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PHYSICS

BOOKS - BAL BHARTI

GRAVITATION

Solved Examples

1. Mahendra and Virat are sitting at a distance of 1 metre from each other. Their masses are

75 kg and 80 kg respectively. What is the gravitational force between them?

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2. In the above example, assuming that the bench on which Mahendra is sitting is frictionless, starting with zero velocity, what will be Mahendra's velocity of motion towards Virat after 1 s ? Will this velocity change with time and how?

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3. Calculate the gravitational force due to the earth on Mahendra in the earlier example.

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4. Starting from rest, what will be Mahendra's velocity after one second if he is falling down due to the gravitational force of the earth?

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5. If a person weighs 750 N on Earth,how much would be his weight on the Moon given that Moon's mass is $\frac{1}{81}$ of that Earth and its radius is $\frac{1}{3.7}$ of that of Earth

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6. An iron ball of mass 3 kg is released from a height of 125 m and falls freely to the ground. Assuming that the value of g is $10m/s^2$, calculate

time taken by the ball to reach the ground

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7. An iron ball of mass 3 kg is released from a height of 125 m and falls freely to the ground. Assuming that the value of g is $10m/s^2$, calculate

velocity of the ball on reaching the ground

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8. An iron ball of mass 3 kg is released from a height of 125 m and falls freely to the ground.

Assuming that the value of g is $10m/s^2$, calculate

he height of the ball at half the time it takes to reach the ground.

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9. A tennis ball is thrown up and reaches a height of 4.05 m before coming down. What was its initial velocity? How much total time will it take to come down? Assume $g = 10m/s^2$

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10. Calculate the escape velocity on the surface of the Moon given the mass and radius of the Moon to be 7.34×10^{22} kg and $1.74 \times 10^{6} m$ respectively.

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Use Your Brain Power

1. Show that in SI units, the unit of G is Newton m^2kg^{-2}. The value of G was first experimentally measured by Henry Cavendish. In SI units its value is $6.673 \times 10^{-11} Nm^2kg^{-2}$.

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2. Is there a gravitational force between two objects kept on a table or between you and

your friend sitting next to you? If yes, why don't the two move towards each other?

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3. According to Newton's law of gravitation, every object attracts every other object.

Thus, if the earth attract an apple towards itself, the apple also attracts the earth towards itself with the same force. Why then does the apple fall toward the earth, but the earth does not move towards the apple ?

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4. Will your remain constant as you go above the surface of the earth ?

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5. A person is standing on a tall ladder. If his distance from the centre of the earth is 2R, what will be his weight ?

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6. According to Newton's law of gravitation,earth's gravitational force is higher on an object of larger mass.Why doesn't that object fall down with higher velocity as compared to an object with lower mass?

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Exercise

1. Study the entries in the following table and rewrite them putting the connected items in a single row.

connected items in a single row :

I	II	III
Mass	m/s^2	Zero at the centre of the earth
Weight	kg	Measure of inertia
Acceleration due to gravity	$N \cdot m^2/kg^2$	Same in the entire universe
Gravitational constant	N	Depends on height

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2. Answer the following questions :

What is the difference between mass and weight of an object ? Will the mass and weight of an object on the earth be the same as their values on Mars ? why ?

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3. Answer the following questions.

What are (i) free fall, (ii) acceleration due to

gravity (iii) escape velocity (iv) centripetal force ?

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4. Answer the following questions :

Write the three laws given by Kepler. How did they help Newton to arrive at the inverse square law of gravity ?

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5. A stone thrown vertically upwards with initaial velocity u reaches a height 'h' before coming down.Show that the time takes to go up is same as time taken to come down

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6. If the value of g suddenly becomes twice its value,it will become two time more difficult to pull a heavy object along the floor.Why?

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7. Answer the following questions :

Explain why the value of g is zero at the centre of the earth.

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8. Let the period of revolution of a planet at a distance R from a star be T. Prove that if it was at a distance of 2R from the star, its period of revolution will be $\sqrt{8}T$.

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9. An object takes 5 s to reach the ground from a height of 5 m on a planet. What is the value of g on the planet ?

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10. The radius of the planet A is half the radius of planet B. If the mass of A is M_A What must be the mass of B so that the alueof g on B is half that of its value on A?

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11. The mass and weight of an object on Earth is 5kg and 49 N respectively. What will be their values on the Moon? Assume that the acceleration due to gravity on the Moon is $\frac{1}{6}$ th of that on the Earth.

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12. An object thrown vertically upwards reaches a height of 500 m. What was its initial

velocity? How long will the object take to come back to the earth ? Assume $g = 10\frac{m}{s^2}$.

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13. A ball falls of a table and reaches the ground in 1 s. Assuming $g = 10m/s^2$, calculate its speed on reaching the ground and the height of the table.

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14. Solve the following examples / numerical problems:

The masses of the earth and the moon are 6 xx 10^24 kg and 7.4 xx 10^22 kg, respectively. The distance between them is 3.84 xx 10^5 km. Calculate the gravitational force of attraction between the two use G = 6.7 xx 10^-11 N-m^2 kg^-2.

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15. Solve the following examples / numerical problems:

The mass of the earth is 6xx10^24 kg. The distance between the earth and the sun is 1.5xx10^11m. If the gravitational force between the two is 3.5xx 10^22 N, what is the mass of the Sun ? (use G =6.7xx 10^-11 Nm^-2kg^-2)

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