PHYSICS

BOOKS - NAVNEET PUBLICATION

GRAVITATION

Solved

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

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2. What types of forces are you familiar with?

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3. What do you know about the gravitational force?

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4. What are Newton's laws of motion.

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5. Take a small stone . Hold it in your hand. What are the forces acting on the stone? Now release the stone . What do you observe? What are the forces acting on the stone after you release it ?

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6. 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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Exercise

1. Fill in the blanks with appropriate words and write the completed sentences:

The ratio g_(earth) / g_(moon) is equal to....

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2. Fill in the blanks with appropriate words and write the completed sentences:

The value of the acceleration due to gravity ..... as we move from the equator to a pole.

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3. Fill in the blanks with appropriate words and write the completed sentences:

If the earth shrinks to half of its radius, its mass remaining the same, the weight of an object on the earth will become..... times.

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4. Fill in the blanks with appropriate words and write the completed sentences:

The SI unit of weight is the .....

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5. Fill in the blanks with appropriate words and write the completed sentences:

The CGS unit of weight is the.....

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6. Fill in the blanks with appropriate words and write the completed sentences:

The weight of a body is..... at the poles.

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7. Fill in the blanks with appropriate words and write the completed sentences:

Outside the earth, the weight of a body varies as.....

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8. Fill in the blanks with appropriate words and write the completed sentences:

Due to the ..... force, the earth attracts all objects towards it.

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9. Fill in the blanks with appropriate words and write the completed sentences:

The acceleration due to gravity does not depend on the..... of the body.

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10. Fill in the blanks with appropriate words and write the completed sentences:

According to Kepler's first law, the orbit of a planet is..... with the Sun at one of the.....

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11. Fill in the blanks with appropriate words and write the completed sentences:

According to Kepler's second law,the line

joining the planet and the Sun..... in equal intervals of time.

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12. Fill in the blanks with appropriate words and write the completed sentences:

According to Kepler's third law $T^2 \propto r^n$, where n=.....

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13. Fill in the blanks with appropriate words and write the completed sentences:

For a freely falling object we can write Newton's second equation of motion as.....

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14. Write the proper answer in the blank.

If this F = x , then F = ...

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15. Write the proper answer in the blank.

If this F = $\frac{Gm_1m_2}{d^2}$, then F=.....

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16. Choose the correct alternative and write it along with its allotted alphabet :

The gravitational force between two particles separated by a distance r varies as.....

A. 1/r

B. r

C. r^2

D. 1/r^2

Answer:

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17. Choose the correct alternative and write it along with its allotted alphabet :

In the usual notation, the acceleration due to

gravity at a height h from the surface of the earth 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:

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18. Choose the correct alternative and write it along with its allotted alphabet :

The SI unit of the universal constant of gravitation is.....

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19. Choose the correct alternative and write it along with its allotted alphabet :

THe escape velocity of a body from the earth's surface, v_(esc)=.....

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20. Choose the correct alternative and write it along with its allotted alphabet :

How much will a person with 72 N weight on the earth, weigh on the moon ?

A. 12 N

B. 36 N

C. 21 N

D. 63 N

Answer:

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21. Choose the correct alternative and write it along with its allotted alphabet :

What will be the weight of a person on the earth, who weighs 9N on the moon ?

A. 3 N

B. 15 N

C. 45 N

D. 54 N

Answer:

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22. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

If the seperation between two particles is doubled, the gravitational force between the particles becomes half the initial force.

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23. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

The CGS unit of the universal constant of gravitation is the dyne. cm^2 / gram^2.

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24. State whether the following statements are True or False: (If a statement is false,

correct it and rewrite it).

At the centre of the earth , the value of the acceleration due to gravity becomes zero.

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25. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

The weight of a body is minimum at the poles.

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26. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

Mass is a vector quantity.

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27. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

Weight is a vector quantity.

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28. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

g has maximum value at the equator.

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29. State whether the following statements are True or False: (If a statement is false,

correct it and rewrite it).

Outside the earth , g varies as 1/(R+h)^2.

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30. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

The value of G changes from place to place.

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31. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

The value of g decreases with depth below the earth's surface.

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32. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

The escape velocity of a body does not depend on the mass of the body.

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33. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

The mass of a body is the amount of matter present in it.

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34. State whether the following statements are True or False: (If a statement is false, correct it and rewrite it).

The value of g increases with altitude.

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35. 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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36. What is centripetal force ?

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37. Define : Centripetal force

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38. Answer the following questions :

Give one example of centripetal force.

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39. Answer the following questions :

Name the force responsible for the motion of

a planet around the sun.

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40. 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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41. Answer the following questions :

Explain with a diagram : Kepler's three laws.

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42. Answer the following questions :

In ithe following figure, an orbit of a planet around the sun (s) has been shown. AB and CD are the distances covered by the planet in equal time. Lines AS and CS sweep equal areas in equal intervals of time. Hence , areas ASB

and CSD are equal.

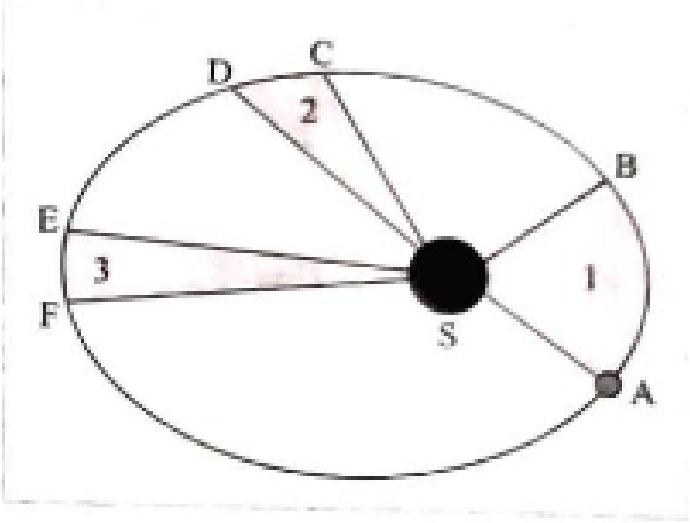

Fig. 1.7 (Schematic diagram)

Write the law regarding area swept.

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43. Answer the following questions :

Write the law `T^2 prop r^3 in your words .

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44. Answer the following questions :

Observe the given figure and state which three laws we understand from it.

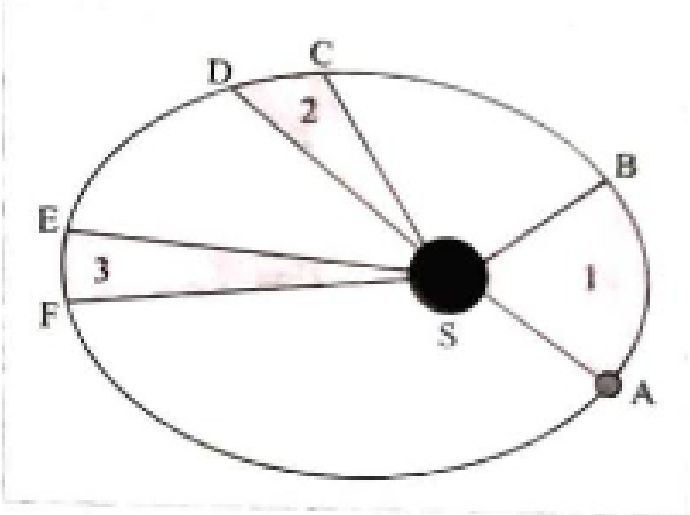

Fig. 1.7 (Schematic diagram)

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45. Answer the following questions :

Observe the given figure showing the orbit of a planet moving around the sun and write the three laws related to it.

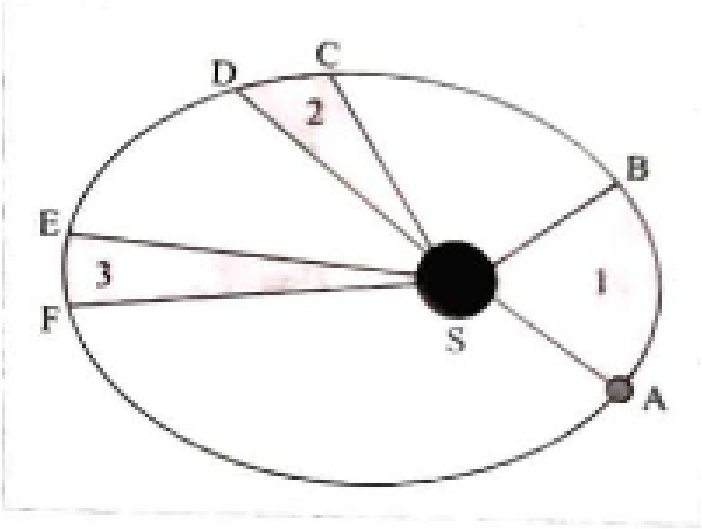

Fig. 1.7 (Schematic diagram)

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46. Answer the following questions :

Explain the term gravitational force. What is gravitation ?

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47. Answer the following questions :

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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48. Answer the following questions :

State Newton's universal law of gravitation. Express it in mathematical form.

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49. Answer the following questions :

Why is the constant of gravitation called a universal constant ?

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50. Answer the following questions :

Newton's law of gravitation is called the universal law of gravitation . Why ?

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51. Answer the following questions :

State any one characteristics of gravitational force.

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52. Answer the following questions :

If the distance between two bodies is increased by a factor of 5,

By what factor will the gravitational force change if the masses are kept constant?

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53. Answer the following questions :

f the distance between two bodies is increased

by a factor of 5,

By what factor will the mass of one of them have to be altered, keeping the other mass the same, to maintain the same gravitational force between the two bodies ?

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54. Answer the following questions :

Determine the SI unit of the universal constant of gravitation from the formula for the gravitational force between two particles.

Hence, state the CGS unit of the constant of gravitation .

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55. Answer the following questions :

Define G (universal gravitational constant).

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56. Answer the following questions :

State the importance of Newton's universal

law of gravitation.

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57. Answer the following questions :

Compare the gravitational force on a body of mass 1 kg due to the earth with the force on the same body due to another body of mass 1 kg at a distance of 1m from the first body. (Mass of the earth = 6xx10^24 kg, radius of the earth= 6400 km)

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58. Answer the following questions :

Explain the term the earth's gravitational force.

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59. Answer the following questions :

Write a short note on the earth's gravitational force.

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60. Answer the following questions :

Take two balls of different masses, go to the top of a building, drop them simultaneously and observe what happens to the balls.

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61. Answer the following questions :

Take two similar pages from your notebook. Crumple one paper and allow this and the

other paper to fall on the ground simultaneously. What do you observe ?

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62. Answer the following questions :

Take a feather and a paper. Allow them to fall to the ground simultaneously . Which will reach the ground earlier? why?

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63. Answer the following questions :

What is the acceleration due to gravity?

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64. Answer the following questions :

Define acceleration due to gravity ?

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65. Answer the following questions :

From Newton's law of gravitation , derive the formula for the acceleration due to gravity.

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66. Answer the following questions :

What is the acceleration due to gravity at a height h (=radius of the earth) from the surface of the earth ? (g=9.8m/s^2)

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67. Answer the following questions :

Explain the factors affecting the value of g.

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68. Answer the following questions :

If g =GM /r^2, then where will the value of g be high, at Goa Beach or on the top of the Mount Everest ?

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69. Answer the following questions :

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

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70. Answer the following questions :

Does the value of g change while going deep inside the earth ? why ?

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71. Answer the following questions :

Explain why the value of g changes if we go inside the earth ?

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72. Answer the following questions :

Why does an object released from the hand, fall on the earth ?

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73. Answer the following questions :

Does the value of g depend on the mass of the falling body ? why ?

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74. Answer the following questions :

Define mass . State its SI and CGS units.

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75. Answer the following questions :

Define weight . State its SI and CGS units.

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76. Answer the following questions :

As per the request of one of his friends from the equator, Rahul buys 100 grams of silver at the north pole. He hands it over to his friend at the equator. Will the friend agree with the weight of the silver bought ? If not, why ?

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77. Answer the following questions :

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

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78. 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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79. What is free fall?

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80. Define free fall

Watch Video Solution

81. Answer the following questions :

Explain the term free fall and state the corresponding kinematical equations of motion in the usual notation.

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82. Answer the following questions :

During a free fall, will a heavier object accelerate more than a lighter one ?

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83. Answer the following questions :

What are the factors on which the maximum height attained by a body throws upward depends ?

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84. Answer the following questions :

If you had to calculate the mass of the earth, how would you do it ?

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85. Answer the following questions :

What is gravitational potential energy ?

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86. Define: Gravitational Potential energy

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87. Answer the following questions :

What is escape velocity ?

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88. Define: Escape velocity

Watch Video Solution

89. Explain the terms: escape velocity

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90. Answer the following questions :

Write a short note on escape velocity.

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91. Answer the following questions :

Using the law of conservation of energy, obtain the expression for the escape velocity.

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92. Answer the following questions :

Express escape velocity in terms of g and R.

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93. Answer the following questions :

Express escape velocity in terms of G,R and rho (the earth's density).

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94. Fill in the blanks and complete the following paragraph . (words given: upward, friction,negligible,downward , gravitational , buoyance , very large, electric)

When a body falls in air, there are three forces acting on the body : (1) the gravitational force due to the earth, acting.....(2) the force of ..... due to air, acting .....(3) the force due to..... with air, acting in the direction oppositeto that of the velocity of the body. Under certain conditions, the force of buoyancy due to air and friction with air can be..... compared to

the.....force of the earth. In that case (near the earth's surface) the body falls with almost uniform acceleration (g). Whenever a body moves under the influence of the force of gravity alone, it is said to be falling freely. Strictly speaking, this is true only if the body falls in vaccum.

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95. Give scientific reasons:

If a feather and a stone are released from the

top of a building simultaneously, the stone reaches the ground earlier than the feather.

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96. Give scientific reasons:

The weight of an object changes from place to place though its mass is constant.

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97. Give scientific reasons:

The weight of a body is different on different planets.

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98. Give scientific reasons:

With a specific initial velocity , we can jump higher on the moon than on the earth.

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99. Distinguish between

Mass and weight.

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100. Distinguish between

universal gravitational constant and gravitational acceleration of the earth.

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101. Solve the following examples / numerical problems:

The time taken by the earth to complete on revolution around the Sun is 3.156 xx 10^7 s. The distance between the earth and the sun is 1.5 xx 10^11 m . Find the speed of revolution of the earth.

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102. Solve the following examples / numerical problems:

Assuming that the earth performs uniform circular motion around the Sun, find the centripetal acceleration of the earth. [Speed of the earth =3 xx10^4 m/s, distance between the earth and the Sun= 1.5xx10^11 m]

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103. Solve the following examples / numerical problems:

What will be the gravitational force on 60 kg man on the Moon,Mars and jupiter ? Are they the same ? why ?

M (Moon) = 7.36xx10^22 kg, R (Moon)= 1.74 xx 10^6 m.

M (Mars) = 6.4xx 10^23 kg, R (Mars) = 3.395 xx10^6 m,

M (Jupiter)=1.9xx10^27 kg. R (Jupiter) = 7.15xx10^7m.

G=6.67 xx10^-11 N-m^2 / kg^2.

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104. 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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105. Solve the following examples / numerical problems:

Mahendra and virat are sitting at a distance of 1 meter from each other. Their masses are 75 kg and 80 kg respectively. What is the gravitational force between them ? G = 6.67 xx 10^-11 N-m^2/kg^2.

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106. Solve the following examples / numerical problems:

Two spheres of uniform density have masses 10 kg and 40 kg . The distance between the centres of the spheres is 200 m. Find the gravitational force between them.

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107. Solve the following examples / numerical problems:

Find the gravitational force between a man of mass 50 kg and a car of mass 1500 kg separated by 10m.

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108. Solve the following examples / numerical problems:

Find the magnitude of the gravitational force between the Sun and the earth.(Mass of the Sun =2xx10^30 kg, mass of the earth = 6xx10^24 kg and the distance between the

centres of the Sun and the earth = 1.5xx 10^11 m, G =6.67 xx10^-11 N-m^2 /kg^2).

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109. 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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110. Solve the following examples / numerical problems:

Find the magnitude of the acceleration due to gravity at the surface of the earth. (M= 6xx 10^24 kg, R= 6400 km)

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111. 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 vlaue of g on B is half that of its value of A?

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112. Solve the following examples / numerical problems:

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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113. Solve the following examples / numerical problems:

The mass of a planet is 3 times the mass of the earth. Its diameter is 25600 km and the earth's diameter is 12800km. Find the acceleration due to gravity at the surface of the planet. [g (earth)=9.8 m/s^2]

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114. Solve the following examples / numerical problems:

If the acceleration due to gravity on the surface of the earth is 9.8 m/s^2, what will be the acceleration due to gravity on the surface of a planet whose mass and radius both are two times the corresponding quantities for the earth ?

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115. 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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116. Solve the following examples / numerical problems:

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 = 10m/s^2.

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117. Solve the following examples / numerical problems:

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

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118. Solve the following examples / numerical problems:

A body is released from the top of a building of height 19.6 m . Find the velocity with which the body hits the ground.

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119. Solve the following examples / numerical problems:

A stone on a bridge on a river falls into the river. If it takes 3 seconds to reach the surface of water, find (i) the velocity of the stone at the instant it touches the surface of water (ii)

the height of the bridge from the surface of water.

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120. Solve the following examples / numerical problems:

A stone is dropped from rest from the top of a building 44.1 m high. It takes 3 s to reach the ground . Use this information to calculate g.

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121. Solve the following examples / numerical problems:

A metal ball of mass 5 kg falls from a height of 490 m. How much time will it take to reach the ground ?

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122. Solve the following examples / numerical problems:

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 10 m/s^2, calculate (a) the time taken by the ball to reach the ground (b) the velocity of the ball on reaching the ground.

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123. Solve the following examples / numerical problems:

If the weight of a body on the surface of the moon is 100 N , what is its mass ?

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124. Solve the following examples / numerical problems:

A 100 kg bag of wheat is placed on a plank of wood. What is the weight of the bag and what is the reaction force exerted by the plank ?

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125. Solve the following examples / numerical problems:

The mass and weight of an object on the earth

are 5 kg and 49 N respectively. What will be their values on the moon? Assume that the acceleration due to gravity on the moon is 1/6th of that on the earth.

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126. Solve the following examples / numerical problems:

Find the gravitational potential energy of a body of mass 10 kg when it is on the earth's

surface. [M_(earth) = 6 xx10^24 kg , R_(earth) = 6.4 xx10^6m, G= 6.67 xx 10^-11 N-m^2/kg^2]

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127. Solve the following examples / numerical problems:

If the body performs uniform circular motion around the earth at a height of 3600 km from the earth's surface, what will be its gravitational potential energy ?

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128. Solve the following examples / numerical problems:

A body of mass 20 kg is at rest on the earth's surface. (i) Find its gravitational potential energy. (ii) Find the kinetic energy to be provided to the body to make it free from the gravitational influence of the earth. (g=9.8 m/s^2, R=6400km)

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129. Solve the following examples / numerical problems:

If the body is moving at 100 m/s on the earth's surface , what will be its (i) Kinetic energy (ii) total energy ?

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130. Solve the following examples / numerical problems:

A satellite of mass 100 kg performs uniform

circular motion around the earth at a height of 6400 km from the earth's surface . Find its gravitational potential energy. [g=9.8 m/s^2, R=6400 km]

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131. Solve the following examples / numerical problems:

Find the escape velocity of a body from the earth. [M_(earth)= 6xx10^24 kg,

R_(earth)=6.4xx10^6m,G=6.67xx10^-11 N-m^2/kg^2]

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132. Solve the following examples / numerical problems:

Find the escape velocity of a body from the earth. [R_(earth)= 6.4xx10^6 m, rho_(earth)= 5.52xx10^3 kg/m^3,G=6.67xx10^-11 N-m^2/kg^2]

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133. Solve the following examples / numerical problems:

Calculate the escape velocity of a body from the moon.[g(moon)=1.67m/s^2, R(moon)=1.74xx10^6m]

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134. Solve the following examples / numerical problems:

The mass of a planet is four times that of the earth and its radius is double the radius of the

earth. The escape velocity of a body from the earth is 11.2×10^3 m/s. Find the escape velocity of a body from the planet.

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135. A satellite of mass 1000 kg revolves around the earth in a circular path. If the distance between the satellite and the centre of the earth is 40000 km, find the gravitational force exerted on the satellite by the earth.

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136. The masses of two spheres are 10 kg and 20 kg respectively. If the distance between their centres is 100 m , find the magnitude of the gravitational force betweem them.

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137. A satellite revolves around the earth along circular path. If the mass of the satellite is 1000 kg and its distance from the centre of the earth is 20000 km, find the magnitude of

the earth's gravitational force acting on the satellite.

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138. Find the acceleration due to gravity at a distance of 20000 km from the centre of the earth.

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139. What is the weight of a body of mass 100 kg at the south pole ? (g=9.832 m/s^2)

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140. What is the weight of a body of mass 20kg at the equator ?(g=9.78 m/s^2)

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141. A body is released from the top of a tower of height 50 m. Find the velocity with which the body hits the ground. (g=9.8 m/s^2)

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142. A body is thrown vertically upward with a velocity of 9.8 m/s. Calculate the maximum height attained by the body.(g=9.8 m/s^2)

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143. A particle of mass 10^-6 kg performs uniform circular motion. Its period is 10 s and the radius of the circle is 2 m. Find (i) the speed of the particle (ii) the centripetal acceleration of the particle (iii) the centripetal force on the particle.

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144. Find the gravitational potential energy of a body of mass 200 kg on the earth's surface . [M (earth) = 6xx 10^24 kg, R(earth) =6400 km]

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145. Find the gravitational potential energy of a body of mass 10 kg when it is at a height of 6400 km from the earth's surface. [M (earth) = 6xx 10^24 kg, R(earth) =6400 km]

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146. Solve the following examples / numerical problems:

Calculate the escape velocity of a body from the moon.[g(moon)=1.67m/s^2, R(moon)=1.74xx10^6m]

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