightlessness	15 10%	17 8%	6 7%
Kepler's Laws & Planetary Motion	3 2%	18 8%	13 14%
Newton's Law of Gravitation	4 3%	15 7%	5 6%
Gravitational Field	6 4%	6 3%	4 4%

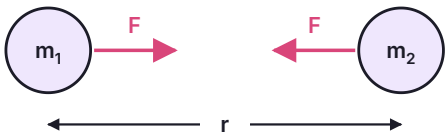
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01 CONCEPT Newton's Law of Gravitation

IN ONE LINE

Every body attracts every other body with a force proportional to the **product of their masses** and inversely proportional to the **square of the distance** between them.

8.1.1 Newton's law of gravitation



Equal and opposite forces along the line joining the centres

$$F = \frac{Gm_1m_2}{r^2}$$

- The force acts along the line joining the two particles.
- The two forces are an action–reaction pair: the earth pulls the moon as hard as the moon pulls the earth.

8.1.2 Universal gravitational constant

$$G = 6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$$

- G equals the force between two unit masses kept unit distance apart.
- Dimensions: $[M^{-1}L^3T^{-2}]$.
- First measured by **Cavendish** with a torsion balance.
- G does not depend on the nature or size of the bodies, or on the medium.

8.1.3 Nature of the gravitational force

- Always **attractive**.
- **Independent of the medium** between the bodies.
- Acts over a wide range: planets to atoms.
- **Central**: along the line joining the centres.
- **Weakest** force in nature: $F_{nuclear} > F_{electromagnetic} > F_{gravitational}$.
- Between two electrons, gravity is about 10^{-43} of the electrostatic force.
- **Conservative**: work around a closed path is zero.

8.1.4 Force due to many particles

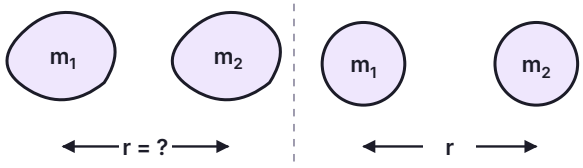
- The force between two particles is not affected by other particles.
- The net force is the **vector sum**.

$$F = F_1 + F_2 + F_3 + \ldots$$

- Equal masses placed symmetrically around a point give zero force there.
- A particle at the centre of a uniform ring feels zero force.
- Square of side a with mass m at each corner: force on one mass is

$$F = \left(\frac{2\sqrt{2}+1}{2}\right)\frac{Gm^2}{a^2}$$

8.1.5 What distance to use



Irregular bodies have no single r; for spheres take the distance between centres

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- The law is stated for point masses.
- A uniform sphere acts as a point mass for any point outside it.
- Two identical spheres in contact are 2R apart, with $m = \frac{4}{3}\pi R^3\rho$:

$$F \propto R^4\rho^2$$

JEE · NEET Corner

Vector form of the law

$$\mathbf{F}_{12} = -\frac{Gm_1m_2}{r^2}\mathbf{r}_{21} = -\mathbf{F}_{21}$$

- $\mathbf{r}_{21}$ is the unit vector from m_2 to m_1; the minus sign shows the force on m_1 points towards m_2.
- $\mathbf{F}_{12} = -\mathbf{F}_{21}$ is Newton's third law.

Sphere with a cavity

- Treat the cavity as a filled sphere plus a sphere of negative mass.
- Force of the rest = force of the full sphere − force of the removed part.
- A part of radius $\frac{R}{n}$ has mass $\frac{M}{n^3}$. Measure its distance from its own centre.

Two bodies released from rest

- Their centre of mass stays at rest, so distance covered $\propto$ one over the mass.
- They collide when the centres are $R_1 + R_2$ apart.

Continuous bodies

- Semicircular wire of length L, mass M, at the centre: $F = \frac{2\pi GMm}{L^2}$.
- Rod with $\lambda(x)$: $F = Gm\int \frac{\lambda\, dx}{x^2}$.

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Solved Examples 01 Newton's Law of Gravitation

SOLVED 1 MHT CET 2023 · 9 May · Shift 1

A thin rod of length L is bent in the form of a circle. Its mass is M. What force will act on mass m placed at the centre of this circle? (G = constant of gravitation)

(a) zero
(b) $\frac{GMm}{4L^2\pi^2}$
(c) $\frac{4\pi^2GMm}{L}$
(d) $\frac{2GMm}{L^2}$

STEP 1 Every small piece of the ring has an equal piece diametrically opposite
STEP 2 The pulls of the two pieces on m are equal and opposite
STEP 3 Net force = **zero**

Answer: **(a)**

SOLVED 2 MHT CET 2023 · 10 May · Shift 2

A system consists of three particles each of mass m_1 placed at the corners of an equilateral triangle of side $\frac{L}{3}$. A particle of mass m_2 is placed at the mid point of any one side of the triangle. Due to the system of particles, the force acting on m_2 is

(a) $\frac{3Gm_1m_2}{L^2}$
(b) $\frac{6Gm_1m_2}{L^2}$
(c) $\frac{9Gm_1m_2}{L^2}$
(d) $\frac{12Gm_1m_2}{L^2}$

STEP 1 The two particles on the same side pull m_2 equally in opposite directions: they cancel
STEP 2 Third particle is at the height of the triangle: $d = \frac{\sqrt{3}}{2} \times \frac{L}{3}$, so $d^2 = \frac{L^2}{12}$
STEP 3 $F = \frac{Gm_1m_2}{d^2} = \frac{\mathbf{12Gm_1m_2}}{\mathbf{L^2}}$

Answer: **(d)**

SOLVED 3 MHT CET 2024 · 3 May · Shift 2

Two identical metal spheres are kept in contact with each other, each having radius R cm and ρ is the density of material of metal spheres. The gravitational force F of attraction between them is proportional to

(a) $R^3\rho$
(b) $R^4\rho^2$
(c) $R^4\rho$
(d) $R^3\rho^2$

STEP 1 Mass of each sphere: $m = \frac{4}{3}\pi R^3\rho$; distance between centres = 2R
STEP 2 $F = \frac{Gm^2}{(2R)^2} \propto \frac{R^6\rho^2}{R^2}$
STEP 3 $F \propto \mathbf{R^4\rho^2}$

Answer: **(b)**

SOLVED 4 MHT CET 2023 · 13 May · Shift 1

If two identical spherical bodies of same material and dimensions are kept in contact, the gravitational force between them is proportional to R^x, where x is non zero integer. [Given: R is radius of each spherical body]

(a) −4
(b) 4
(c) 2
(d) −2

STEP 1 $m \propto R^3$, so $m^2 \propto R^6$
STEP 2 Separation of centres = 2R, so $F \propto \frac{R^6}{R^2}$
STEP 3 $F \propto R^4 \Rightarrow x = \mathbf{4}$

Answer: **(b)**

SOLVED 5 JEE Main 2022 · 28 Jun · Shift 2

Two objects of equal masses placed at certain distance from each other attracts each other with a force of F. If one-third mass of one object is transferred to the other object, then the new force will be

(a) $\frac{2}{9}$ F
(b) $\frac{16}{9}$ F
(c) $\frac{8}{9}$ F
(d) F

STEP 1 New masses: $\frac{2m}{3}$ and $\frac{4m}{3}$
STEP 2 Product = $\frac{8}{9}m^2$
STEP 3 $F' = \mathbf{\frac{8}{9}F}$

Answer: **(c)**

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Solved Examples 01 Newton's Law of Gravitation (contd.)

SOLVED 6 AIPMT 2003

Two spheres of masses m and M are situated in air and the gravitational force between them is F. The space around the masses is now filled with a liquid of specific gravity 3. The gravitational force will now be

(a) 3 F (b) F

(c) $\frac{F}{3}$ (d) $\frac{F}{9}$

STEP 1 Gravitational force does not depend on the medium between the bodies

STEP 2 G, m, M and r are unchanged

STEP 3 Force stays **F**

Answer: **(b)**

SOLVED 7 JEE Main 2024 · 31 Jan · Shift 1

Four identical particles of mass m are kept at the four corners of a square. If the gravitational force exerted on one of the masses by the other masses is $\left(\frac{2\sqrt{2}+1}{32}\right)\frac{Gm^2}{L^2}$, the length of the sides of the square is

(a) 4L (b) 3L

(c) 2L (d) $\frac{L}{2}$

STEP 1 Two sides give $\sqrt{2}\,\frac{Gm^2}{a^2}$; the diagonal gives $\frac{Gm^2}{2a^2}$, along the same line

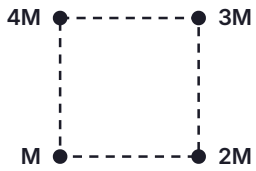
STEP 2 Net $F = \left(\frac{2\sqrt{2}+1}{2}\right)\frac{Gm^2}{a^2}$

STEP 3 Compare: $a^2 = 16L^2 \Rightarrow a = \mathbf{4L}$

Answer: **(a)**

SOLVED 8 JEE Main 2026 · 22 Jan · Shift 1

Net gravitational force at the centre of a square is F_1 when four particles of mass M, 2M, 3M and 4M are placed at the four corners as shown, and it is F_2 when the positions of 3M and 4M are interchanged. The ratio $\frac{F_1}{F_2}$ is $\frac{\alpha}{\sqrt{5}}$. The value of α is



(a) 2 (b) $2\sqrt{5}$

(c) 1 (d) 3

STEP 1 Opposite corners cancel partly. First case: along 4M–2M net 2M; along 3M–M net 2M; these are perpendicular

STEP 2 $F_1 \propto \sqrt{(2^2 + 2^2)} = 2\sqrt{2}$. After the swap: along 3M–2M net 1M; along 4M–M net 3M, so $F_2 \propto \sqrt{10}$

STEP 3 $\frac{F_1}{F_2} = \frac{2\sqrt{2}}{\sqrt{10}} = \frac{2}{\sqrt{5}} \Rightarrow \alpha = \mathbf{2}$

Answer: **(a)**

SOLVED 9 JEE Main 2022 · 27 Jun · Shift 1

Statement I: The law of gravitation holds good for any pair of bodies in the universe. Statement II: The weight of any person becomes zero when the person is at the centre of the earth. Choose the correct answer.

(a) Both Statement I and Statement II are true

(b) Both Statement I and Statement II are false

(c) Statement I is true but Statement II is false

(d) Statement I is false but Statement II is true

STEP 1 Statement I: the law is universal, so it is true

STEP 2 Statement II: at the centre d = R, so g′ = g(1 – 1) = 0 and weight = 0: true

STEP 3 **Both are true**

Answer: **(a)**

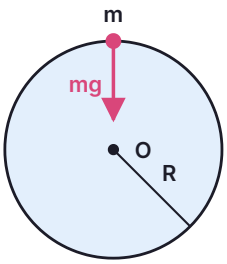
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02 CONCEPT Acceleration Due to Gravity

IN ONE LINE

Near a planet every body falls with the **same acceleration g**, whatever its mass. It depends only on the planet's mass and radius.

8.2.1 Acceleration due to gravity



Pull on a body at the surface

- Pull of the earth on the body = mg.

$$mg = \frac{GMm}{R^2}$$

$$g = \frac{GM}{R^2}$$

- Put M = volume × density = $\frac{4}{3}\pi R^3 \rho$:

$$g = \frac{4}{3}\pi \rho G R$$

- g does not depend on the mass, shape or density of the falling body.
- g is a vector, directed towards the centre of the planet.
- Dimensions $[LT^{-2}]$; average value 9.8 m s^{-2}.
- $GM = gR^2$: use it to replace GM in every formula.

8.2.2 Which formula to use

Given	Use
M and R	$g \propto \frac{M}{R^2}$
ρ and R	$g \propto \rho R$
same density	$g \propto R$, and $g \propto M^{1/3}$
same mass	$g \propto \frac{1}{R^2}$
same g	$\rho \propto \frac{1}{R}$

- Radius falls by x% (mass fixed): g rises by 2x%.
- Mass rises by x% (radius fixed): g rises by x%.
- Density falls by x% (radius fixed): g falls by x%.
- Diameter halved (mass fixed): g becomes 4g.

8.2.3 What changes with g on a planet

- Weight: W = mg, while the mass m stays the same.
- Work in lifting a body: W = mgh.

$$\text{pendulum: } T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T \propto \frac{1}{\sqrt{g}}$$

- A seconds pendulum keeps T = 2 s, so its length $l \propto g$.

$$\text{height of a jump: } h = \frac{v^2}{2g} \Rightarrow h \propto \frac{1}{g}$$

8.2.4 Weighing the earth

$$M = \frac{gR^2}{G}$$

- With g = 9.8 m s^{-2} and R = 6400 km, $M \approx 6 \times 10^{24}$ kg.

$$\rho = \frac{3g}{4\pi G R}$$

- $\rho \approx 5478$ kg m^{-3} for the earth.
- ρ is directly proportional to g.

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GRAVITATION

LEVEL 1 · EASY

Topic-wise Previous Year Questions

MHT CET · NEET · JEE Main

199	23	8
questions	concepts	topics

CONTENTS

01	Newton's Law of Gravitation	Q 1–6	6 Qs
02	Acceleration Due to Gravity	Q 7–84	78 Qs
03	Gravitational Field	Q 85–87	3 Qs
04	Gravitational Potential & Energy	Q 88–99	12 Qs
05	Escape Velocity	Q 100–135	36 Qs
06	Kepler's Laws & Planetary Motion	Q 136–156	21 Qs
07	Satellites - Orbital Velocity & Period	Q 157–190	34 Qs
08	Satellite Energy & Weightlessness	Q 191–199	9 Qs
	Answer key		

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TOPIC 01

Newton's Law of Gravitation

6 PYQs · Easy 6 · Medium 0 · Difficult 0 | MHT CET 1 · NEET 3 · JEE 2

Concepts covered: Newton's law, G & nature of the force (5) · Superposition: force due to many particles (1)

LEVEL 1 · EASY 6 questions

◆ Newton's law, G & nature of the force 5 Qs

1. Match List - I with List - II

	List - I		List - II
(a)	Gravitational constant (G)	(i)	$[L^2T^{-2}]$
(b)	Gravitational potential energy	(ii)	$[M^{-1}L^3T^{-2}]$
(c)	Gravitational potential	(iii)	$[LT^{-2}]$
(d)	Gravitational intensity	(iv)	$[ML^2T^{-2}]$

Choose the correct answer from the options given below

NEET 2022 · PHASE 1

(a) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(b) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)
(c) (a)-(ii), (b)-(iv), (c)-(iii), (d)-(i)
(d) (a)-(iv), (b)-(ii), (c)-(i), (d)-(iii)

2. Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will

NEET 2017

(a) move towards each other.
(b) move away from each other.
(c) will become stationary.
(d) keep floating at the same distance between them.

3. Two spheres of masses m and M are situated in air and the gravitational force between them is F. The space around the masses is now filled with a liquid of specific gravity 3. The gravitational force will now be

AIPMT 2003

(a) 3 F (b) F (c) F/3 (d) F/9

4. Two objects of equal masses placed at certain distance from each other attracts each other with a force of F. If one-third mass of one object is transferred to the other object, then the new force will be:

JEE MAIN 2022 · 28 JUN · SHIFT 2

(a) $\frac{2}{9}$ F (b) $\frac{16}{9}$ F (c) $\frac{8}{9}$ F (d) F

5. Given below are two statements:

Statement I: The law of gravitation holds good for any pair of bodies in the universe. Statement II: The weight of any person becomes zero when the person is at the centre of the earth. In the light of the above statements, choose the correct answer from the options given below.

JEE MAIN 2022 · 27 JUN · SHIFT 1

(a) Both Statement I and Statement II are true
(b) Both Statement I and Statement II are false
(c) Statement I is true but Statement II is false
(d) Statement I is false but Statement II is true

◆ Superposition: force due to many particles 1 Q

6. A thin rod of length 'L' is bent in the form of a circle. Its mass is 'M'. What force will act on mass 'm' placed at the centre of this circle?

(G = constant of gravitation)

MHT CET 2023 · 9 MAY · SHIFT 1

(a) zero (b) $\frac{GMm}{4L^2\pi^2}$
(c) $\frac{4\pi^2GMm}{L}$ (d) $\frac{2GMm}{L^2}$

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TOPIC 02

Acceleration Due to Gravity

78 PYQs · Easy 78 · Medium 0 · Difficult 0 | MHT CET 35 · NEET 16 · JEE 27

Concepts covered: g at the surface & comparing planets (16) · Mass & density of a planet (7) · g above the surface (height) (27) · g below the surface (depth) (15) · Height versus depth & the g–r graph (10) · Shape & rotation of the earth (3)

LEVEL 1 · EASY 78 questions

◆ g at the surface & comparing planets 16 Qs

7. The density of a planet is three times that of earth and radius 2.5 times that of earth. If g_p and g_e represents acceleration due to gravity on planet and earth respectively then ratio g_p to g_e is

MHT CET 2026 · 11 APR · SHIFT 2

(a) 7.5 (b) 3.5 (c) 6.5 (d) 9.5

8. Two planets A and B have densities ' ρ_1 ', ' ρ_2 ' and have radii ' r_1 ', ' r_2 ', respectively. The ratio of acceleration due to gravity on A to that of B is

MHT CET 2025 · 25 APR · SHIFT 1

(a) $r_1 : r_2$ (b) $r_1\rho_1 : r_2\rho_2$
(c) $r_1^2\rho_1 : r_2^2\rho_2$ (d) $r_1\rho_2 : r_2\rho_1$

9. The density of a new planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to that at the surface of earth. If R is the radius of earth, then radius of the planet would be

MHT CET 2024 · 15 MAY · SHIFT 2

(a) 4 R (b) R/2 (c) $\frac{R}{4}$ (d) $2R$

10. The acceleration due to gravity at the surface of the planet is same as that at the surface of the earth, but the density of planet is thrice that of the earth. If 'R' is the radius of the earth, the radius of the planet will be

MHT CET 2024 · 11 MAY · SHIFT 1

(a) $\frac{R}{9}$ (b) $\frac{R}{3}$ (c) 3R (d) 9R

11. If two planets have their radii in the ratio $x : y$ and densities in the ratio $m : n$, then the acceleration due to gravity on them are in the ratio

MHT CET 2023 · 13 MAY · SHIFT 2

(a) $\frac{ny}{mx}$ (b) $\frac{my}{nx}$ (c) $\frac{nx}{my}$ (d) $\frac{mx}{ny}$

12. Consider a planet whose density is same as that of the earth but whose radius is three times the radius 'R' of the earth. The acceleration due to gravity 'g_n' on the surface of planet is $g_n = x.\ g$ where g is acceleration due to gravity on surface of earth. The value of 'x' is

MHT CET 2023 · 9 MAY · SHIFT 2

(a) 9 (b) 3 (c) $\frac{1}{3}$ (d) $\frac{1}{9}$

13. The mass of a planet is $\frac{1}{10}$th that of the earth and its diameter is half that of the earth. The acceleration due to gravity on that planet is:

NEET 2024

(a) 19.6 m s^{-2} (b) 9.8 m s^{-2}
(c) 4.9 m s^{-2} (d) 3.92 m s^{-2}

14. A spherical planet has a mass MP and diameter DP. A particle of mass m falling freely near the surface of this planet will experience an acceleration due to gravity, equal to

AIPMT 2012 · PRELIMS

(a) $\frac{4GM_P}{D_P^2}$ (b) $\frac{GM_Pm}{D_P^2}$ (c) $\frac{GM_P}{D_P^2}$ (d) $\frac{4GM_Pm}{D_P^2}$

15. Imagine a new planet having the same density as that of earth but it is 3 times bigger than the earth in size. If the acceleration due to gravity on the surface of earth is g and that on the surface of the new planet is g', then

AIPMT 2005

(a) g' = g/9 (b) g' = 27g (c) g' = 9g (d) g' = 3g

16. The density of a newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to that at the surface of the earth. If the radius of the earth is R, the radius of the planet would be

AIPMT 2004

(a) 2R (b) 4R (c) $\frac{1}{4}$ R (d) $\frac{1}{2}$ R

17. The acceleration due to gravity on the surface of earth is g. If the diameter of earth reduces to half of its original value and mass remains constant, then acceleration due to gravity on the surface of earth would be:

JEE MAIN 2024 · 27 JAN · SHIFT 1

(a) g/4 (b) 2g (c) g/2 (d) 4g

18. Two planets A and B of radii R and 1.5 R have densities ρ and $\rho/2$ respectively. The ratio of acceleration due to gravity at the surface of B to A is:

JEE MAIN 2023 · 13 APR · SHIFT 2

(a) 2: 1 (b) 2: 3 (c) 4: 3 (d) 3: 4

19. The radii of two planets 'A' and 'B' are 'R' and '4R' and their densities are ρ and $\rho/3$ respectively. The ratio of acceleration due to gravity at their surfaces $(g_A : g_B)$ will be:

JEE MAIN 2023 · 11 APR · SHIFT 1

(a) 3: 16 (b) 4: 3 (c) 1: 16 (d) 3: 4

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20. If the radius of earth shrinks by 2% while its mass remains same. The acceleration due to gravity on the earth's surface will approximately:
JEE MAIN 2022 · 28 JUL · SHIFT 1
(a) decrease by 2% (b) decrease by 4%
(c) increase by 2% (d) increase by 4%

21. The radii of two planets A and B are in the ratio 2: 3. Their densities are 3ρ and 5ρ respectively. The ratio of their acceleration due to gravity is:
JEE MAIN 2022 · 30 JUN · SHIFT 1
(a) 9: 4 (b) 9: 8 (c) 9: 10 (d) 2: 5

22. Acceleration due to gravity on the surface of earth is ' g '. If the diameter of earth is reduced to one third of its original value and mass remains unchanged, then the acceleration due to gravity on the surface of the earth is _____ g.
JEE MAIN 2025 · 24 JAN · SHIFT 2 *(Numerical)*

◆ Mass & density of a planet 7 Qs

23. If ' R ' is the radius of earth \& ' g ' is acceleration due to gravity on earth's surface, then mean density of earth is
MHT CET 2024 · 4 MAY · SHIFT 1
(a) $\frac{4\pi G}{3gR}$ (b) $\frac{3\pi R}{4gG}$ (c) $\frac{3\,g}{4\pi RG}$ (d) $\frac{\pi RG}{12\,g}$

24. Considering earth to be a sphere of radius 'R' having uniform density 'ρ', then value of acceleration due to gravity 'g' in terms of R, ρ and G is
MHT CET 2023 · 14 MAY · SHIFT 1
(a) $g=\sqrt{\frac{3\pi R}{\rho G}}$ (b) $g=\sqrt{\frac{4}{3}\pi\rho GR}$
(c) $g=\frac{4}{3}\pi\rho GR$ (d) $g=\frac{GM}{\rho R^2}$

25. The average density of the earth is [g is acceleration due to gravity]
MHT CET 2021 · 24 SEP · SHIFT 2
(a) inversely proportional to g^2.
(b) directly proportional to g.
(c) inversely proportional to g.
(d) directly proportional to g^2.

26. If R is the radius of the earth and g is the acceleration due to gravity on the earth surface. Then the mean density of the earth will be:
NEET 2023
(a) $\frac{\pi RG}{12\,g}$ (b) $\frac{3\pi R}{4gG}$ (c) $\frac{3g}{4\pi RG}$ (d) $\frac{4\pi G}{3gR}$

27. What will be the formula of mass of the earth in terms of g, R and G?
AIPMT 1996
(a) $G\frac{R}{g}$ (b) $g\frac{R^2}{G}$ (c) $g^2\frac{R}{G}$ (d) $G\frac{g}{R}$

28. The acceleration due to gravity g and mean density of the earth ρ are related by which of the following relations? (where G is the gravitational constant and R is the radius of the earth.)
AIPMT 1995
(a) $\rho=\frac{3g}{4\pi GR}$ (b) $\rho=\frac{3g}{4\pi GR^3}$
(c) $\rho=\frac{4\pi gR^2}{3G}$ (d) $\rho=\frac{4\pi gR^3}{3G}$

29. Average density of the earth
AIEEE 2005
(a) is a complex function of g
(b) does not depend on g
(c) is inversely proportional to g
(d) is directly proportional to g

◆ g above the surface (height) 27 Qs

30. Time period of a simple pendulum is T_1 when on the earth's surface and T_2 when taken to a height '2R' above the earth's surface, where 'R' is the radius of the earth. The ratio $T_1 : T_2$ is
MHT CET 2026 · 18 APR · SHIFT 1
(a) 1 : 2 (b) 1 : 3 (c) 1 : 4 (d) 1 : 5

31. The time taken by simple pendulum for one oscillation is T on earth's surface. Its time period becomes xT when taken to a height R (equal to earth's radius) above the earth's surface. The value of x is
MHT CET 2026 · 16 APR · SHIFT 2
(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) 2 (d) 4

32. A body weighs 45 N on the surface of the earth. The gravitational force on a body due to earth at a height equal to half the radius of earth will be
MHT CET 2025 · 26 APR · SHIFT 1
(a) 20 N (b) 22.5 N (c) 30 N (d) 36 N

33. Time period of a simple pendulum on earth's surface is ' T '. It time period becomes ' xT ' when taken to a height ' $2R$ ' above earth's surface. The value of x will be (R = radius of earth)
MHT CET 2025 · 22 APR · SHIFT 1
(a) 2 (b) 4 (c) 1 (d) 3

34. A boy weighs 72 N on the surface of earth. The gravitational force on a body due to earth at a height equal to half the radius of earth will be
MHT CET 2024 · 16 MAY · SHIFT 2
(a) 32 N (b) 48 N (c) 96 N (d) 162 N

35. A simple pendulum has a periodic time ' T_1 ' when it is on the surface of earth of radius ' R '. Its periodic time is ' T_2 ' when it is taken to a height ' R ' above the earth's surface. The value of $\frac{T_2}{T_1}$ is
MHT CET 2024 · 16 MAY · SHIFT 1
(a) $\sqrt{2}$ (b) 1 (c) 2 (d) $\frac{1}{2}$

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36. The height ' h ' above the earth's surface at which the value of acceleration due to gravity (g) becomes $\left(\frac{g}{3}\right)$ is (R = radius of the earth)

MHT CET 2024 · 4 MAY · SHIFT 1

(a) $(\sqrt{3}+1)R$ (b) $(\sqrt{3}-1)R$
(c) $\sqrt{3}$R (d) $3\sqrt{R}$

37. The height at which the weight of the body becomes $\frac{1^{th}}{16}$ of its weight on the surface of the earth of radius ' R ' is

MHT CET 2024 · 3 MAY · SHIFT 2

(a) 2 R (b) 3 R (c) 4 R (d) 5 R

38. The height above the earth's surface at which the acceleration due to gravity becomes $\left(\frac{1}{n}\right)$ times the value at the surface is (R = radius of earth)

MHT CET 2024 · 2 MAY · SHIFT 1

(a) $\frac{R}{\sqrt{n}}$ (b) R · $\sqrt{n}$
(c) $(\sqrt{n}+1)R$ (d) $(\sqrt{n}-1)$R

39. Time period of simple pendulum on earth's surface is ' T'. Its time period becomes 'xT' when taken to a height R (equal to earth's radius) above the earth's surface. Then the value of 'x' will be

MHT CET 2023 · 12 MAY · SHIFT 1

(a) 4 (b) 2 (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

40. The height at which the weight of the body becomes $\left(\frac{1}{9}\right)^{th}$ its weight on the surface of earth is (R = radius of earth)

MHT CET 2023 · 12 MAY · SHIFT 1

(a) 8R (b) 4R (c) 3R (d) 2R

41. At a height 'R' above the earth's surface the gravitational acceleration is (R = radius of earth, g = acceleration due to gravity on earth's surface)

MHT CET 2021 · 22 SEP · SHIFT 2

(a) g (b) $\frac{g}{8}$ (c) $\frac{g}{4}$ (d) $\frac{g}{2}$

42. When the value of acceleration due to gravity 'g' becomes $\frac{g}{3}$ above surface of height 'h' then relation between 'h' and 'R' is (R = radius of earth)

MHT CET 2021 · 21 SEP · SHIFT 1

(a) h = $\frac{R}{\sqrt{3}-1}$ (b) h = $\frac{\sqrt{3}}{R}$
(c) $h=(\sqrt{2}-1)R$ (d) h = $(\sqrt{3}-1)$R

43. A body weighs 48 N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one-third the radius of the earth from its surface is:

NEET 2025

(a) 32 N (b) 36 N (c) 16 N (d) 27 N

44. A body weighs 72 N on the surface of the earth. What is the gravitational force on it, at a height equal to half the radius of the earth?

NEET 2020 · PHASE 1

(a) 32 N (b) 30 N (c) 24 N (d) 48 N

45. The height at which the weight of a body becomes $\left(\frac{1}{16}\right)^{th}$, its weight on the surface of earth (radius R), is

AIPMT 2012 · PRELIMS

(a) 5R (b) 15R (c) 3R (d) 4R

46. A body of weight 72 N moves from the surface of earth at a height half of the radius of earth, then gravitational force exerted on it will be

AIPMT 2000

(a) 36 N (b) 32 N (c) 144 N (d) 50 N

47. The height in terms of radius of the earth (R), at which the acceleration due to gravity becomes $\frac{g}{9}$, where g is acceleration due to gravity on earth's surface, is ____.

JEE MAIN 2026 · 4 APR · SHIFT 2

(a) $\sqrt{3}R$ (b) $2\sqrt{2}R$ (c) $2R$ (d) $\frac{4}{9}R$

48. A 90 kg body placed at 2R distance from surface of earth experiences gravitational pull of: (R = Radius of earth, g = 10 m s^{-2})

JEE MAIN 2024 · 4 APR · SHIFT 2

(a) 300 N (b) 225 N (c) 100 N (d) 120 N

49. The weight of a body on the surface of the earth is 100 N. The gravitational force on it when taken at a height, from the surface of earth, equal to one-fourth the radius of the earth is:

JEE MAIN 2023 · 6 APR · SHIFT 2

(a) 50 N (b) 64 N (c) 25 N (d) 100 N

50. A body weight W, is projected vertically upwards from earth's surface to reach a height above the earth which is equal to nine times the radius of earth. The weight of the body at that height will be:

JEE MAIN 2023 · 31 JAN · SHIFT 2

(a) $\frac{W}{91}$ (b) $\frac{W}{3}$ (c) $\frac{W}{100}$ (d) $\frac{W}{9}$

51. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: A pendulum clock when taken to Mount Everest becomes fast.

Reason R: The value of g (acceleration due to gravity) is less at Mount Everest than its value on the surface of earth.

In the light of the above statements, choose the most appropriate answer from the options given below

JEE MAIN 2023 · 24 JAN · SHIFT 2

(a) Both A and R are correct but R is NOT the correct explanation of A
(b) A is correct but R is not correct
(c) Both A and R are correct and R is the correct

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explanation of A
(d) A is not correct but R is correct

52. The weight of a body at the surface of earth is 18 N. The weight of the body at an altitude of 3200 km above the earth's surface is (given, radius of earth $R_e = 6400$ km):
JEE MAIN 2023 · 24 JAN · SHIFT 1
(a) 9.8 N (b) 4.9 N (c) 19.6 N (d) 8 N

53. The percentage decrease in the weight of a rocket, when taken to a height of 32 km above the surface of earth will, be:
(Radius of earth = 6400 km)
JEE MAIN 2022 · 26 JUL · SHIFT 1
(a) 1% (b) 3% (c) 4% (d) 0.5%

54. The height of any point P above the surface of earth is equal to diameter of earth. The value of acceleration due to gravity at point P will be: (Given g = acceleration due to gravity at the surface of earth).
JEE MAIN 2022 · 25 JUN · SHIFT 1
(a) g/2 (b) g/4 (c) g/3 (d) g/9

55. The value of acceleration due to gravity at Earth's surface is 9.8 ms–2. The altitude above its surface at which the acceleration due to gravity decreases to 4.9 ms–2, is close to: (Radius of earth = 6.4 × 106 m)
JEE MAIN 2019 · 10 APR · SHIFT 1
(a) 1.6 × 106 m (b) 9.0 × 106 m
(c) 6.4 × 106 m (d) 2.6 × 106 m

56. The height at which the acceleration due to gravity becomes $\frac{g}{9}$ (where g = the acceleration due to gravity on the surface of the earth) in terms of R, the radius of the earth, is:
AIEEE 2009
(a) $\frac{R}{\sqrt{2}}$ (b) $R/2$ (c) $\sqrt{2}\,R$ (d) $2\,R$

◆ g below the surface (depth) 15 Qs

57. The depth at which the value of acceleration due to gravity becomes $\left(\frac{1}{n}\right)$ times the value at the surface of the earth is
(R = radius of the earth)
MHT CET 2025 · 25 APR · SHIFT 2
(a) $\frac{R(n-1)}{n}$ (b) $\frac{R(n+1)}{n}$ (c) $\frac{Rn}{(n-1)}$ (d) $\frac{R}{n}$

58. The depth 'd' at which the value of acceleration due to gravity becomes $\frac{1}{n-1}$ times the value at the earth's surface is (R = radius of the earth)
MHT CET 2024 · 11 MAY · SHIFT 1
(a) $R\left(\frac{n}{n-1}\right)$ (b) $R\left(\frac{n-2}{n-1}\right)$
(c) $R\left(\frac{2n-1}{n}\right)$ (d) $R\left(\frac{n-1}{2n-1}\right)$

59. A mine is located at depth $R/3$ below earth's surface. The acceleration due to gravity at that depth in mine is (R = radius of earth, g = acceleration due to gravity)
MHT CET 2023 · 13 MAY · SHIFT 2
(a) g (b) $3g$ (c) $\frac{2g}{3}$ (d) $\frac{g}{3}$

60. The depth at which acceleration due to gravity becomes $\frac{g}{2n}$ is (R = radius of earth, g = acceleration due to gravity on earth's surface, n is integer)
MHT CET 2023 · 12 MAY · SHIFT 2
(a) $\frac{R(1-2n)}{n}$ (b) $\frac{R(1-n)}{2n}$ (c) $\frac{R(n-1)}{n}$ (d) $\frac{R(2n-1)}{2n}$

61. A body weighs 300 N on the surface of the earth. How much will it weigh at a distance $\frac{R}{2}$ below the surface of earth? ($R \rightarrow$ Radius of earth)
MHT CET 2023 · 9 MAY · SHIFT 1
(a) 300 N (b) 250 N (c) 200 N (d) 150 N

62. A body weighs 500 N on the surface of the earth. At what distance below the surface of the earth it weighs 250 N? (Radius of earth, R = 6400 km)
MHT CET 2022 · 11 AUG · SHIFT 2
(a) 6400 km (b) 800 km (c) 1600 km (d) 3200 km

63. The depth from the surface of the earth of radius R, at which acceleration due to gravity will be 60% of the value on the earth surface is
MHT CET 2021 · 24 SEP · SHIFT 2
(a) $\frac{2R}{3}$ (b) $\frac{2R}{5}$ (c) $\frac{3R}{5}$ (d) $\frac{5R}{3}$

64. The depth at which acceleration due to gravity becomes $\frac{g}{n}$ is [R = radius of earth, g = acceleration due to gravity, n = integer]
MHT CET 2021 · 20 SEP · SHIFT 2
(a) $\frac{R(n-1)}{n}$ (b) $\frac{(n-1)}{nR}$ (c) $\frac{Rn}{(n-1)}$ (d) $\frac{n}{R(n-1)}$

65. The depth 'd' below the surface of the earth where the value of acceleration due to gravity becomes $\left(\frac{1}{n}\right)$ times the value at the surface of the earth is (R = radius of the earth)
MHT CET 2021 · 20 SEP · SHIFT 1
(a) $R\left(\frac{n-1}{n}\right)$ (b) $R\left(\frac{n}{n+1}\right)$ (c) $\frac{R}{n}$ (d) $\frac{R}{n^2}$

66. A hole is drilled half way to the centre of the earth. A body weighs 300 N on the surface of the earth. How much will, it weigh at the bottom of the hole?
MHT CET 2019 · 3 MAY · SHIFT 1
(a) 200 N (b) 250 N (c) 120 N (d) 150 N

67. What is the depth at which the value of acceleration due to gravity becomes $1/n$ times the value that at the surface of earth? (radius of earth = R)
NEET 2020 · PHASE 2
(a) R/n (b) R/n^2
(c) $R(n-1)/n$ (d) $Rn/(n-1)$

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68. A body weighs 200 N on the surface of earth. How much will it weigh half way down to the centre of the earth?

NEET 2019

(a) 200 N (b) 250 N (c) 100 N (d) 150 N

69. Assuming the earth to be a sphere of uniform mass density, a body weighed 300 N on the surface of earth. How much it would weigh at R/4 depth under surface of earth?

JEE MAIN 2024 · 6 APR · SHIFT 2

(a) 75 N (b) 375 N (c) 300 N (d) 225 N

70. Assuming the earth to be a sphere of uniform mass density, the weight of a body at a depth $d = \frac{R}{2}$ from the surface of earth, if its weight on the surface of earth is 200 N, will be:

(Given R = radius of earth)

JEE MAIN 2023 · 10 APR · SHIFT 1

(a) 100 N (b) 400 N (c) 300 N (d) 500 N

71. The weight of a body on the earth is 400 N. Then weight of the body when taken to a depth half of the radius of the earth will be:

JEE MAIN 2023 · 8 APR · SHIFT 1

(a) 300 N (b) 200 N (c) 100 N (d) Zero

◆ Height versus depth & the g-r graph 10 Qs

72. Select the correct statement out of the following

MHT CET 2026 · 20 APR · SHIFT 2

(a) Acceleration due to gravity decreases as we go up or down from earth's surface.
(b) Acceleration due to gravity is same at a height 'h' and depth 'd' from earth's surface, if $h = d$.
(c) Acceleration due to gravity at 640 km above the earth surface decreases by 10% of its value at earth's surface (earth's radius is 6400 km)
(d) There is reduction in acceleration due to gravity at poles due to rotation of earth as the poles are lying on the axis of rotation and do not revolve.

73. Given below are two statements:

Statement I: Acceleration due to earth's gravity decreases as you go 'up' or 'down' from earth's surface.

Statement II: Acceleration due to earth's gravity is same at a height 'h' and depths 'd' from earth's surface, if $h = d$.

In the light of above statements, choose the most appropriate answer from the options given below.

MHT CET 2026 · 11 APR · SHIFT 1

(a) Statement I is incorrect but statement II is correct
(b) Both statement I and statement II are incorrect
(c) Statement I is correct but statement II is incorrect
(d) Both Statement I and II are correct.

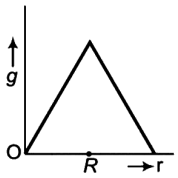
74. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth d below the surface of earth. Then

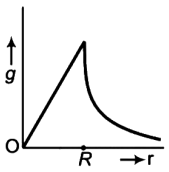
NEET 2017

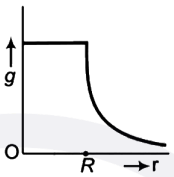
(a) d = 1 km (b) d = $\frac{3}{2}$ km (c) d = 2 km (d) d = $\frac{1}{2}$ km

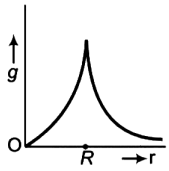
75. Starting from the centre of the earth having radius R, the variation of g (acceleration due to gravity) is shown by

NEET 2016 · PHASE 2

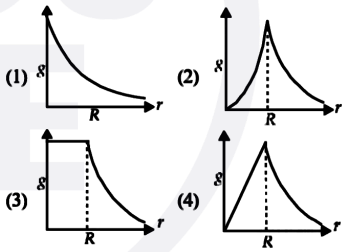
(a) 

(b) 

(c) 

(d) 

76. The dependence of acceleration due to gravity g on the distance r from the centre of the earth, assumed to be a sphere of radius R of uniform density is as shown in figures below



The correct figure is

AIPMT 2010 · MAINS

(a) (4) (b) (1) (c) (2) (d) (3)

77. Given below are two statements:

Statement I: Acceleration due to gravity is different at different places on the surface of earth. Statement II: Acceleration due to gravity increases as we go down below the earth's surface. In the light of the above statements, choose the correct answer from the options given below

JEE MAIN 2023 · 1 FEB · SHIFT 1

(a) Both Statement I and Statement II are true
(b) Both Statement I and Statement II are false
(c) Statement I is false but Statement II is true
(d) Statement I is true but Statement II is false

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78. Given below are two statements:

Statement I: Acceleration due to earth's gravity decreases as you go 'up' or 'down' from earth's surface.

Statement II: Acceleration due to earth's gravity is same at a height 'h' and depth 'd' from earth's surface, if h = d.

In the light of above statements, choose the most appropriate answer from the options given below

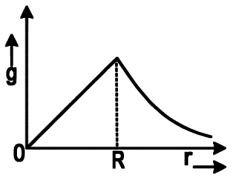
JEE MAIN 2023 · 24 JAN · SHIFT 2

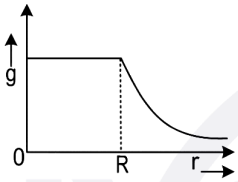
(a) Statement I is correct but statement II is incorrect
(b) Both Statement I and II are correct
(c) Statement I is incorrect but statement II is correct
(d) Both Statement I and Statement II are incorrect

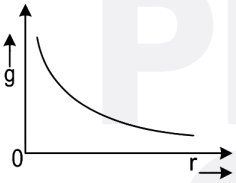
79. The variation of acceleration due to gravity (g) with distance (r) from the center of the earth is correctly represented by:

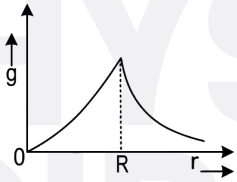
(Given R = radius of earth)

JEE MAIN 2022 · 26 JUN · SHIFT 1

(a) 

(b) 

(c) 

(d) 

80. If RE be the radius of Earth, then the ratio between the acceleration due to gravity at a depth 'r' below and a height 'r' above the earth surface is: (Given: r < RE)

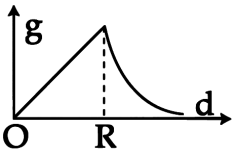
JEE MAIN 2021 · 31 AUG · SHIFT 2

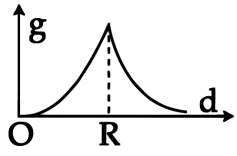
(a) $1-\frac{r}{R_E}-\frac{r^2}{R_E^2}-\frac{r^3}{R_E^3}$ (b) $1+\frac{r}{R_E}+\frac{r^2}{R_E^2}+\frac{r^3}{R_E^3}$

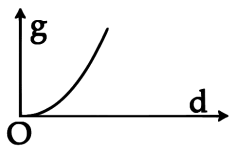
(c) $1+\frac{r}{R_E}-\frac{r^2}{R_E^2}+\frac{r^3}{R_E^3}$ (d) $1+\frac{r}{R_E}-\frac{r^2}{R_E^2}-\frac{r^3}{R_E^3}$

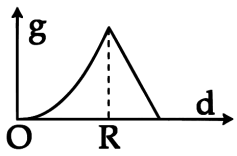
81. The variation of acceleration due to gravity g with distance d from centre of the earth is best represented by (R = Earth's radius):

JEE MAIN 2017

(a) 

(b) 

(c) 

(d) 

◆ Shape & rotation of the earth 3 Qs

82. As we go from the equator of the earth to pole of the earth, the value of acceleration due to gravity

MHT CET 2020 · 16 OCT · SHIFT 2

(a) decreases
(b) decreases up to latitude of 45° and increases thereafter
(c) remains same
(d) increases

83. Given below are two statements:

Statement I: Rotation of the earth shows effect on the value of acceleration due to gravity (g) Statement II: The effect of rotation of the earth on the value of 'g' at the equator is minimum and that at the pole is maximum.

In the light of the above statements, choose the correct answer from the options given below

JEE MAIN 2023 · 10 APR · SHIFT 2

(a) Statement I is false but statement II is true
(b) Statement I is true but statement II is false
(c) Both Statement I and Statement II are true
(d) Both Statement I and Statement II are false

84. Suppose that the angular velocity of rotation of earth is increased. Then, as a consequence:

JEE MAIN 2018 · 16 APR · SHIFT 1

(a) Weight of the object, everywhere on the earth, will increase.
(b) Weight of the object, everywhere on the earth, will decrease.
(c) There will be no change in weight anywhere on the earth.
(d) Except at poles, weight of the object on the earth will decrease.

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TOPIC 03

Gravitational Field

3 PYQs · Easy 3 · Medium 0 · Difficult 0 | MHT CET 0 · NEET 3 · JEE 0

Concepts covered: Field intensity & null point (1) · Field of sphere, shell & other bodies (2)

LEVEL 1 · EASY 3 questions

◆ Field intensity & null point 1 Q

85. A body of mass 60 g experiences a gravitational force of 3.0 N, when placed at a particular point. The magnitude of the gravitational field intensity at that point is

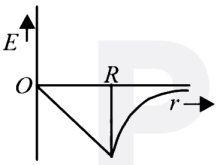
NEET 2022 · PHASE 1

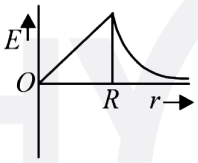
(a) 0.05 N/kg (b) 50 N/kg
(c) 20 N/kg (d) 180 N/kg

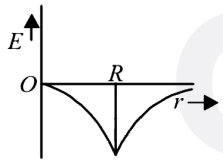
◆ Field of sphere, shell & other bodies 2 Qs

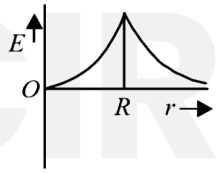
86. Dependence of intensity of gravitational field (E) of earth with distance (r) from centre of earth is correctly represented by

AIPMT 2014

(a) 

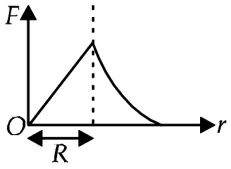
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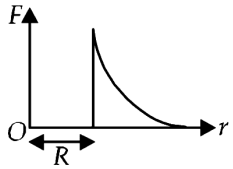
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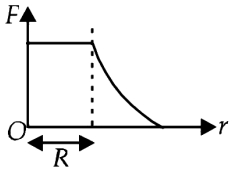
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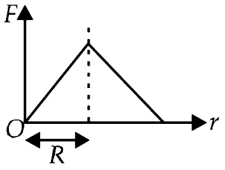
87. Which one of the following plots represents the variation of gravitiational field on a particle with distance r due to a thin spherical shell of radius R? (r is measured from the centre of the spherical shell)

AIPMT 2012 · MAINS

(a) 

(b) 

(c) 

(d) 

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TOPIC 04

Gravitational Potential & Energy

12 PYQs · Easy 12 · Medium 0 · Difficult 0 | MHT CET 2 · NEET 4 · JEE 6

Concepts covered: Gravitational potential (2) · Change in PE & work against gravity (10)

LEVEL 1 · EASY 12 questions

◆ Gravitational potential 2 Qs

88. If V is the gravitational potential due to sphere of uniform density on its surface, then its value at the center of sphere will be:-

JEE MAIN 2023 · 11 APR · SHIFT 2

(a) $\frac{3V}{2}$ (b) $\frac{V}{2}$ (c) $\frac{4}{3}$ V (d) V

89. Inside a uniform spherical shell:

(1) the gravitational field is zero

(2) the gravitational potential is zero

(3) the gravitational field is same everywhere

(4) the gravitational potential is same everywhere

(5) all of the above

Choose the most appropriate answer from the options given below:

JEE MAIN 2021 · 26 AUG · SHIFT 1

(a) (1), (3) and (4) only (b) (5) only

(c) (1), (2) and (3) only (d) (2), (3) and (4) only

◆ Change in PE & work against gravity 10 Qs

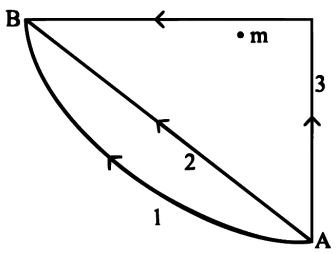
90. A body of mass m is taken from earth surface to a height h equal to twice the radius of earth, the increase in potential energy will be (g = acceleration due to gravity on earth's surface) (R - radius of earth)

MHT CET 2026 · 16 APR · SHIFT 2

(a) $\frac{2}{3}$ mgR (b) $\frac{1}{3}$ mgR (c) $\frac{1}{2}$ mgR (d) 3mgR

91. If W_1, W_2 and W_3 represent the work done in moving a particle from A to B along three different paths 1,2 and 3 (as shown in fig) in the gravitational field of the point mass ' m '. Find the correct relation between ' W_1 ', ' W_2 ' and ' W_3 '

MHT CET 2019 · 2 MAY · SHIFT 1



(a) $W_1 < W_3 < W_2$ (b) $W_1 < W_2 < W_3$

(c) $W_1 = W_2 = W_3$ (d) $W_1 > W_3 > W_2$

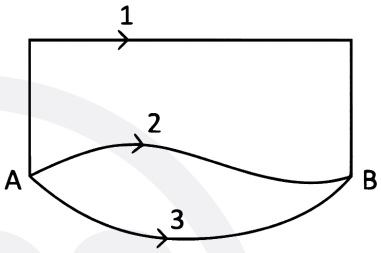
92. The amount of work done to raise a mass ' m ' from the surface of the Earth to a height equal to the radius of the Earth ' R ' will be

NEET 2026

(a) $2mgR$ (b) $mg\frac{R}{4}$ (c) mgR (d) $mg\frac{R}{2}$

93. A gravitational field is present in a region and a mass is shifted from A to B through different paths as shown. If W1, W2 and W3 represent the work done by the gravitational force along the respective paths, then:

NEET 2022 · PHASE 2



(a) W1 < W2 < W3 (b) W1 = W2 = W3

(c) W1 > W2 > W3 (d) W1 > W3 > W2

94. The work done to raise a mass m from the surface of the earth to a height h, which is equal to the radius of the earth, is:

NEET 2019

(a) mgR (b) 2mgR (c) $\frac{1}{2}$ mgR (d) $\frac{3}{2}$ mgR

95. A body of mass 'm' is taken from the earth's surface to the height equal to twice the radius (R) of the earth. The change in potential energy of body will be

NEET 2013

(a) 3mgR (b) $\frac{1}{3}$ mgR (c) mg2R (d) $\frac{2}{3}$ mgR

96. A body of mass m is taken from the surface of earth to a height equal to twice the radius of earth (R_e). The increase in potential energy will be ____.

(g is acceleration due to gravity at the surface of earth)

JEE MAIN 2026 · 5 APR · SHIFT 2

(a) $\frac{1}{2}mgR_e$ (b) $\frac{3}{4}mgR_e$ (c) $\frac{1}{4}mgR_e$ (d) $\frac{2}{3}mgR_e$

97. A body of mass m is taken from earth surface to the height h equal to twice the radius of earth (R_e), the increase in potential energy will be:

(g = acceleration due to gravity on the surface of Earth)

JEE MAIN 2023 · 25 JAN · SHIFT 2

(a) $\frac{1}{2}mgR_e$ (b) $3\,mgR_e$ (c) $\frac{1}{3}mgR_e$ (d) $\frac{2}{3}mgR_e$

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98. A particle of mass 10 g is kept on the surface of a uniform sphere of mass 100 kg and radius 10 cm. Find the work to be done against the gravitational force between them to take the particle far away from the sphere (you may take $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$)

AIEEE 2005

(a) $3.33 \times 10^{-10}\ J$ (b) $13.34 \times 10^{-10}\ J$
(c) $6.67 \times 10^{-10}\ J$ (d) $6.67 \times 10^{-9}\ J$

99. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth is

AIEEE 2004

(a) $\frac{1}{4}mgR$ (b) $2mgR$ (c) $\frac{1}{2}mgR$ (d) mgR

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TOPIC 05

Escape Velocity

36 PYQs · Easy 36 · Medium 0 · Difficult 0 | MHT CET 6 · NEET 12 · JEE 18

Concepts covered: Escape velocity & comparing planets (34) · Escape from an orbit, a height or two bodies (2)

LEVEL 1 · EASY 36 questions

◆ Escape velocity & comparing planets 34 Qs

100. The escape velocity of a satellite from the surface of earth does NOT depend on

MHT CET 2025 · 19 APR · SHIFT 2

(a) mass of the earth.
(b) mass of the object to be projected.
(c) radius of the earth.
(d) gravitational constant.

101. The radius of the planet is double that of the earth, but their average densities are same. V_p and V_E are the escape velocities of planet and earth respectively. If $\frac{V_P}{V_E} = x$, the value of ' x ' is

MHT CET 2024 · 9 MAY · SHIFT 2

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$ (c) 2 (d) 4

102. The escape velocity from earth surface is 11 km/s. The escape velocity from a planet having twice the radius and same mean density as earth is

MHT CET 2024 · 4 MAY · SHIFT 2

(a) 22 km/s (b) 11 km/s
(c) 5.5 km/s (d) 15.5 km/s

103. The radius of a planet is twice the radius of the earth. Both have almost equal average mass densities. If 'V_P' and 'V_E' are escape velocities of the planet and the earth respectively, then

MHT CET 2021 · 23 SEP · SHIFT 1

(a) $V_E = 1.5\ V_P$ (b) $V_P = 1.5\ V_E$
(c) $V_P = 2V_E$ (d) $V_E = 3V_P$

104. The mass of a planet is six times that of the earth. The radius of the planet is twice that of the earth. If the escape velocity from the earth is 'V_e', then the escape velocity from the planet is

MHT CET 2021 · 22 SEP · SHIFT 1

(a) $\sqrt{3}\ V_e$ (b) $\sqrt{2}\ V_e$ (c) V_e (d) $\sqrt{5}\ V_e$

105. The escape velocity of a body from any planet, whose mass is six times the mass of earth and radius is twice the radius of earth will (v_e = escape velocity of a body from the earth's surface)

MHT CET 2020 · 19 OCT · SHIFT 2

(a) $2\sqrt{2}v_e$ (b) $\frac{3}{2}v_e$ (c) $2v_e$ (d) $\sqrt{3}v_e$

106. Two planets P_1 and P_2 with equal mass have radii R_1 and R_2, respectively, where $R_2 = \frac{R_1}{2}$. The escape speeds of P_1 and P_2 are v_1 and v_2, respectively. Then $\frac{v_2}{v_1}$ is:

RE-NEET 2026

(a) 2 (b) $\frac{1}{\sqrt{2}}$ (c) 1 (d) $\sqrt{2}$

107. The escape velocity for earth is v. A planet having 9 times mass that of earth and radius, 16 times that of earth, has the escape velocity of:

NEET 2024

(a) $\frac{v}{3}$ (b) $\frac{2v}{3}$ (c) $\frac{3v}{4}$ (d) $\frac{9v}{4}$

108. The escape velocity from the Earth's surface is v. The escape velocity from the surface of another planet having a radius, four times that of Earth and same mass density is:

NEET 2021

(a) $4v$ (b) v (c) $2v$ (d) $3v$

109. The ratio of escape velocity at earth (ve) to the escape velocity at a planet (vp) whose radius and mean density are twice as that of earth is

NEET 2016 · PHASE 1

(a) 1: 4 (b) 1: $\sqrt{2}$ (c) 1: 2 (d) 1: $2\sqrt{2}$

110. The radius of a planet is twice the radius of earth. Both have almost equal average mass densities. VP and VE are escape velocities of the planet and the earth, respectively, then

NEET 2013

(a) VP = 1.5 VE (b) VP = 2 VE
(c) VE = 3 VP (d) VE = 1.5 VP

111. A particle of mass m is thrown upwards from the surface of the earth, with a velocity u. The mass and the radius of the earth are, respectively, M and R. G is gravitational constant and g is acceleration due to gravity on the surface of the earth. The minimum value of u so that the particle does not return back to earth, is

AIPMT 2011 · MAINS

(a) $\sqrt{\frac{2GM}{R^2}}$ (b) $\sqrt{\frac{2GM}{R}}$ (c) $\sqrt{\frac{2gM}{R^2}}$ (d) $\sqrt{2gR^2}$

112. For a planet having mass equal to mass of the earth but radius is one fourth of radius of the earth. Then escape velocity for this planet will be

AIPMT 2000

(a) 11.2 km/sec (b) 22.4 km/sec
(c) 5.6 km/sec (d) 44.8 km/sec.

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113. The escape velocity of a sphere of mass m is given by (G = universal gravitational constant, M_e = mass of earth and R_e = radius of earth)

AIPMT 1999

(a) $\sqrt{\frac{GM_e}{R_e}}$ (b) $\sqrt{\frac{2GM_e}{R_e}}$

(c) $\sqrt{\frac{2Gm}{R_e}}$ (d) $\frac{GM_e}{R_e^2}$

114. The escape velocity of a body on the surface of the earth is $11.2\,\text{km/s}$. If the earth's mass increases to twice its present value and radius of the earth becomes half, the escape velocity becomes

AIPMT 1997

(a) $22.4\,\text{km/s}$ (b) $44.8\,\text{km/s}$

(c) $5.6\,\text{km/s}$ (d) $11.2\,\text{km/s}$

115. The escape velocity from earth is $11.2\,\text{km/s}$. If a body is to be projected in a direction making an angle 45° to the vertical, then the escape velocity is

AIPMT 1993

(a) $11.2 \times 2\,\text{km/s}$ (b) $11.2\,\text{km/s}$

(c) $11.2/\sqrt{2}\,\text{km/s}$ (d) $11.2\sqrt{2}\,\text{km/s}$

116. For a satellite escape velocity is $11\,\text{km/s}$. If the satellite is launched at an angle of 60° with the vertical, then escape velocity will be

AIPMT 1989

(a) $11\,\text{km/s}$ (b) $11\sqrt{3}\,\text{km/s}$

(c) $\frac{11}{\sqrt{3}}\,\text{km/s}$ (d) $33\,\text{km/s}$

117. The escape velocity from a spherical planet A is $10\,\text{km/s}$. The escape velocity from another planet B whose density and radius are 10% of those of planet A, is ____ m/s.

JEE MAIN 2026 · 22 JAN · SHIFT 1

(a) 1000 (b) $200\sqrt{5}$

(c) $1000\sqrt{2}$ (d) $100\sqrt{10}$

118. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason **R**

Assertion A: The kinetic energy needed to project a body of mass m from earth surface to infinity is $\frac{1}{2}$mgR, where R is the radius of earth.

Reason R: The maximum potential energy of a body is zero when it is projected to infinity from earth surface.

In the light of the above statements, choose the correct answer from the options given below

JEE MAIN 2025 · 4 APR · SHIFT 1

(a) **A** is false but **R** is true

(b) Both **A** and **R** are true and **R** is the correct explanation of **A**

(c) **A** is true but **R** is false

(d) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

119. Earth has mass 8 times and radius 2 times that of a planet. If the escape velocity from the earth is 11.2 km/s, the escape velocity in km/s from the planet will be:

JEE MAIN 2025 · 28 JAN · SHIFT 2

(a) 8.4 (b) 11.2 (c) 5.6 (d) 2.8

120. To project a body of mass m from earth's surface to infinity, the required kinetic energy is (assume, the radius of earth is R_E, g = acceleration due to gravity on the surface of earth):

JEE MAIN 2024 · 6 APR · SHIFT 1

(a) $1/2mgR_E$ (b) $4mgR_E$

(c) mgR_E (d) $2mgR_E$

121. The mass of the moon is $\frac{1}{144}$ times the mass of a planet and its diameter is $\frac{1}{16}$ times the diameter of a planet. If the escape velocity on the planet is v, the escape velocity on the moon will be:

JEE MAIN 2024 · 31 JAN · SHIFT 2

(a) $\frac{v}{4}$ (b) $\frac{v}{6}$ (c) $\frac{v}{12}$ (d) $\frac{v}{3}$

122. Escape velocity of a body from earth is $11.2\,\text{km/s}$. If the radius of a planet be one-third the radius of earth and mass be one-sixth that of earth, the escape velocity from the planet is:

JEE MAIN 2024 · 30 JAN · SHIFT 2

(a) 7.9 km/s (b) 8.4 km/s

(c) 4.2 km/s (d) 11.2 km/s

123. Given below are two statements:

Statement I: For a planet, if the ratio of mass of the planet to its radius increases, the escape velocity from the planet also increases.

Statement II: Escape velocity is independent of the radius of the planet.

In the light of above statements, choose the most appropriate answer form the options given below

JEE MAIN 2023 · 13 APR · SHIFT 2

(a) Both Statement I and Statement II are correct

(b) Statement I is correct but statement II is incorrect

(c) Both Statement I and Statement II are incorrect

(d) Statement I is incorrect but statement II is correct

124. A planet having mass 9Me and radius 4R_e, where Me and Re are mass and radius of earth respectively, has escape velocity in km/s given by:

(Given escape velocity on earth $\text{V}_e = 11.2 \times 10^3\,\text{m/s}$)

JEE MAIN 2023 · 13 APR · SHIFT 1

(a) 33.6 (b) 11.2 (c) 16.8 (d) 67.2

125. The ratio of escape velocity of a planet to the escape velocity of earth will be:-

Given: Mass of the planet is 16 times mass of earth and radius of the planet is 4 times the radius of earth.

JEE MAIN 2023 · 12 APR · SHIFT 1

(a) 1 : 4 (b) $1 : \sqrt{2}$ (c) 4 : 1 (d) 2 : 1

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126. Given below are two statements: one is labelled as Assertion **A** and the other is labelled as Reason **R**.
Assertion A: Earth has atmosphere whereas moon doesn't have any atmosphere. Reason R: The escape velocity on moon is very small as compared to that on earth. In the light of the above statements, choose the correct answer from the options given below:
JEE MAIN 2023 · 6 APR · SHIFT 1
(a) **A** is false but **R** is true
(b) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**
(c) Both **A** and **R** are correct and **R** is the correct explanation of **A**
(d) **A** is true but **R** is false

127. If earth has a mass nine times and radius twice to that of a planet P. Then $\frac{v_e}{3}\sqrt{x}\ \text{ms}^{-1}$ will be the minimum velocity required by a rocket to pull out of gravitational force of P, where v_e is escape velocity on earth. The value of x is
JEE MAIN 2023 · 1 FEB · SHIFT 1
(a) 1 (b) 3 (c) 2 (d) 18

128. The escape velocity of a body on a planet 'A' is 12 kms $^{-}$1. The escape velocity of the body on another planet 'B', whose density is four times and radius is half of the planet 'A', is:
JEE MAIN 2022 · 29 JUN · SHIFT 1
(a) 12 kms^{-}1 (b) 24 kms^{-}1
(c) 36 kms^{-}1 (d) 6 kms^{-}1

129. Planet A has mass M and radius R. Planet B has half the mass and half the radius of Planet A. If the escape velocities from the Planets A and B are vA and vB, respectively, then $\frac{v_A}{v_B} = \frac{n}{4}$. The value of n is:
JEE MAIN 2020 · 9 JAN · SHIFT 2
(a) 1 (b) 2 (c) 4 (d) 3

130. A planet in a distant solar system is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is 11 $km\,s^{-1}$, the escape velocity from the surface of the planet would be
AIEEE 2008
(a) 1.1 $km\,s^{-1}$ (b) 100 $km\,s^{-1}$
(c) 110 $km\,s^{-1}$ (d) 0.11 $km\,s^{-1}$

131. The escape velocity for a body projected vertically upwards from the surface of earth is 11 km/s. If the body is projected at an angle of 45° with the vertical, the escape velocity will be
AIEEE 2003
(a) $11\sqrt{2}\ km/s$ (b) 22 km/s
(c) 11 km/s (d) $\frac{11}{\sqrt{2}} km/s$

132. The kinetic energy needed to project a body of mass m from the earth surface (radius R) to infinity is
AIEEE 2002
(a) $mgR/2$ (b) $2mgR$ (c) mgR (d) $mgR/4$

133. The escape velocity of a body depends upon mass as
AIEEE 2002
(a) m^0 (b) m^1 (c) m^2 (d) m^3

◆ Escape from an orbit, a height or two bodies 2 Qs

134. If v_e is escape velocity and v_o is orbital velocity of a satellite for orbit close to the earth's surface, then these are related by
AIPMT 2012 · MAINS
(a) $v_o = \sqrt{2v_e}$ (b) vo = ve
(c) $v_e = \sqrt{2v_o}$ (d) $v_e = \sqrt{2}v_o$

135. A body is moving in a low circular orbit about a planet of mass M and radius R. The radius of the orbit can be taken to be R itself. Then the ratio of the speed of this body in the orbit to the escape velocity from the planet is:
JEE MAIN 2020 · 4 SEP · SHIFT 2
(a) 2 (b) 1 (c) $\sqrt{2}$ (d) $\frac{1}{\sqrt{2}}$

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TOPIC 06

Kepler's Laws & Planetary Motion

21 PYQs · Easy 21 · Medium 0 · Difficult 0 | MHT CET 3 · NEET 7 · JEE 11

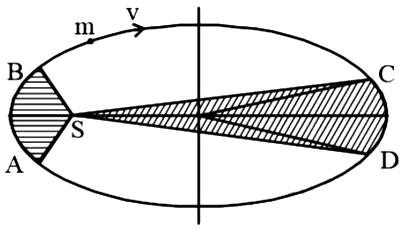
Concepts covered: Law of orbits & law of areas (7) · Law of periods (10) · Perigee & apogee: speeds & energies (2) · Solar-system estimates (2)

LEVEL 1 · EASY 21 questions

◆ Law of orbits & law of areas 7 Qs

136. The figure shows elliptical orbit of a planet m about the sun S. The shaded area SCD is twice the shaded area SAB. If t1 is the time for the planet to move from C to D and t2 is the time to move from A to B then

AIPMT 2009



(a) t1 = 4t2 (b) t1 = 2t2 (c) t1 = t2 (d) t1 > t2

137. The earth (mass $= 6 \times 10^{24}$ kg) revolves around the sun with an angular velocity of 2×10^{-7} rad/s in a circular orbit of radius 1.5×10^{8} km. The force exerted by the sun on the earth, in newton, is

AIPMT 1995

(a) 36×10^{21} (b) 27×10^{39}
(c) zero (d) 18×10^{25}

138. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): The radius vector from the Sun to a planet sweeps out equal areas in equal intervals of time and thus areal velocity of planet is constant.

Reason (R): For a central force field the angular momentum is a constant.

In the light of the above statements, choose the most appropriate answer from the options given below:

JEE MAIN 2025 · 7 APR · SHIFT 2

(a) (A) is not correct but (R) is correct
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(c) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(d) (A) is correct but (R) is not correct

139. Choose the incorrect statement from the following:

JEE MAIN 2023 · 6 APR · SHIFT 2

(a) The linear speed of a planet revolving around the sun remains constant.
(b) When a body falls towards earth, the displacement of earth towards the body is negligible.
(c) The speed of satellite in a given circular orbit remains constant.
(d) For a planet revolving around the sun in an elliptical orbit, the total energy of the planet remains constant.

140. Every planet revolves around the sun in an elliptical orbit :-

A. The force acting on a planet is inversely proportional to square of distance from sun. B. Force acting on planet is inversely proportional to product of the masses of the planet and the sun.

C. The Centripetal force acting on the planet is directed away from the sun.

D. The square of time period of revolution of planet around sun is directly proportional to cube of semi-major axis of elliptical orbit.

Choose the correct answer from the options given below:

JEE MAIN 2023 · 25 JAN · SHIFT 2

(a) C and D only (b) B and C only
(c) A and D only (d) A and C only

141. The angular momentum of a planet of mass M moving around the sun in an elliptical orbit is $\vec{L}$. The magnitude of the areal velocity of the planet is:

JEE MAIN 2021 · 18 MAR · SHIFT 2

(a) $\frac{2L}{M}$ (b) $\frac{L}{2M}$ (c) $\frac{L}{M}$ (d) $\frac{4L}{M}$

142. A planet revolving in elliptical orbit has:

A. a constant velocity of revolution.

B. has the least velocity when it is nearest to the sun.

C. its areal velocity is directly proportional to its velocity.

D. areal velocity is inversely proportional to its velocity.

E. to follow a trajectory such that the areal velocity is constant.

Choose the correct answer from the options given below:

JEE MAIN 2021 · 26 FEB · SHIFT 1

(a) D only (b) E only (c) C only (d) A only

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◆ Law of periods 10 Qs

143. The period of a planet around the sun is 8 times that of earth. The ratio of radius of planet's orbit to the radius of the earth's orbit is
MHT CET 2024 · 9 MAY · SHIFT 1
(a) 4 (b) 8 (c) 16 (d) 64

144. The period of revolution of planet A around the sun is 8 times that of planet B. How many times the distance of A from the sun is greater than that of B from the sun?
MHT CET 2021 · 24 SEP · SHIFT 1
(a) 5 times (b) 2 times (c) 3 times (d) 6 times

145. In a solar system, the time-period of revolution of a planet tracing a circular orbit of radius R is proportional to:
RE-NEET 2026
(a) R^3 (b) $R^{1/2}$ (c) $R^{3/2}$ (d) R^2

146. The period of revolution of planet A around the sun is 8 times that of B. The distance of A from the sun is how many times greater than that of B from the sun?
AIPMT 1997
(a) 4 (b) 5 (c) 2 (d) 3

147. The distance of two planets from the sun are 10^{13} m and 10^{12} m respectively. The ratio of time periods of the planets is
AIPMT 1994
(a) $\sqrt{10}$ (b) $10\sqrt{10}$ (c) 10 (d) $\frac{1}{\sqrt{10}}$

148. The distance of two planets from the sun are 10^{13} m and 10^{12} m respectively. The ratio of time periods of the planets is
AIPMT 1988
(a) $\sqrt{10}$ (b) $10\sqrt{10}$ (c) 10 (d) $\frac{1}{\sqrt{10}}$

149. A planet takes 200 days to complete one revolution around the Sun. If the distance of the planet from Sun is reduced to one fourth of the original distance, how many days will it take to complete one revolution:
JEE MAIN 2024 · 29 JAN · SHIFT 2
(a) 20 (b) 50 (c) 100 (d) 25

150. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A): The angular speed of the moon in its orbit about the earth is more than the angular speed of the earth in its orbit about the sun.
Reason (R): The moon takes less time to move around the earth than the time taken by the earth to move around the sun.
In the light of the above statements, choose the most appropriate answer from the options given below:
JEE MAIN 2024 · 27 JAN · SHIFT 2
(a) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(b) (A) is correct but (R) is not correct
(c) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(d) (A) is not correct but (R) is correct

151. Two planets A and B of equal mass are having their period of revolutions TA and TB such that TA = 2TB. These planets are revolving in the circular orbits of radii rA and rB respectively. Which out of the following would be the correct relationship of their orbits?
JEE MAIN 2022 · 28 JUN · SHIFT 1
(a) $2r_A^2 = r_B^3$
(b) $r_A^3 = 2r_B^3$
(c) $r_A^3 = 4r_B^3$
(d) $T_A^2 - T_B^2 = \frac{\pi^2}{GM}\left(r_B^3 - 4r_A^3\right)$

152. The distance between Sun and Earth is R. The duration of year if the distance between Sun and Earth becomes 3R will be:
JEE MAIN 2022 · 24 JUN · SHIFT 2
(a) $\sqrt{3}$ years (b) 3 years
(c) 9 years (d) $3\sqrt{3}$ years

◆ Perigee & apogee: speeds & energies 2 Qs

153. A planet moving along an elliptical orbit is closest to the sun at a distance r1 and farthest away at a distance of r2. If $v1$ and $v2$ are the linear velocities at these points respectively, then the ratio $\frac{v_1}{v_2}$ is
AIPMT 2011 · PRELIMS
(a) (r1 /r2)2 (b) r2/r1
(c) (r2/r1)2 (d) r1/r2

154. The maximum and minimum distances of a comet from the Sun are 1.6 × 1012 m and 8.0 × 1010 m respectively. If the speed of the comet at the nearest point is 6 × 104 ms−1, the speed at the farthest point is:
JEE MAIN 2021 · 16 MAR · SHIFT 1
(a) 3.0 × 103 m/s (b) 6.0 × 103 m/s
(c) 1.5 × 103 m/s (d) 4.5 × 103 m/s

◆ Solar-system estimates 2 Qs

155. The radius of the earth and the radius of orbit around the sun are 6371 km and 149×10^6 km respectively. The order of magnitude of the diameter of the orbit is greater than that of earth by
MHT CET 2019 · 2 MAY · SHIFT 1
(a) 10^3 (b) 10^2 (c) 10^4 (d) 10^5

156. The distance of the Sun from earth is 1.5 × 1011 m and its angular diameter is (2000)″ when observed from the earth. The diameter of the Sun will be:
JEE MAIN 2022 · 27 JUN · SHIFT 2
(a) 2.45 × 1010 m (b) 1.45 × 1010 m
(c) 1.45 × 109 m (d) 0.14 × 109 m

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TOPIC 07

Satellites - Orbital Velocity & Period

34 PYQs · Easy 34 · Medium 0 · Difficult 0 | MHT CET 14 · NEET 5 · JEE 15

Concepts covered: Orbital velocity (15) · Time period of a satellite (14) · Height of a satellite & geostationary orbit (5)

LEVEL 1 · EASY 34 questions

◆ Orbital velocity 15 Qs

157. Two planets A and B are orbiting around the sun. The distances of the two planets A and B from the sun are r_A and r_B respectively. Also $r_B = 225\, r_A$. If the orbital speed of the planet A is 'V' then the orbital speed of planet B will be

MHT CET 2026 · 17 APR · SHIFT 2

(a) $\frac{V}{3}$ (b) $\frac{V}{5}$ (c) $\frac{V}{15}$ (d) $\sqrt{15}\,V$

158. The distance of the two planets A and B from the sun are 'r_A' and 'r_B' respectively such that $r_B = 100\, r_A$. The ratio of the speed of planet A to that of planet B is (both the planets are revolving around the sun)

MHT CET 2026 · 15 APR · SHIFT 2

(a) $\frac{1}{\sqrt{10}}$ (b) $\sqrt{10}$ (c) 10 (d) $10\sqrt{10}$

159. Two satellites P and Q go round a planet in circular orbits having radii '$3R$' and 'R' respectively. If the speed of satellite P is '$2V$', the speed of the satellite Q will be

MHT CET 2025 · 22 APR · SHIFT 1

(a) $2\sqrt{3}$ V (b) $\frac{2\,\mathrm{V}}{\sqrt{3}}$ (c) $\frac{\mathrm{V}}{2}$ (d) $\frac{\mathrm{V}}{\sqrt{3}}$

160. The radii of circular orbits of two satellites A and B of the earth are '$4R$' and 'R' respectively, where R is the radius of earth. If the speed of satellite B is 6 V, then the speed of satellite A will be

MHT CET 2025 · 21 APR · SHIFT 2

(a) 3 V (b) 4 V (c) 12 V (d) $\frac{3}{4}$ V

161. The distance of the two planets A and B from the sun are r_A and r_B respectively. Also r_B is equal to $100 r_A$. If the orbital speed of the planet A is 'v' then the orbital speed of the planet B is

MHT CET 2024 · 3 MAY · SHIFT 1

(a) $\frac{v}{10}$ (b) $\frac{v}{2}$ (c) $\sqrt{2}v$ (d) 10 v

162. A satellite moves in a stable circular orbit round the earth if (where $\mathrm{V_H}, \mathrm{V_c}$ and $\mathrm{V_e}$ are the horizontal velocity, critical velocity and escape velocity respectively)

MHT CET 2023 · 10 MAY · SHIFT 1

(a) $\mathrm{V_H} < \mathrm{V_c}$ (b) $\mathrm{V_H} = \mathrm{V_e}$
(c) $V_H = V_c$ (d) $V_H > V_e$

163. The radii of circular orbits of two satellites A and B of the earth, are 4R and R, respectively. If the speed of satellite A is 3V, then the speed of satellite B will be

AIPMT 2010 · PRELIMS

(a) $\frac{3V}{4}$ (b) $6V$ (c) $12V$ (d) $\frac{3V}{2}$

164. Two satellites of earth, S1 and S2 are moving in the same orbit. The mass of S1 is four times the mass of S2. Which one of the following statements is true?

AIPMT 2007

(a) The potential energies of earth and satellite in the two cases are equal.
(b) S1 and S2 are moving with the same speed.
(c) The kinetic energies of the two satellites are equal.
(d) The time period of S1 is four times that of S2.

165. A ball is dropped from a spacecraft revolving around the earth at a height of 120 km. What will happen to the ball?

AIPMT 1996

(a) it will fall down to the earth gradually
(b) it will go very far in the space
(c) it will continue to move with the same speed along the original orbit of spacecraft
(d) it will move with the same speed, tangentially to the spacecraft

166. Two satellite A and B go round a planet in circular orbits having radii 4R and R respectively. If the speed of A is $3v$, the speed of B will be:

JEE MAIN 2024 · 8 APR · SHIFT 2

(a) $6v$ (b) $\frac{4}{3}v$ (c) $3v$ (d) $12v$

167. Two satellites A and B move round the earth in the same orbit. The mass of A is twice the mass of B. The quantity which is same for the two satellites will be

JEE MAIN 2023 · 12 APR · SHIFT 1

(a) Potential energy (b) Kinetic energy
(c) Total energy (d) Speed

168. Two satellites of masses m and 3m revolve around the earth in circular orbits of radii r & 3r respectively. The ratio of orbital speeds of the satellites respectively is

JEE MAIN 2023 · 10 APR · SHIFT 1

(a) 3: 1 (b) $\sqrt{3}$: 1 (c) 1: 1 (d) 9: 1

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169. A satellite of mass m revolves around the earth of radius R at a height x from its surface. If g is the acceleration due to gravity on the surface of the earth, the orbital speed of the satellite is

AIEEE 2004

(a) $\frac{gR^2}{R+x}$ (b) $\frac{gR}{R-x}$

(c) gx (d) $\left(\frac{gR^2}{R+x}\right)^{1/2}$

170. If suddenly the gravitational force of attraction between Earth and a satellite revolving around it becomes zero, then the satellite will

AIEEE 2002

(a) continue to move in its orbit with same velocity

(b) move tangentially to the original orbit with the same velocity

(c) become stationary in its orbit

(d) move towards the earth

171. Two satellites S1 and S2 are revolving in circular orbits around a planet with radius R1 = 3200 km and R2 = 800 km respectively. The ratio of speed of satellite S1 to be speed of satellite S2 in their respective orbits would be $\frac{1}{x}$ where x = _____.

JEE MAIN 2022 · 25 JUN · SHIFT 2 *(Numerical)*

◆ Time period of a satellite 14 Qs

172. A satellite is revolving around a planet in a circular orbit close to its surface. Let ρ be mean density and R be the radius of the planet; then the period of the satellite is

(G = Universal constant of gravitation).

MHT CET 2026 · 19 APR · SHIFT 2

(a) $\sqrt{\frac{4\pi}{\rho G}}$ (b) $\sqrt{\frac{2\pi}{\rho G}}$ (c) $\sqrt{\frac{\pi}{\rho G}}$ (d) $\sqrt{\frac{3\pi}{\rho G}}$

173. The time period of a satellite of earth is 24 hours. If the separation between the earth and the satellite is decreased to one fourth of the previous value then its new time period will become

MHT CET 2025 · 20 APR · SHIFT 2

(a) 3 hours (b) 6 hours (c) 24 hours (d) 12 hours

174. A satellite is orbiting just above the surface of the planet of density ' ρ ' with periodic time ' T '. The quantity $T^2\rho$ is equal to (G = universal gravitational constant)

MHT CET 2024 · 16 MAY · SHIFT 1

(a) $\frac{4\pi^2}{G}$ (b) $\frac{3\pi^2}{G}$ (c) $\frac{3\pi}{G}$ (d) $\frac{\pi}{G}$

175. A satellite is revolving around a planet in a circular orbit close to its surface. Let ' ρ ' be the mean density and ' R ' be the radius of the planet. Then the period of the satellite is (G = universal constant of gravitation)

MHT CET 2024 · 9 MAY · SHIFT 2

(a) $\sqrt{\frac{4\pi}{\rho G}}$ (b) $\sqrt{\frac{\pi}{\rho G}}$ (c) $\sqrt{\frac{3\pi}{\rho G}}$ (d) $\sqrt{\frac{2\pi}{\rho G}}$

176. The time period of a satellite of earth is 5 hours. If the separation between the earth and the satellite is increased to four times the previous value, the new time period of the satellite will be

MHT CET 2021 · 23 SEP · SHIFT 2

(a) 20 hours (b) 40 hours (c) 80 hours (d) 10 hours

177. A satellite is orbiting just above the surface of the earth with period T. If d is the density of the earth and G is the universal constant of gravitation, the quantity $\frac{3\pi}{Gd}$ represents:

NEET 2023

(a) T^2 (b) T^3 (c) $\sqrt{T}$ (d) T

178. Given below are two statements:

Statement I: A satellite is moving around earth in the orbit very close to the earth surface. The time period of revolution of satellite depends upon the density of earth.

Statement II: The time period of revolution of the satellite is $T = 2\pi\sqrt{\frac{R_e}{g}}$ (for satellite very close to the earth surface), where R_e radius of earth and g acceleration due to gravity. In the light of the above statements, choose the correct answer from the options given below:

JEE MAIN 2026 · 22 JAN · SHIFT 2

(a) Statement I is true but Statement II is false

(b) Statement I is false but Statement II is true

(c) Both Statement I and Statement II are true

(d) Both Statement I and Statement II are false

179. If a satellite orbiting the Earth is 9 times closer to the Earth than the Moon, what is the time period of rotation of the satellite? Given rotational time period of Moon = 27 days and gravitational attraction between the satellite and the moon is neglected.

JEE MAIN 2025 · 23 JAN · SHIFT 2

(a) 3 days (b) 27 days (c) 81 days (d) 1 day

180. The time period of a satellite of earth is 24 hours. If the separation between the earth and the satellite is decreased to one fourth of the previous value, then its new time period will become.

JEE MAIN 2023 · 29 JAN · SHIFT 2

(a) 12 hours (b) 3 hours (c) 6 hours (d) 4 hours

181. The time period of a satellite revolving around earth in a given orbit is 7 hours. If the radius of orbit is increased to three times its previous value, then approximate new time period of the satellite will be

JEE MAIN 2022 · 29 JUN · SHIFT 2

(a) 40 hours (b) 36 hours (c) 30 hours (d) 25 hours

182. The time period of a satellite in a circular orbit of radius R is T. The period of another satellite in a circular orbit of radius 9R is:

JEE MAIN 2021 · 18 MAR · SHIFT 1

(a) 9 T (b) 27 T (c) 12 T (d) 3 T

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183. Consider two satellites S1 and S2 with periods of revolution 1 hr. and 8 hr. respectively revolving around a planet in circular orbits. The ratio of angular velocity of satellite S1 to the angular velocity of satellite S2 is:

JEE MAIN 2021 · 24 FEB · SHIFT 1

(a) 1: 4 (b) 8: 1 (c) 2: 1 (d) 1: 8

184. The time period of an earth satellite in circular orbit is independent of

AIEEE 2004

(a) both the mass and radius of the orbit
(b) radius of its orbit
(c) the mass of the satellite
(d) neither the mass of the satellite nor the radius of its orbit

185. The time period of satellite of earth is 5 hours. If the separation between the earth and the satellite is increased to 4 times the previous value, the new time period will become

AIEEE 2003

(a) 10 hours (b) 80 hours (c) 40 hours (d) 20 hours

◆ Height of a satellite & geostationary orbit 5 Qs

186. The geostationary satellite is revolving round the earth of mean radius R. If g is the acceleration due to gravity at earth's surface, ω is the angular speed of rotation of earth about its own axis and r is the radius of orbit of a satellite, then the correct relation between r, ω, g and R is

MHT CET 2026 · 20 MAY · SHIFT 1

(a) $r^2 = \frac{gR^2}{w^3}$ (b) $R^2 = \frac{r^3w^2}{g}$
(c) $R^3 = \frac{r^2w}{g^2}$ (d) $R = \sqrt{\frac{rw^3}{g}}$

187. If mean radius of earth is 'R', its angular velocity is 'ω' and acceleration due to gravity at the surface of the earth is 'g' then the cube of the radius of the orbit of geostationary satellite will be

MHT CET 2026 · 13 MAY · SHIFT 1

(a) $\frac{R^2\omega^2}{g}$ (b) $\frac{R^2g^2}{\omega^2}$ (c) $\frac{R^2g}{\omega}$ (d) $\frac{R^2g}{\omega^2}$

188. The radius of the orbit of a geostationary satellite is (mean radius of earth is 'R', angular velocity about own axis is 'ω' and acceleration due to gravity on earth's surface is 'g')

MHT CET 2023 · 11 MAY · SHIFT 2

(a) $\left(\frac{gR^2}{\omega^2}\right)^{\frac{1}{3}}$ (b) $\left(\frac{gR^2}{\omega^2}\right)^{\frac{2}{3}}$ (c) $\left(\frac{gR^2}{\omega^2}\right)^{\frac{1}{2}}$ (d) $\frac{gR^2}{\omega^2}$

189. The mean radius of earth is R, its angular speed on its own axis is ω and the acceleration due to gravity at earth's surface is g. What will be the radius of the orbit of a geostationary satellite?

AIPMT 1992

(a) $(R^2g/\omega^2)^{1/3}$ (b) $(Rg/\omega^2)^{1/3}$
(c) $(R^2\omega^2/g)^{1/3}$ (d) $(R^2g/\omega)^{1/3}$

190. Correct formula for height of a satellite from earth's surface is:

JEE MAIN 2024 · 4 APR · SHIFT 2

(a) $\left(\frac{T^2R^2g}{4\pi^2}\right)^{1/3} - R$ (b) $\left(\frac{T^2R^2g}{4\pi}\right)^{1/2} - R$
(c) $\left(\frac{T^2R^2g}{4\pi^2}\right)^{-1/3} + R$ (d) $\left(\frac{T^2R^2}{4\pi^2g}\right)^{1/3} - R$

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TOPIC 08

Satellite Energy & Weightlessness

9 PYQs · Easy 9 · Medium 0 · Difficult 0 | MHT CET 5 · NEET 3 · JEE 1

Concepts covered: KE, PE & total energy of a satellite (7) · Weightlessness (2)

LEVEL 1 · EASY 9 questions

◆ KE, PE & total energy of a satellite 7 Qs

191. The total energy of a circularly orbiting satellite is

MHT CET 2025 · 21 APR · SHIFT 1

(a) half the kinetic energy of the satellite.
(b) half the potential energy of the satellite.
(c) twice the kinetic energy of the satellite.
(d) twice the potential energy of the satellite.

192. For a satellite moving in an orbit around the earth at height ' h ' the ratio of kinetic energy to potential energy is

MHT CET 2024 · 11 MAY · SHIFT 2

(a) $2:1$ (b) $1:2$ (c) $1:\sqrt{2}$ (d) $\sqrt{2}:1$

193. For a satellite orbiting around the earth in a circular orbit, the ratio of potential energy to kinetic energy at same height is

MHT CET 2023 · 10 MAY · SHIFT 1

(a) $\frac{1}{\sqrt{2}}$ (b) $\frac{1}{2}$ (c) $\sqrt{2}$ (d) 2

194. The kinetic energy of a revolving satellite (mass m) at a height equal to thrice the radius of the earth (R) is

MHT CET 2019 · 2 MAY · SHIFT 1

(a) $\frac{mgR}{8}$ (b) $\frac{mgR}{16}$ (c) $\frac{mgR}{2}$ (d) $\frac{mgR}{4}$

195. For a satellite moving in an orbit around the earth, the ratio of kinetic energy to potential energy is

AIPMT 2005

(a) 1/2 (b) $1/\sqrt{2}$ (c) 2 (d) $\sqrt{2}$

196. The satellite of mass m is orbiting around the earth in a circular orbit with a velocity v. What will be its total energy?

AIPMT 1991

(a) $(3/4)mv^2$ (b) $(1/2)mv^2$
(c) mv^2 (d) $-(1/2)mv^2$

197. Given below are two statements:

Statement I: If E be the total energy of a satellite moving around the earth, then its potential energy will be $\frac{E}{2}$.

Statement II: The kinetic energy of a satellite revolving in an orbit is equal to the half the magnitude of total energy E.

In the light of the above statements, choose the most appropriate answer from the options given below

JEE MAIN 2023 · 8 APR · SHIFT 1

(a) Both Statement I and Statement II are incorrect
(b) Statement I is incorrect but Statement II is correct
(c) Statement I is correct but Statement II is incorrect
(d) Both Statement I and Statement II are correct

◆ Weightlessness 2 Qs

198. A seconds pendulum is placed in a space laboratory orbiting round the earth at a height '3R' from the earth's surface. The time period of the pendulum will be (R = radius of earth)

MHT CET 2023 · 9 MAY · SHIFT 1

(a) zero (b) $\frac{\pi}{3}$ s^2 (c) 4 s (d) infinite

199. Gravitational force is required for

AIPMT 2000

(a) stirring of liquid (b) convection
(c) conduction (d) radiation.

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ANSWER KEY

Shaded by level: **Easy**

01 Newton's Law of Gravitation

1. (b)	2. (a)	3. (b)	4. (c)	5. (a)	6. (a)				

02 Acceleration Due to Gravity

7. (a)	8. (b)	9. (b)	10. (b)	11. (d)	12. (b)	13. (d)	14. (a)	15. (d)	16. (d)
17. (d)	18. (d)	19. (d)	20. (d)	21. (d)	22. 9	23. (c)	24. (c)	25. (b)	26. (c)
27. (b)	28. (a)	29. (d)	30. (b)	31. (c)	32. (a)	33. (d)	34. (a)	35. (c)	36. (b)
37. (b)	38. (d)	39. (b)	40. (d)	41. (c)	42. (d)	43. (d)	44. (a)	45. (c)	46. (b)
47. (c)	48. (c)	49. (b)	50. (c)	51. (d)	52. (d)	53. (a)	54. (d)	55. (d)	56. (d)
57. (a)	58. (b)	59. (c)	60. (d)	61. (d)	62. (d)	63. (b)	64. (a)	65. (a)	66. (d)
67. (c)	68. (c)	69. (d)	70. (a)	71. (b)	72. (a)	73. (c)	74. (c)	75. (b)	76. (a)
77. (d)	78. (a)	79. (a)	80. (d)	81. (a)	82. (d)	83. (b)	84. (d)		

03 Gravitational Field

85. (b)	86. (a)	87. (b)							

04 Gravitational Potential & Energy

88. (a)	89. (a)	90. (a)	91. (c)	92. (d)	93. (b)	94. (c)	95. (d)	96. (d)	97. (d)
98. (c)	99. (c)								

05 Escape Velocity

100. (b)	101. (c)	102. (a)	103. (c)	104. (a)	105. (d)	106. (d)	107. (c)	108. (a)	109. (d)
110. (b)	111. (b)	112. (b)	113. (b)	114. (a)	115. (b)	116. (a)	117. (d)	118. (a)	119. (c)
120. (c)	121. (d)	122. (a)	123. (b)	124. (c)	125. (d)	126. (c)	127. (c)	128. (a)	129. (c)
130. (c)	131. (c)	132. (c)	133. (a)	134. (d)	135. (d)				

06 Kepler's Laws & Planetary Motion

136. (b)	137. (a)	138. (c)	139. (a)	140. (c)	141. (b)	142. (b)	143. (a)	144. (c)	145. (c)
146. (a)	147. (b)	148. (b)	149. (d)	150. (c)	151. (c)	152. (d)	153. (b)	154. (a)	155. (c)
156. (c)									

07 Satellites - Orbital Velocity & Period

157. (c)	158. (c)	159. (a)	160. (a)	161. (a)	162. (c)	163. (b)	164. (b)	165. (c)	166. (a)
167. (d)	168. (b)	169. (d)	170. (b)	171. 2	172. (d)	173. (a)	174. (c)	175. (c)	176. (b)
177. (a)	178. (c)	179. (d)	180. (b)	181. (b)	182. (b)	183. (b)	184. (c)	185. (c)	186. (b)
187. (d)	188. (a)	189. (a)	190. (a)						

08 Satellite Energy & Weightlessness

191. (b)	192. (b)	193. (d)	194. (a)	195. (a)	196. (d)	197. (a)	198. (d)	199. (b)	

Note: *"Bonus" = no option is correct as the question is printed (dropped in the official key). Numerical questions show the numerical answer.*

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