PHYSICS

BOOKS - CHETAN PHYSICS (TAMIL ENGLISH)

GRAVITATION

Fill In The Blanks

1. Gravitation was discovered by_____

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2. Every object in the universe attracts every other object with _____force.

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3. $F\alpha\frac{m_1m_2}{d^2}$ means $F=$ _____.

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4. If the distance between the two objects is double, then the gravitational force between them will be _____ times.

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5. If mass increases, force_____.

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6. If mass triples, value of G_____.

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7. If Earth attracts a body with a forcce of 10N, then the body attracts the Earth with _____N.

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8. S.I. unit of G is _____.

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9. Places on Earth exactly 90° to the direction of the moon experience_____.

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10. _____ is a constant known as universal gravitational constant.

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11. The Earth's gravitational force is always in the direction of the _____ of the Earth.

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12. The Earth's gravitational acceleration is denoted by letter_____.

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13. Derive the Relation between g and G .

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14. The value of acceleration due to gravity at poles is _____ m/s^2

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15. The value of acceleration due to gravity at the equator is _____ cm/s^2

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16. If altitude increases, value of g _____.

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17. When a spaceship is two Earth radii distance from the centre of Earth, its becomes_____.

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18. During free fall, the object comes vertically downward with uniform_____.

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19. Mass is also a measure of _____ of an object.

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20. The mass of the Earth is _____ kg.

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21. The radius of the Earth is_____ m.

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22. What are the values of g and G at the centre of the earth?

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23. The unit of weight is _____.

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24. The gravitational force acting on any object on the Earth is called it's_____

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25. The weight of an object on the Earth is _____ times its weight on the Moon.

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26. The weight of an object is maximum at _____ on the surface of the Earth.

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27. The orbit of a planet is an _____ with the Sun at one of the foci.

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28. The energy possessed because of position or configuration is called_____.

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29. $v_{esc} =$ _____

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30. Gravitation waves are detected by_____

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31. During acent_____ is zero and during descent _____ is zero.

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32. Formula for centripetal force is _____.

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Find The Odd Word Out

1. Choose the odd one out :

Acceleration, mass, force, weight

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2. Choose the odd one out :

Change in value 'g' at surface, change in value of g at height, change in value of g at depth, change in value of g on thickness.

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3. Choose the odd one out :

Light, sound, heat, laws of planetary motion.

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4. Choose the odd one out :

mass, potential energy, radius, weight.

Watch Video Solution

5. Choose the odd one out :

$9.83m/s^2, 9.8m/s^2, 980cm/s^2, 9.77m/s^2$

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6. Choose the odd one out :

Weight, Thrust, Froce, Pressure.

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7. Choose the odd one out :

Newton's first law, Newton's law of gravity, Newton,s third law, Newton's second law

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8. Choose the odd one out :

Newton, ohm,Kepler, Galileo

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9. Choose the odd one out :

$983m/s^2, 977m/s^2, 980m/s^2, 9.83m/s^2$

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10. Choose the odd one out :

$9.83m/s^2, 98.3m/s^2, 983m/s, 98.03m^2s$

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Complete The Analogy

1. $6 \times 10^{24} kg$: Mass of the Earth :: $6.4 \times 10^{6} m$: _____.

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2. Height of a weather satellite: $8.7 m / s^{2}$ :: Height of Communication satellite:_____.

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3. Mass: Scalar quantity :: Weight:_____.

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4. Complete the analogy:

At poles $9.83 m / s^2$ :: At equator:_____

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5. Complete the analogy :

Shape of the Earth at equator: Bulged :: shape of the Earth at poles:_____

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6. Complete the analogy :

Kinetic energy: $\frac{1}{2}mv^2$ :: Gravitational Potential energy:_____

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7. Complete the analogy :

Force: ma:: Gravitational force:_____

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8. Complete the analogy :

Force:Vector::Weight:_____

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With The Information In Three Columns Match Up And Complete The Chart

1. Match the column

Column A	Column B
(1) Mass	(a) m/s
(2) Weight	(b) m/s^2
(3) Acceleration	(c) kg
(4) Velocity	(d) N

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2. Complete the chart

	F (N)	m_1 (kg)	m_2 (kg)	d (m)
(1)	.....	500	84	02
(2)	30×10^{27}	15×10^5	.....	03
(3)	16×10^9	.....	17	34
(4)	250×10^{-7}	45	47	.....

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State Whether The Following Statements Are True Or False Correct Thefalse Statement

1. Say True or False.

Force $=$ mass $\times$ velocity

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2. State whether True or False.

G is called gravitational acceleration.

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3. Say True or False.

Aceleration is a scalar quantity.

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4. Say True or False.

Gravitational force at the Moon is double than the Earth's gravitation force.

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5. Say True or False.

$1N = 1kg \times 1m/s^2$

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6. Say True or False.

1dyne $= 10^5 N$

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7. Say True or False.

The force towards the centre of the circular orbit is called centripetal force.

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8. Say True or False.

The gravitational acceleration does not become zero at the centre of the Earth.

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9. Say True or False.

At the poles, the acceleration due to gravity is

$9.77m/s^2$

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10. Say True or False.

g is called universal constant.

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11. Say True or False.

Mass is a scalar quantity.

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12. Say True or False.

Beyond the surface of the Eartth $g\alpha\frac{1}{(R+h)^2}$

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13. Say True or False.

Weight is a vector quantity.

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14. Say True or False.

The mass of the Earth is $6.4 \times 10^6 kg$.

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15. Say True or False.

At a height of h from the ground, the graitational potential energy is $\frac{-GMm}{R+h}$

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Choose And Write The Correct Option

1. The gravitational force of attraction between two objects is given by_____.

A. $F\alpha\frac{m_1m_2}{d^2}$

B. $F\alpha\frac{d^2}{m_1m_2}$

C. $F\alpha\frac{m_1m_2}{\sqrt{d^2}}$

D. $F\alpha\frac{m_1m_2}{d^3}$

Answer: A

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2. If the distance between two bodies becomes half, the gravitational force between them becomes_____.

A. half

B. one forth

C. 4 times

D. 2 times

Answer: C

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3. If the distance between two objects increases 5 times, the gravitational force becomes _____ times.

A. 5

B. 15

C. $\frac{1}{25}$

D. 25

Answer: C

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4. The gravitational force on the surface of the Moon is_____ times than that on the surface of the Earth.

A. five

B. one fifth

C. one sixth

D. six

Answer: C

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5. The gravitational causes_____.

A. Tides

B. Circular motion of moon

C. None of these

D. Both a and b

Answer: D

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6. If Earth attracts a body with a forcce of 10N, then the body attracts the Earth with _____N.

A. less than $10^{20} N$

B. $10^{20} N$

C. greater than $10^{20} N$

D. $10^{-20} N$

Answer: B

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7. SI unit of the universal constant of gravitation

A. Nm^2/kg^2

B. Nkg^2/m^2

C. m/s^2

D. Ncm^2/g^{20}

Answer: A

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8. The value of acceleration due to gravity at the height h from the ground is_____.

A. $g = \frac{GM}{R+h}$

B. $g = \frac{GM}{\sqrt{R+h}}$

C. $g = \frac{GM}{(R+h)^2}$

D. $g = GM(R+h)^2$

Answer: C

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9. The value of acceleration due to gravity at poles is _____ m/s^2

A. 9.72m/s

B. $9.83m/s^2$

C. $9.83m/s$

D. $9.72m/s^2$

Answer: B

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10. The value of g at the centre of the Earth is zero. Explain?

A. Centre of Earth

B. Poles

C. Infinite distance

D. Both a and b

Answer: D

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11. When an objects is thrown upward, the force of gravity_____.

A. is opposite to the direction of motion

B. is in the same direction as that of motion

C. becomes zero at higher point

D. increase as it rise up

Answer: A

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12. The acceleration due to earth's gravity decreases as _____ increases.

A. increases

B. fluctuates

C. decreases

D. varies

Answer: C

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13. As the height of the object from the surface of the Earth increases, value of g becomes_____.

A. a) more

B. b) less

C. c) equal

D. d) can't say

Answer: B

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14. The mass of objects_____ at any place on the surface on the Earth.

A. remains constant

B. is non-unifrom

C. changes

D. increases

Answer: A

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15. According to Newton's first law, if mass is more, then the inertia of the body is _____

A. less

B. very less

C. more

D. can't say

Answer: C

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16. The weight of body gradually decreases from _____.

A. equator of poles

B. poles to equator

C. pole to pole

D. height to surface

Answer: B

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17. A body of mass 1 kg is attracted by the Earth with a force which is equal to _____

A. $9.8N$

B. 6.67×10^{-1}

C. $1N$

D. $9.8m/s$

Answer: A

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18. The gravitational potential energy at the height of h from the ground is

A. $\frac{-GMm}{R+h}$

B. $\frac{-GMm_1}{R^2+h}$

C. $\frac{GMm_1}{R^2+h^2}$

D. $\frac{GMm}{R^2+h}$

Answer: A

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19. The orbit of a planet is an ellipse with the Sun at one of the _____.

A. a) foci

B. b) centre

C. c) middle

D. d) surface

Answer: A

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20. The straight line joining the planet and the Sun sweeps equal_____ in equal interval of time.

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21. The square of time period of revolution around the Sun is directly proportional to the _____ of the planet from the Sun.

A. mean distance

B. square of the distance

C. cube root the distance

D. cube of the mean distance

Answer: D

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22. Which of the following is not an example of free fall?

A. Moon revolving aroung the Earth

B. Earth revolving around the Sun

C. Parachute jumping

D. Artificial satellites revolving around the Earth

Answer: C

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23. The centre of mass of an object having uniform density is at its_____.

A. centre

B. Geometrical centre

C. centroid

D. circumference

Answer: C

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Soleve The Following

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. The mass of the Earth and Moon are 6×10^{24} kg and 7.4×10^{22} kg respectively. The distance between them is 3.84×10^{5}km. Calculate the gravitational force of attraction between the two? $G = 6.7 \times 10^{-11} Nm^2 / kg^2$

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3. The mass of the Earth is $6 \times 10^{24} kg$. The distance between the Earth and the sun is $1.5 \times 10^{11} m$. If the gravitational force between the two is $3.5 \times 10^{22} N$ what is the mass of the sun? $G = 6.7 \times 10^{-11} Nm^2 / kg^2$

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4. Assuming that acceleration remains constant $\left(5.34 \times 10^{-9} m / s^2\right)$, How long will Mahendra take to move 1 cm towards Virat if he starts from rest?

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5. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400m is 20s. Find its acceleration. Also find the force acting on it if its mass is 7000 kg.

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6. Karan and Arjun are two friends of mass m_1 and m_2 respectively, separated by a distance d. What would happen to the force between them if

(i) Massof Arjun is doubled.

(ii) Mass of both Karan and Arjun is doubled.

(iii) Distance between them is doubled.

(iv) Value of G doubled.

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Numericals For Practice

1. Two boys are sitting is very close to each other at a distance of 0.5 m from each other. If the mass of one boy is 40 kg and other is 50 kg, find the gravitational force between them.

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2. If the force of gravitational between the Earth and an object of mass m is $9 \times 10^7 N$, find the mass of an object if the mass of the

Earth is 6×10^{24} kg and its radius is $6.4 \times 10^{6} m$

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3. If two objects of masses 500 kg and 84 kg respectively are at a distance of 2m apart from each other. Find gravitational force between them?

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4. If two objects of 45 kg and 47 kg respectively are attracted towards each other by a gravitational force of $250 \times 10^{-7} N$, find the distance between their centres.

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5. Calculaste the gravitational force due to the Earth on Mahendra if mass of Earth is $6 \times 10^{24} kg$ Radius is

$6.4 \times 10^6 m, g = 9.77 m/s^2$ and mass of Mahendra is 75 kg.

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6. Starting from rest, due to the gravitational force of the Earth i.e. 733N, What is the speed of Mahendra after 1 second? If his mass is 75 kg.

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

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8. 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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9. 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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10. Suppose your are standing on a tall ladder. If your distance from the centre of the Eart is

2R, what will be your weight?

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11. What would be the value of g on the surface of the earth if its mass was twice as large and its radius half of what if is now?

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12. Find the weight of a man whose mass is 50 kg.

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13. Find the gravitational force between man of mass 60 kg and the Earth.

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14. A stone of mass 2 kg is falling from a certain height. Find the force of attraction between the Earth and the stone. Also, find the acceleration.

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15. The planet in space has mass twice as that of the Earth and a radius thrice as that of the Earth. If the weight of a book is 90N on the Earth, what would be the weight on the planet?

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16. Calculate the value of g on the Moon, it its mass is 7.4×10^{22}kg and radius is 1740 km.

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17. If the weight of a body on the surface of the Moon is 100N what is its mass?

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18. If the acceleration due to gravity on the surface of the Earth is $9.8m/s^2$, what will be the aceleration due to gravity on the surface of the planet whose mass and radius both are

two times the corresponding quantities for the Earth.

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19. 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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20. 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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21. The escape velocity for mass is 5.02km/s. If its radius is 3390 km, What is the value of g on its surface.

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22. A planet orbits the Sun in time T at a distance of R from it. Another planet orbits the Sun in a time of 8T. What is its distance R' from the Sun.

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

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

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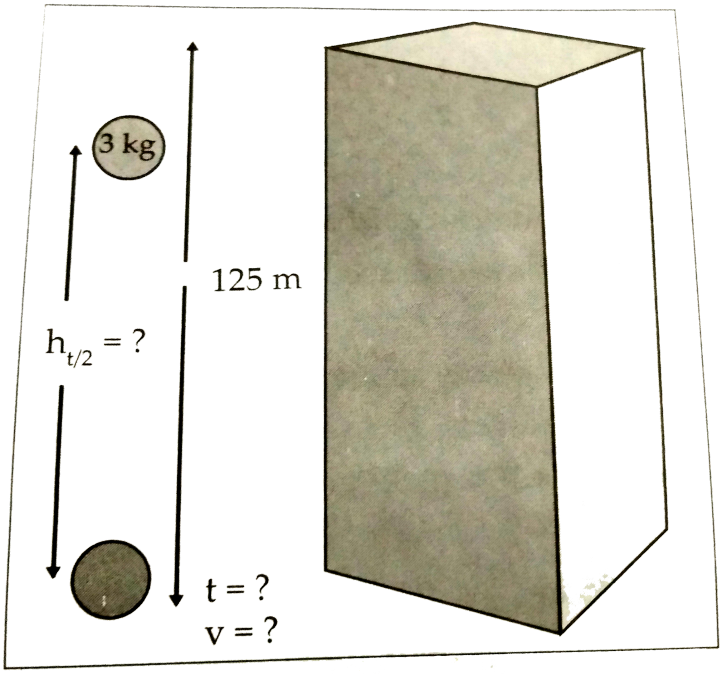
25. An iron ball of mass of 3 kg is released from height of 125 m and falls freely to the ground. Assuming that the value of g is

$10m/s^2$, calculate

(i) time taken by the ball to reach the ground

ii. Velocity of the ball on reaching the ground

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



(Diagram is only for reference)

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

velcoity? How long will the object take to come back to the Earth? Assume $g = 10m/s^2$

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28. Find a formula for maximum height attained by object.

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29. A stone thrown vertically upwards with initial velocity u reaches a height h before

coming down. Show that the time taken to go up is same as the time taken to come down.

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30. A ball thrown up vertically returns to the person after 6s. Find the velocity with which it was thrown up.

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31. A boy drops a coin from the top of a building which is 49 m high. Find the velocity with which the coin strikes the ground.

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32. A ball is thrown vertically upwards with velocity of 49 m/s. Calculate i. Maximum height to which it rises ii. Total time t it takes to return to the surface of Earth.

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33. A stone is thrown vertically upwards with initial velocity of 40 m/s. Taking $g = 10m/s^2$ find the maximum height and total distance covered by stone.

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Define Write The Laws

1. Force

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2. State Newtons Universal law of gravitaion.

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3. Universal constant of gravitation (G)

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4. Centre of mass

Watch Video Solution

5. Gravitational acceleration g OR Acceleration due to gravity.

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6. Free fall

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7. Mass(m)

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8. Weight (W)

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9. Centripetal force

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10. Uniform circular motion.

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11. Potential energy

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12. Escape velocity

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Answer The Following Is One Or Two Senctences

1. What do you know about gravitational force?

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2. Will the direction of the gravitational force change as we go inside the earth?

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3. What would happen if ther were no gravity?

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4. What would happen if the value of G was twice as large?

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5. What are the types of forces?

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6. What is the value of g at the centre of the Earth?

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7. Will the mass and weight of an object on the earth be same as their values on Mars? Why?

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Write Short Notes

1. Earth's gravitational force

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2. Gravitational acceleration g OR Acceleration due to gravity.

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3. Variation in the value of g.

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4. Complete the following table:

	Place	Altitude from the Earth's surface (km)	g (m/s^2)
(i)	Surface of Earth	0	.....
(ii)	Mount Everest	8.8	.....
(iii)	Altitude attained by Man-made balloon	36.6	.....
(iv)	Orbit of space shuttle	400	.....
(v)	Communication satellite	35700	.....

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Distinguish Between

1. Gravitational constant and Gravitational acceleration:

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2. Weight and Mass

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Give Scientific Reasons

1. High and low tides are regular phenomena.

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2. In the spacecraft, travellers and objects appear floating.

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3. Weight of an object changes from place to plate on the surface of the Earth.

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Explain The Following

1. Explain terms:

a. Free fall b. Acceleration due to gravity

c Escape velocity d. Centripetal force

e. Potential energy

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2. Define: The universal law of gravitation and derive mathematically.

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3. What are Newton's laws of motion?

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4. What are the effects of force acting on an object?

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5. Define: Acceleration due to gravity and derive mathematically.

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6. The value of g at the centre of the Earth is zero. Explain?

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

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8. State Kepler's third law and derive mathematically to obtain constant.

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

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10. Explain centripetal force with suitable example.

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11. Define: Escape velocity and derive mathematically.

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Open Ended Questions

1. According to Newton's law of gravitation, the apple and the earth experience equal and opposite forces due to gravitation. But it is

the apple falls towards the earth and not vice-versa. Why?

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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. Will your weight remains constant as you go above the surface of the earth?

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

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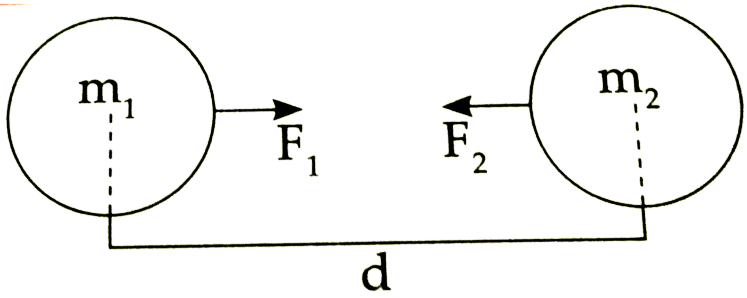
Application Based Questions On Figures

1. Observe the figure and answer the following questions:



The force of gravitatiion between two bodies having irregular shape is taken to be the distance between their

a.centre of mass

b. centre of the body

c. Edge of the body

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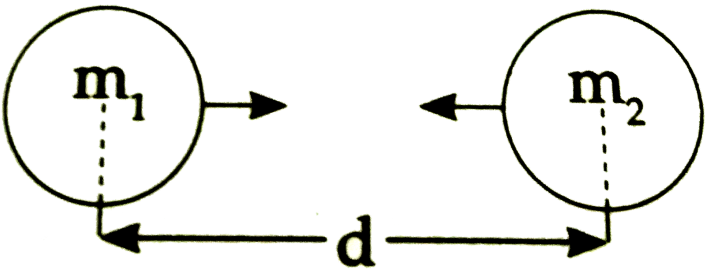
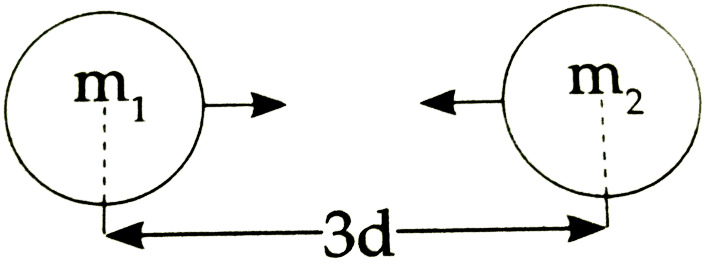
2. If two objects are at a distance of d from each others.



Then $F = \frac{Gm_1m_2}{d^2}$

If the distance between two bodies is 3d



Then F = .

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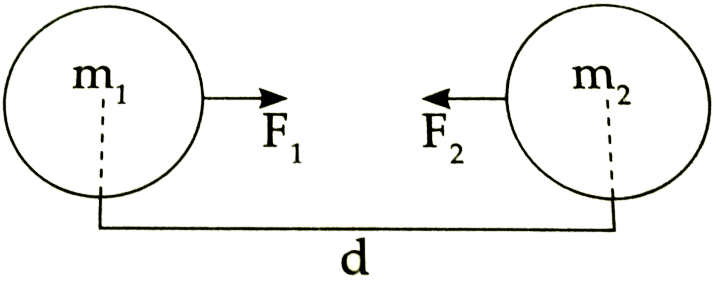
3. Observe the figure and answer the following questions:



The mass of $m(2)$ was reduced to 50% and the force exerted by m_1 on m_2 was found to eb 20 N what will be the force exerted by m_2 on m_1?

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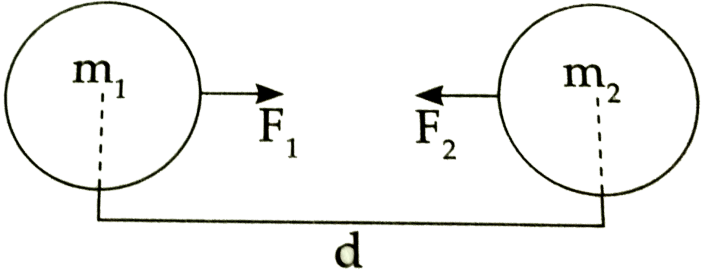
4. Observe the figure and answer the following questions:



Why gravitational constant is called universal constant?

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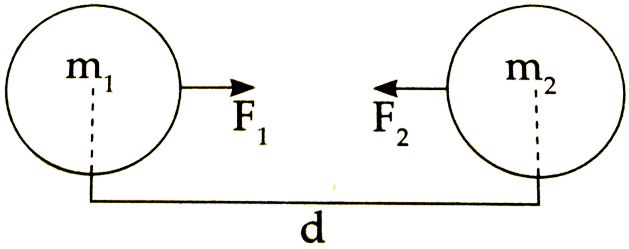
5. Observe the figure and anwer the following question:



What will happen to gravitational force if mass of one of the objects is doubled?

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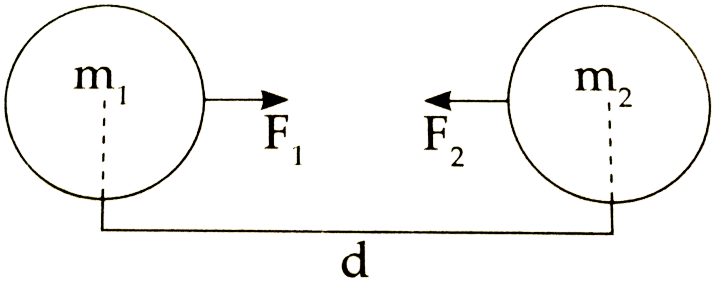
6. Observe the figure and anwer the following question:



What is the value of universal gravitational constant in SI system?

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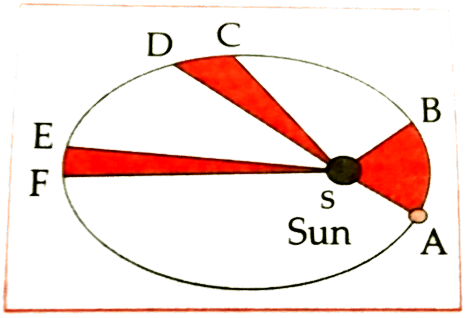
7. Observe the following diagram and answer the questions:



: The orbit of a planet moving around the Sun.

In the given figure , area ESF is equal to ASB, then what can you say about EF?

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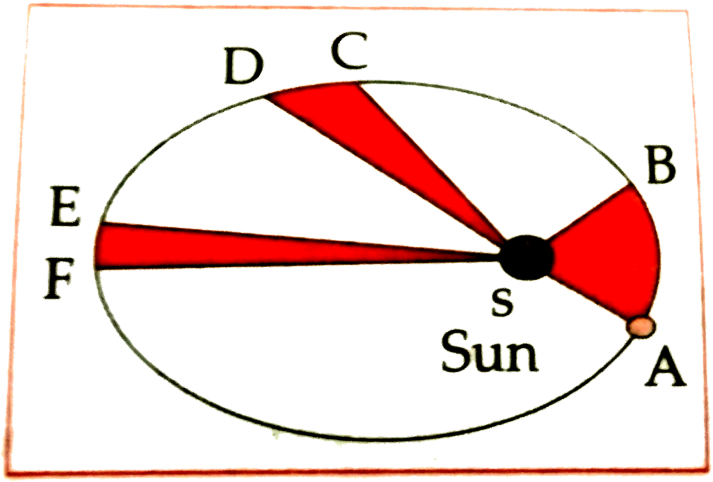
8. Observe the follwing diagram and answer the questions:

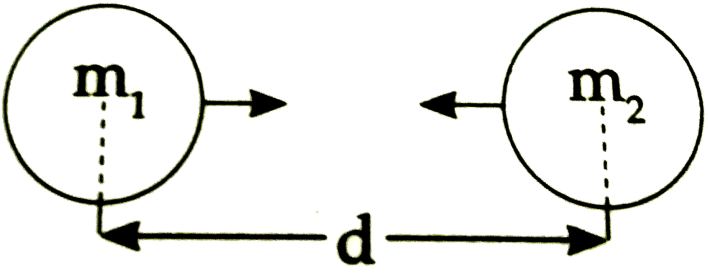


Correct and rewrite Kepler's thrid law.

The period of revolution of a planet around the sun is directly proportional to the cube of the distance of the planet from the sun.

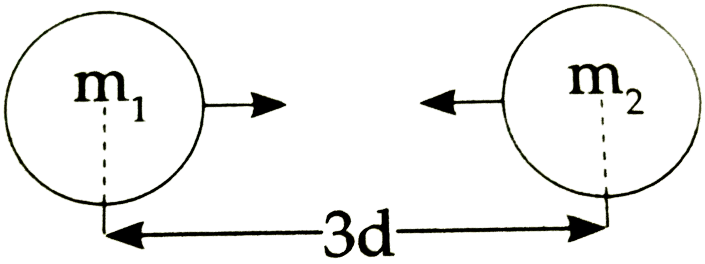
View Text Solution

9. If two objects are at a distance of d from each others.



Then $F = \dfrac{Gm_1m_2}{d^2}$

If the distance between two bodies is 3d



Then F = [.]

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10. An elephant and a matchbox fall from a height of 200m. If they are in state of free fall, which of them will reach the ground first and why?

Watch Video Solution

11. Complete the following for an object of mass m on

On Earth's surface : A $KE = \frac{1}{2}mv^2$, B $PE =$

.....

At infinity :A. $KE =$ ..... , B. $PE = 0$

View Text Solution

12. An artificial satellite is shifted from LEO to HEO, how will the value of g vary?

Watch Video Solution

13. How will the value of g change if a person travels from Delhi to Moscow?

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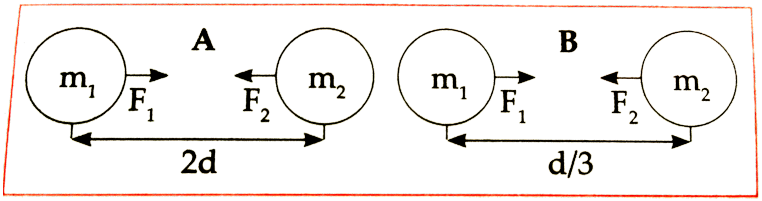
14.



In which of the two cases, A or B is the force exerted stronger?

Watch Video Solution

15. If a traveler in a spacecraft orbiting the Earth releases an object from hishand, it

remaisn stationary and appears to be in a state of weightlessness. Does this mean there is no force of gravity acting on the object?

View Text Solution

16. i. Will the velocity of a stone thrown vertically upwards remian constant or will it change with time? How will it change?

ii. Why doesn't the stone move up all the time? Why does it fall down after reaching a certain

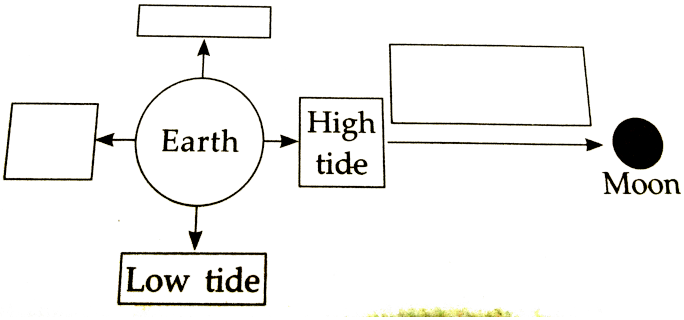
height?

iii. What does its maximum height depend on?

Watch Video Solution

Complete The Flow Chart

1. Fill in the blanks



Watch Video Solution

Paragraph Based Questions

1. Read the paragraph and answer the following question:

You must be knowing about the high and low tides that occur regularly in the sea. The level of the sea water at any given location along sea shore increase and decreases twice a day at regular intervals. High and low tides occur at different times at places. The level of water in sea changes because of the gravitational

force exerted by the moon. Water directly under the moon gets pulled towards the moon and the level of water there goes up causing high tide at that place. At two places on the earth at 90° from the place of high tide, the level of water is minimum and low tides occur there.

How many times the sea level at the coast change?

Watch Video Solution

2. Read the paragraph and answer the following question:

You must be knowing about the high and low tides that occur regularly in the sea. The level of the sea water at any given location along sea shore increases and decreases twice a day at regular intervals. High and low tides occur at different times at places. The level of water in sea changes because of the gravitational force exerted by the moon. Water directly under the moon gets pulled towards the moon and the level of water there goes up

causing high tide at that place. At two places on the earth at 90° from the place of high tide, the level of water is minimum and low tides occur there.

How does sea level changed?

Watch Video Solution

3. Read the paragraph and answer the following question:

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of the sea water at any given location along sea shore increases and decreases twice a day at regular intervals. High and low tides occur at different times at places. The level of water in sea changes because of the gravitational force exerted by the moon. Water directly under the moon gets pulled towards the moon and the level of water there goes up causing high tide at that place. At two places on the earth at 90° from the place of high tide, the level of water is minimum and low tides occur there.

Where is high tide and low tide caused?

Watch Video Solution

4. The centre of mass of an object is the point inside or outside the object at which the total mass of the object can be assumed to be concentrated. The centre of mass of spherical object having uniform density is a its geometrical centre. The centre of mass of any object having uniform density is at its centroid.

Where can the total mass of an object be assumed to be concentrated?

Watch Video Solution

5. The centre of mass of an object is the point inside or outside the object at which the total mass of the object can be assumed to be concentrated. The centre of mass of spherical object having uniform density is a its geometrical centre. The centre of mass of any object having uniform density is at its centroid.

Where is the centre of mass located for an object of uniform density?

Watch Video Solution

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Where is the centre of mass located for a spherical object?

Watch Video Solution

7. The centre of mass of an object is the point inside or outside the object at which the total mass of the object can be assumed to be concentrated. The centre of mass of spherical object having uniform density is a its geometrical centre. The centre of mass of any object having uniform density is at its centroid.

What was basis of Kepler's laws?

Watch Video Solution

8. Gravitational waves:

Waves are created on the surface of water when we drop a stone into it. Similarly you must have seen the waves generated on a string when both its ends are held in hand and it is shaken. Light is also a type of wave called the electromagnetic wave. Gamma rays, X-rays, ultraviolet rays, infrared rays, microwave and radio waves are all different types of electromagnetic waves. Astronomical objects emit these waves and we receive them

using our instruments. All our knowledge about the universe has been obtained through these waves.

Gravitational waves are a very different type of waves. They have been called the waves on the fabric of space-time. Insteine predicted their existence in 1916. These waves are very weak and it is very difficult to detect them. Scientists have constructed extremely sensitive instruments to detect the gravitational waves emitted by astronomical sources. Among these, LIGO (Laser Interferometrc Gravitational Wave

Observatory) is the prominent one. Exactly after hundred years of their prediction, scientists detected these waves coming from an astronomical source. Indian scientist have contributed significantly in this discovery. This discovery has opened a new path to obtain information about the Universe.

What are the different types of electro magnetic waves?

Watch Video Solution

9. Gravitational waves:

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What are the waves on the fabric of space time called?

Watch Video Solution

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Is it easy to detect Gravitational waves?

Watch Video Solution

11. Gravitational waves:

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contributed significantly inthis discovery. This discovery has opened a new path to obtain information about the Universe.

What is the device, used to detect GRavitational waves?

Watch Video Solution

12. Weightlessness in space:

Space travellers as well as objects in the spacecraft appear to be floating. Why does this happen? Though the spacecradft is at a

height from the surface of the earth the value of g there is not zero. In the space station the value of g is only 11% less than its value on the surface of the earth. Thus, the height of a spacecraft is not the reason for their weightlessness.

Their weightlessness is caused by their being in the state of free fall. Though the spacecraft is not falling on the earth because of its velocity along the orbit, the only force acting on it is the gravitational force of the earth and therefore it is in a free fall state. As the velocity of free fall does not depend on the

properties of an object, the velocity of free falls is the same for the spacecraft, the travellers and the objects in the craft. Thus, if a traveller releases an object from her hand, it will remain stationary with respect to her and will appear to be weightless.

Is the value of g zero in the space station?

 Watch Video Solution

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Why is weightlessness caused in a spacecraft?

 Watch Video Solution

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Space travellers as well as objects in the spacecraft appear to be floating. Why does this happen? Though the spacecradft is at a height from the surface of the earth the value of g there is not zero. In the space station the value of g is only 11% less than its value on the surface of the earth. Thus, the height of a spacecraft is not the reason for their weightlessness.

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Why doesn't the spacecraft fall towards the Earth?

Watch Video Solution

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If a traveller releases an object from her hand in the spacecraft, what will happen?

Watch Video Solution

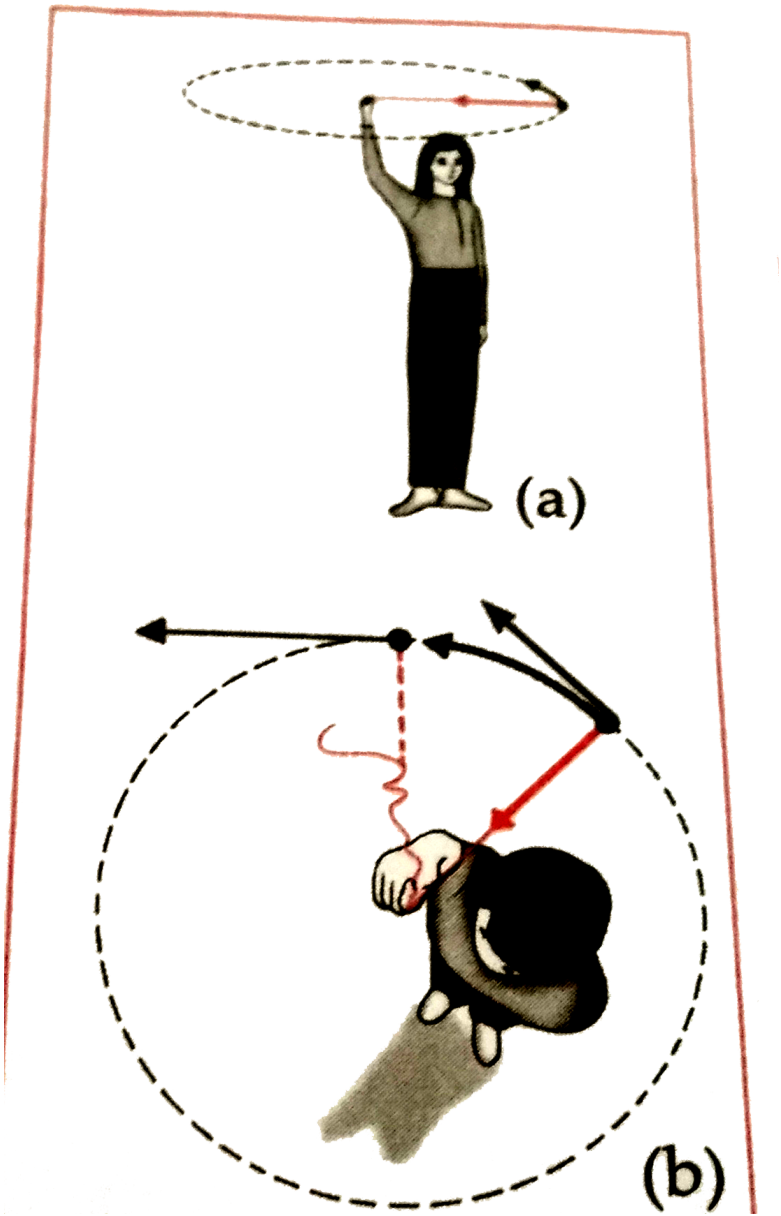
Activity Based Questions

1. Read the following paragraph carefully and answer the following:

Tie a stone to one end of a string. Take the other end in your hand and rotate the string so that the stone moves along a circle.

As long as we are holding the string, we are pulling the stone towards us i.e. towards the centre of the circle and are appliying a force towards it. The force stops acting on it if we release the string. In this case, the stone will fly off along a straight line which is the tangent to the circle at the position of the stone when the string is released, because that the directionn of its velocity at that instant of time. You may recall a similar activity in which a 5 rupee coin kept on a rotating circular disc flies off the disc along the tangent to the disc. Thus, a force acts on any

object moving along a circle and it is directed towards the centre of the circle. This is called the Centripetal force.



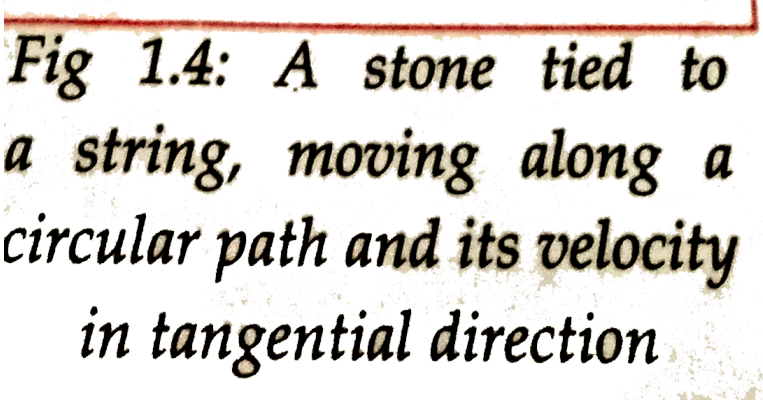


Fig 1.4: A stone tied to a string, moving along a circular path and its velocity in tangential direction

The impressed force on the same is in which direction?

Watch Video Solution

2. Read the following paragraph carefully and answer the following:

Tie a stone to one end of a string. Take the other end in your hand and rotate the string

so that the stone moves along a circle.

As long as we are holding the string, we are pulling the stone towards us i.e. towards the centre of the circle and are appliying a force towards it. The force stops acting on it if we release the string. In this case, the stone will fly off along a straight line which is the tangent to the circle at the position of the stone when the string is released, because that the directionn of its velocity at that instant of time. You may recall a similar activity in which a 5 rupee coin kept on a rotating circular disc flies off the disc along the

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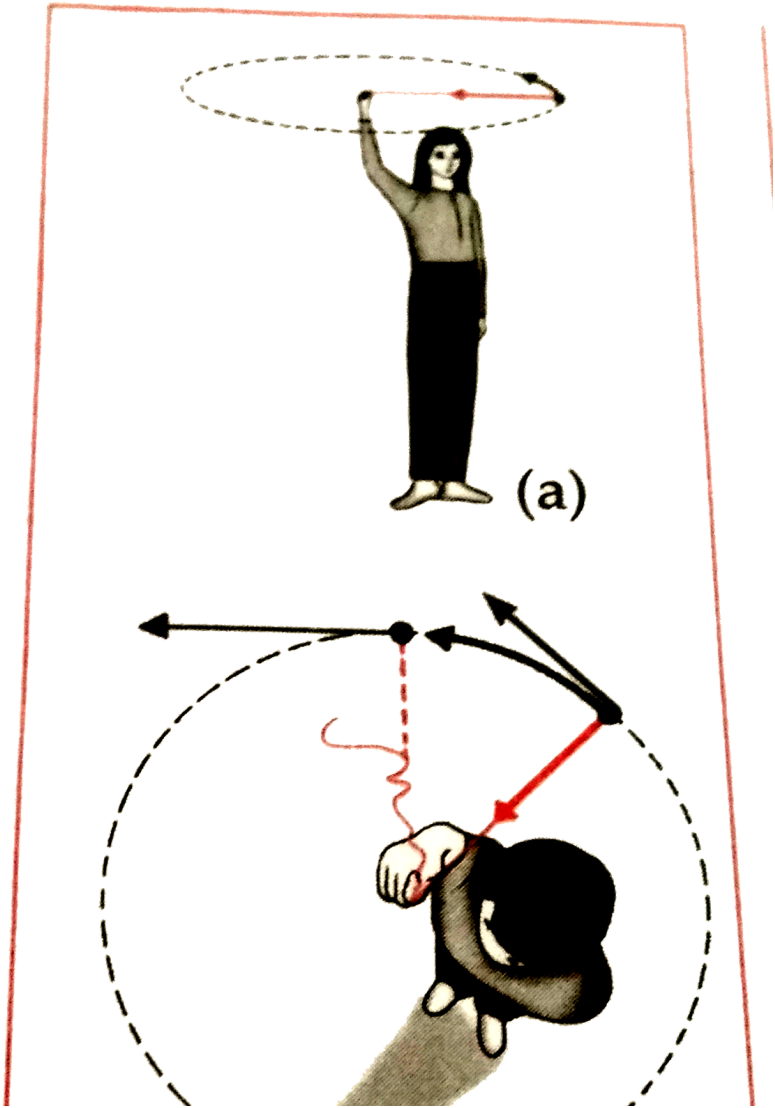

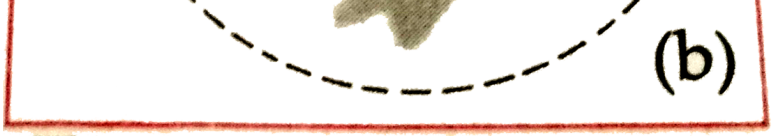

Fig 1.4: A stone tied to a string, moving along a circular path and its velocity in tangential direction

What happens if the string is released?

Watch Video Solution

3. Read the following paragraph carefully and answer the following:

Tie a stone to one end of a string. Take the other end in your hand and rotate the string

so that the stone moves along a circle.

As long as we are holding the string, we are pulling the stone towards us i.e. towards the centre of the circle and are appliying a force towards it. The force stops acting on it if we release the string. In this case, the stone will fly off along a straight line which is the tangent to the circle at the position of the stone when the string is released, because that the directionn of its velocity at that instant of time. You may recall a similar activity in which a 5 rupee coin kept on a rotating circular disc flies off the disc along the

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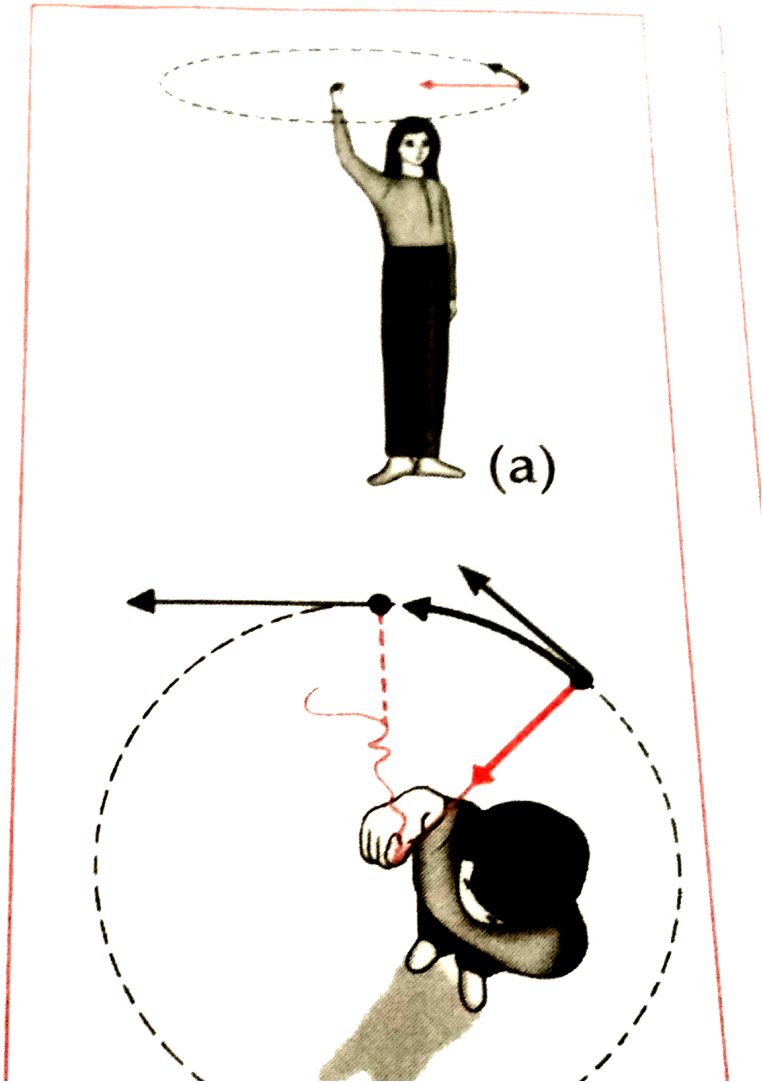

Fig 1.4: A stone tied to a string, moving along a circular path and its velocity in tangential direction

What is centripetal force?

Watch Video Solution

4. Take a small stone. Hold it in your hand.

We know that the force gravity due to the earth acts on each and every object. When we were holding the stone in our hand, the stone

was experiencing this force, but it was balanced by a force that we were applying onn it in the opposite direction. As a result, the stone remained at rest. Once we release the stone from our hands the only force that acts onit is the gravitational force of the earth and the stone falls down under its influence. Whenever an object moves under the influence of the force of gravity alone, it is said to be falling freely. Thus the released stone is in a free fall. In free fall, the initial velocity of the object is zero and goes on increasing due toi acceleration due to gravity of the earth.

During free fall, the frictional force due to air opposes the motion of the object anda buoyant force also acts on the object. Thus, true free fall is posible only in vacuum. For a freely falling object, the velocity on reachign the earth and the time taken for it can be calculated by using Newton's eqwuations of motion. For free fall the initial velocity $u = 0$ and the acceleration $a = g$. Thus, we can write the equations as

$$v = \mathrm{gt}, s = \frac{1}{2}\mathrm{gt}^2, v^2 = 2gs$$

For calculating the motion of an object thrown upwards, acceleration is negative, i.e.

in a direction opposite ot the velocity and is taken to be -g. The magnitude of g is the same but the velocity of the object decreases due to -ve acceleration.

The moon and the artificial satellites are moving only under the influence of the gravitational field of the earth. Thus they are in free fall.

Which force acts on the stone when held in the hand?

 Watch Video Solution

5. Take a small stone. Hold it in your hand.

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Which force acts on the stone in free fall after you release it?

Watch Video Solution

6. Take a small stone. Hold it in your hand.

We know that the force gravity due to the earth acts on each and every object. When we were holding the stone in our hand, the stone was experiencing this force, but it was balanced by a force that we were applying onn it in the opposite direction. As a result, the

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What is free fall?

Watch Video Solution

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For calculating the motion of an object

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The moon and the artificial satellites are moving only under the influence of the gravitational field of the earth. Thus they are in free fall.

What is the initial velocity and what is the effect of gravitational acceleration on the object in free fall?

 Watch Video Solution

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The moon and the artificial satellites are moving only under the influence of the gravitational field of the earth. Thus they are

in free fall.

Write kinematic equations used in free fall?

 Watch Video Solution

Assignment 1

1. The value of g at the centre of the Earth is zero. Explain?

 Watch Video Solution

2. Mass is also a measure of _____ of an object.

Watch Video Solution

3. Complete the analogy:

At poles $9.83 m / s^2$ :: At equator:_____

Watch Video Solution

4. The gravitational force of attraction between two objects is given by_____.

A. $F\alpha\frac{m_1m_2}{d^2}$

B. $F\alpha\frac{d^2}{m_1m_2}$

C. $F\alpha\frac{m_1m_2}{\sqrt{d^2}}$

D. $F\alpha\frac{m_1m_2}{d^3}$

Answer: A

Watch Video Solution

5. The gravitational force on the surface of the Moon is_____ times than that on the surface of the Earth.

A. five

B. one fifth

C. one sixth

D. six

Answer: C

 Watch Video Solution

6. 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?

Watch Video Solution

7. Defie: i. Centre of mass ii. Free fall

Watch Video Solution

8. Distinguish between : Weight and Mass

Watch Video Solution

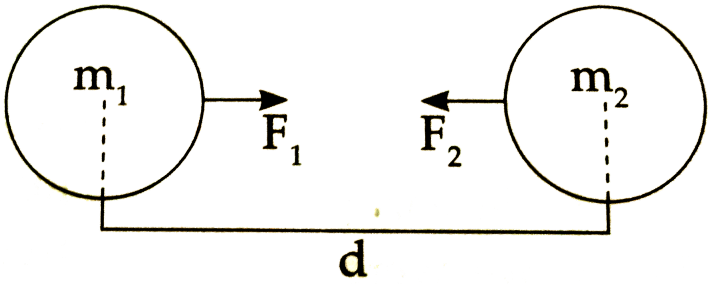
9. If a person weights 750 N on Earth, how much would be his weight on the Moon given that Moon's mass is $\frac{1}{81}$ of that of the Earth andits radius is $\frac{1}{3.7}$ of that of Earth.

Watch Video Solution

10. State the universal law of gravitation and derive its mathematical expression .

Watch Video Solution

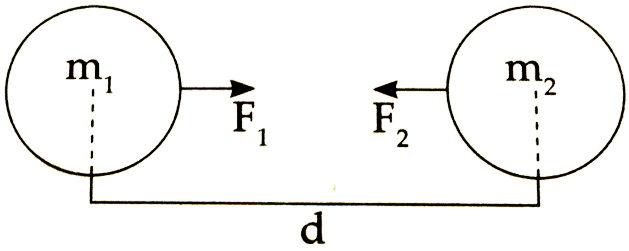
11. Observe the figure and anwer the following question:



Write gravitational force between them.

Watch Video Solution

12. Observe the figure and anwer the following question:



What will happen to gravitational force if mass of one of the objects is doubled?

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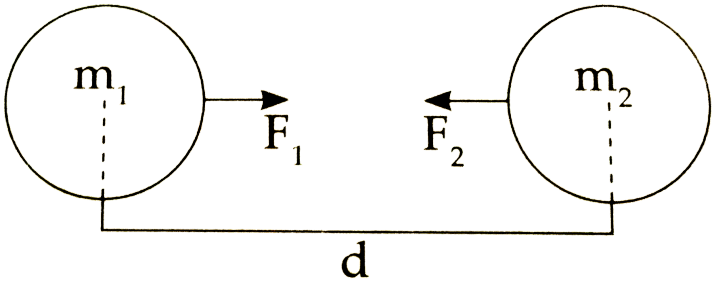
13. Observe the figure and anwer the following question:



What is the value of universal gravitational constant in SI system?

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14. Write the three laws given by Kepler. How did they help Newton to derive the inverse

square law of gravity?

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15. Define: Escape velocity and derive mathematically.

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