TEST

JEE Mains PYQs Gravitation (Physics Master Academy)

QUESTIONS

SECTIONS

1. Section A - 25 Questions

Section 1 : Section A - 25 Questions

SECTION INSTRUCTIONS

This section contains 25 MCQs. +4 for every correct anser, -1 for eery incorrect answer.

1 A planet revolving in elliptical orbit has

A. A constant velocity of revolution
B. has the least velocity is when it is nearest to the sun
C. its areal velocity is directly proportional to its velocity
D. areal velocity is inversely proportional to its velocity
E. to follow a trajectory such that the areal velocity is constant

Choose the correct answer from the options given below:

- ○ A only
- ○ E only
- ○ D only
- ○ C only

Correct: +4 · Incorrect: -1

2 A particle is moving with uniform speed along the circumference of a circle of radius R under the action of a central kctitious force F which is inversely proportional to R^3. Its time period of revolution will be given by

- ○ $T \propto R^{4/3}$
- ○ $T \propto R^{3/2}$
- ○ $T \propto R^2$

○ $T \propto R^{5/2}$

Correct: +4 · Incorrect: -1

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

○ 10 hours

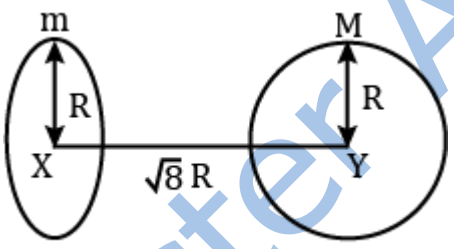
○ 80 hours

○ 40 hours

○ 20 hours

Correct: +4 · Incorrect: -1

4 Find the gravitational force of attraction between the ring and sphere as shown in diagram, where the plane of the ring is perpendicular to the line joining the centres. If $\sqrt{8}$ R is the distance between the centres of a ring (of mass m)and a sphere of mass M) where both have equal radius R.



○ $\frac{1}{3\sqrt{8}} \cdot \frac{GMm}{R^2}$

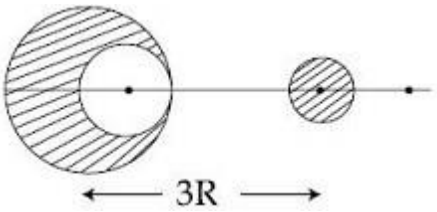
○ $\frac{\sqrt{8}}{9} \cdot \frac{GMm}{R^2}$

○ $\frac{\sqrt{8}}{27} \cdot \frac{GMm}{R^2}$

○ $\frac{2\sqrt{2}}{3} \cdot \frac{GMm}{R^2}$

Correct: +4 · Incorrect: -1

5 From a sphere of mass M and radius R a smaller sphere of radius R/2 is carved out such that the cavity made in the original sphere is between its centre and the periphery (see kg). For the conkguration in the kgure where the distance between the centre of the original sphere and the removed sphere is 3R, the gravitational force between the two spheres is



- $\frac{41GM^2}{3600R^2}$
- $\frac{41GM^2}{450R^2}$
- $\frac{59GM^2}{450R^2}$
- $\frac{GM^2}{225R^2}$

Correct: +4 · Incorrect: -1

6 Consider a planet in some solar system which has a mass double the mass of earth and density equal to the average density of earth. If the weight of an object on earth is W, the weight of the same object on that planet will be

- 2W
- W
- $2^{1/3}$W
- $\sqrt{2}$W

Correct: +4 · Incorrect: -1

7 A body weights 49N on a spring balance at the north pole. What wil be its weight recorded on the same weighing machine if it is shifted to the equator? (use and radius of earth, R = 6400km)

- 49N
- 48.83N
- 49.83N
- 49.17N

Correct: +4 · Incorrect: -1

8 A box weighs 196N on a spring balance at the north pole. Its weight recorded on the same balance if it is shifted to the equator is close to (take g = 10 ms^{-2} at the north pole and the radius of the earth = 6400km)

- 195.66N
- 194.32N
- 194.66N
- 195.32N

Correct: +4 · Incorrect: -1

9 The ratio of the weights of a body on earth's surface to that on the surface of a planet is 9:4. The mass of planet is 1/9 th of that of the earth. If 'R' is the radius of the earth, what is the radius of the planet? (take the planets to have the same density)

- R/3
- R/4
- R/9
- R/2

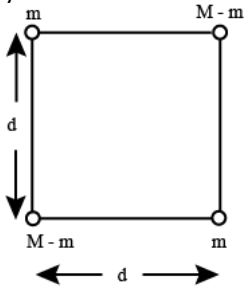
Correct: +4 · Incorrect: -1

10 Suppose that the angular velocity of rotation of earth is increased, Then as a consequence

- there will be no change in weight in anywhere on the earth
- weight of the object everywhere on the earth, will decrease
- weight of the object everywhere on the earth, will increase
- except at poles, weight of the object on the earth will decrease

Correct: +4 · Incorrect: -1

11 A body of mass(2M) splits into four masses (m, M – m, m, M = - m) which are rearranged to form a square as shown in kgure. The ratio of M/m for which the gravitational potential energy of the system becomes maximum is x: 1. The value of x is ___



- 1
- 2
- 3
- 4

Correct: +4 · Incorrect: -1

12 Inside a uniform spherical shell
A. the gravitational keld is zero
B. the gravitational potential is zero
C. the gravitational keld is same everywhere
D. the gravitation potential is same everywhere
E. all of the above
Choose the most appropriate answer from the options given below

- A, C and D only
- E only
- A, B and C only
- B, C and D only

Correct: +4 · Incorrect: -1

13 If one wants to remove all the mass of the earth to inknity in order to break it up completely. The amount of energy that needs to be supplied will be $\frac{x}{5}\frac{GM^2}{R}$ where x is____(Round off to nearest integer) (M is the mass of earth, R is radius of earth, G is the gravitational constant)

- 1
- 2
- 3
- 4

Correct: +4 · Incorrect: -1

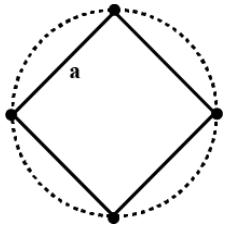
14 A solid sphere of mass 'M' and radius 'a' is surrounded by a uniform concentric spherical shell of thickness 2a and mass 2M. The gravitational keld at distance '3a' from the centre will be

- $\frac{2GM}{9a^2}$

- $\frac{GM}{9a^2}$
- $\frac{GM}{3a^2}$
- $\frac{2GM}{3a^2}$

Correct: +4 · Incorrect: -1

15 Four identical particles of mss M are located at the corners of a square of side 'a'. What should be their sped if each of them revolves under the influence of others gravitational keld in a circular orbit of circumscribing the square?



- $1.35\sqrt{\frac{GM}{a}}$
- $1.16\sqrt{\frac{GM}{a}}$
- $1.21\sqrt{\frac{GM}{a}}$
- $1.41\sqrt{\frac{GM}{a}}$

Correct: +4 · Incorrect: -1

16 The masses are radii of the earth and moon are (M_1, R_1) and (M_2, R_2) respectively. Their centres are at a distance 'r' apart. Find the minimum escape velocity for a particle of mass 'm' to be projected from the middle of these two masses:

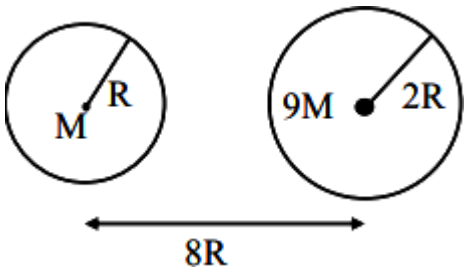
- $V=\frac{1}{2}\sqrt{\frac{4G(M_1+M_2)}{r}}$
- $V=\sqrt{\frac{4G(M_1+M_2)}{r}}$
- $V=\frac{1}{2}\sqrt{\frac{2G(M_1+M_2)}{r}}$

○ $V=\frac{\sqrt{2}G(M_1+M_2)}{r}$

Correct: +4 · Incorrect: -1

17 Suppose two planets (spherical in shape) of radii R and 2R, but mass M and 9M respectively have a center to centre separation 8R as shown in kgure. A satellite of mass 'm' is projected from the surface of the planet of mass 'M' directly towards the centre of the second planet. The minimum speed 'v' required for the satellite to reach the surface of the second planet is $\sqrt{\frac{a}{7}\frac{GM}{R}}$ then the value of 'a' is ___

[Given : Two planes are kxed in their position]



○ 2

○ 3

○ 4

○ 5

Correct: +4 · Incorrect: -1

18 A satellite is launched into a circular orbit of radius R around earth, while a second satellite is launched into a circular orbit of radius 1.02R. The percentage difference in the same periods of the two satellites is

○ 1.5

○ 2.0

○ 0.7

○ 0.03

Correct: +4 · Incorrect: -1

19 The maximum and minimum distances of a comet from the sun are 1.6×10^{12}m and 8.0×10^{10}m respectively. If the speed of the comet at the nearest point is 6×10^{4} ms^{-1}, the speed at the farthest point is

○ 6.0×10^{3} m/s

○ 3.0×10^{3} m/s

- 4.5×10^3 m/s
- 1.5×10^3 m/s

Correct: +4 · Incorrect: -1

20 The initial velocity v_i required to project a body vertically upward form the surface of the earth t reach a height of 10R, where R is the radius of the earth, may be described in terms of escape velocity v_e such that v_i = $\sqrt{\frac{x}{y}}\times v_e$. The value of x is____

- 5
- 10
- 15
- 20

Correct: +4 · Incorrect: -1

21 Two stars of masses m an d2m at a distance d rotate about their common centre of mss in free space. The period of revolution is

- $\frac{1}{2\pi}\sqrt{\frac{d^3}{3Gm}}$
- $2\pi\sqrt{\frac{d^3}{3Gm}}$
- $\frac{1}{2\pi}\sqrt{\frac{3Gm}{d^3}}$
- $2\pi\sqrt{\frac{3Gm}{d^3}}$

Correct: +4 · Incorrect: -1

22 A body of mass m is moving in a circular orbit of radius R about a planet. Another body B of mass m/2 collides with A with a velocity which is half ($\vec{v}/2$) the instantaneous velocity $\vec{v}$ of A. The collision is completely inelastic. Then, the combined body

- continues to move in a circular orbit
- escapes from the planet's gravitational keld

- falls vertically downwards towards the planet
- starts moving in an elliptical orbit around the planet

Correct: +4 · Incorrect: -1

23 A satellite of mass m is launched vertically upwards with an initial speed u from the surface of the earth. After it reaches height R (R = radius of the earth), it ejects a rocket of mass m/10 so that subsequently the satellite moves in a circular orbit. The kinetic energy of the rocket is (G is gravitational constant; M is the mass of the earth)

- $\frac{m}{20}\left(u^2+\frac{113}{200}\frac{GM}{R}\right)$
- $5m\left(u^2-\frac{119}{200}\frac{GM}{R}\right)$
- $\frac{3m}{8}\left(u+\sqrt{\frac{5GM}{6R}}\right)^2$
- $\frac{m}{20}\left(u-\sqrt{\frac{2GM}{3R}}\right)^2$

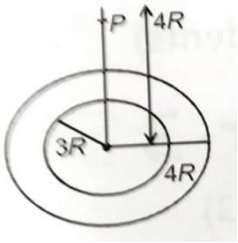
Correct: +4 · Incorrect: -1

24 Two stars of masses 3×10^{31} kg each and of distance 2×10^{11}m rotate in plane about their common centre of mass O. A meteorite passes through O moving perpendicular to the star's rotation plane. In order to escape from the gravitational keld of this double star, the minimum speed that meteorite should have a O is (take gravitational constant G = $66\times10^{-11}Nm^2kg^{-2}$)

- 2.4×10^4m/s
- 1.4×10^5m/s
- 3.8×10^4m/s
- 2.8×10^5m/s

Correct: +4 · Incorrect: -1

25 A thin uniform annular disc, in the kgure given below has mass M. its outer radius is 4R and inner radius 3R



The work required to take a unit mass from point p on its axis to inknity is

- $\frac{2GM}{7R}$¿-5)
- $\frac{-2GM}{7R}$¿-5)
- GM/4R
- $\frac{2GM}{5R}$¿-1)

Correct: +4 · Incorrect: -1

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ANSWERS

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3 40 hours

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5 $\frac{41\,GM^2}{3600\,R^2}$

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7 48.83N

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9 R/2

10 except at poles, weight of the object on the earth will decrease

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14 $\frac{GM}{3a^2}$

15 $1.16\sqrt{\frac{GM}{a}}$

16 $V=\sqrt{\frac{4G(M_1+M_2)}{r}}$

17 4

18 0.03

19 3.0×10^3 m/s

20 10

21 $2\pi\sqrt{\frac{d^3}{3Gm}}$

22 starts moving in an elliptical orbit around the planet

23 $5m\left(u^2-\frac{119}{200}\frac{GM}{R}\right)$

24 2.8×10^{5}m/s

25 $\frac{2GM}{7R}$¿-5)

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