Gravitation JEE Main PYQ - 3

Total Time: 25 Minute **Total Marks:** 40

Instructions

Instructions

1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Gravitation

1. Given below are two statements: **(+4, -1)**
Statement I : Acceleration due to gravity is different at different places on the surface of earth
Statement II : Acceleration due to gravity increases as we go down below the earth's surface
In the light of the above statements, choose the correct answer from the options given below

[24-Jan-2023 Shift 2]

a. Both Statement I and Statement II are false

b. Statement I is false but Statement II is true

c. Statement I is true but Statement II is false

d. Both Statement I and Statement II are true

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2. At a certain depth "d" below surface of earth, value of acceleration due to gravity becomes four times that of its value at a height $3R$ above earth surface Where R is Radius of earth (Take $R = 6400\,km$) The depth d is equal to **(+4, -1)**

[31-Jan-2023 Shift 1]

a. $4800\,km$

b. $640\,km$

c. $2560\,km$

d. $5260\,km$

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3. The weight of a body at the surface of earth is $18\,N$ The weight of the body at an altitude of $3200\,km$ above the earth's surface is (given, radius of earth $R_e = 6400\,km$): **(+4, -1)**

[24-Jan-2023 Shift 1]

a. 19.6 N

b. 9.8 N

c. 4.9 N

d. 8 N

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4. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R **(+4, -1)**

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

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

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

[24-Jan-2023 Shift 2]

a. Both A and R are correct but R is NOT the correct explanation of A

b. Both A and R are correct and R is the correct explanation of A

c. A is not correct but R is correct

d. A is correct but R is not correct

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5. A body of mass is taken from earth surface to the height h equal to twice the radius of earth (R_e) the inerease in potential energy will be:(g = acceleration due to gravity on the surface of Earth) **(+4, -1)**

[25-Jan-2023•Shift•2]

a. $\frac{1}{2}mgR_e$

b. $3mgR_e$

c. $\frac{2}{3}mgR_e$

d. $\frac{1}{3}mgR_e$

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6. The length of a seconds pendulum at a height $h=2R$ from earth surface will be : **(+4, -1)**

(Given : R= Radius of earth and acceleration due to gravity at the surface of earth $g=\pi^2 ms^{-2}$)

[1-Feb-2024 Shift 1]

a. $\frac{2}{9}m$

b. $\frac{4}{9}m$

c. $\frac{8}{9}m$

d. $\frac{1}{9}m$

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7. An object is taken to a height above the surface of earth at a distance $\frac{5}{4}R$ from the centre of the earth Where radius of earth, $R = 6400km$ The percentage decrease in the weight of the object will be **(+4, -1)**

[25-Jul-2022-Shift-2]

a. 36%

b. 50%

c. 64%

d. 25%

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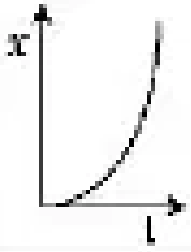
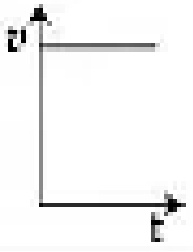
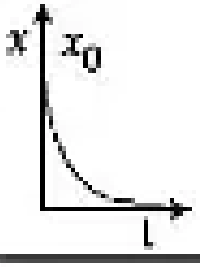
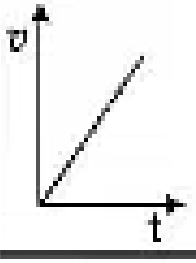
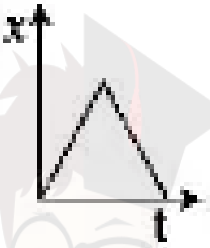
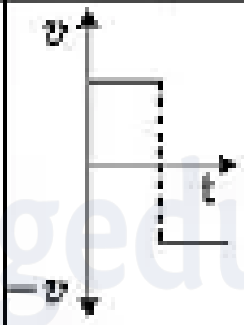
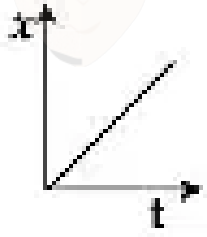
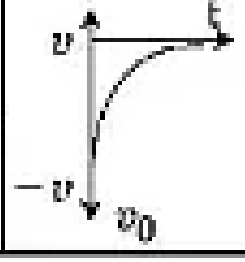
8. Match Column-I with Column-II : Choose the correct answer from the options given below: **(+4, -1)**

Column-I (x-t graphs)		Column-II (v-t graphs)	
A.		I.	
B.		II.	
C.		III.	
D.		IV.	

a. A- I, B-III, C-IV, D-II

b. A- II, B-IV, C-III, D-I

c. A- II, B-III, C-IV, D-I

d. A- I, B-II, C-III, D-IV

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9. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R). **(+4, -1)**

Assertion (A): Earth has atmosphere and moon doesn't
Reason (R): escape speed on moon is less than that of Earth.
In the light of the above statements, choose the correct answer from the options given below:

[6-Apr-2023 shift 1]

a. (A) and (R) are correct and (R) is the correct explanation of (A)

b. (A) and (R) are correct and (R) is not the correct explanation of (A)

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

d. (A) and (R) both are false

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10. A planet has density same as that of Earth and mass is twice that of Earth. If the weight of an object on Earth is "W" then the weight on the planet is: **(+4, -1)**

a. $2^{\frac{2}{3}}W$

b. $2^{\frac{1}{3}}W$

c. $2^{\frac{4}{3}}W$

d. W

Answers

1. **Answer: c**

Explanation:

$g_{\text{eff}} = g - \omega^2 R_e \sin^2\theta, \theta \rightarrow$ co-latitude angle
$g_{\text{eff}} = g\left(1 - \frac{d}{R_e}\right)$, d here depth

Concepts:

1. Gravitation:

In mechanics, the universal force of attraction acting between all matter is known as **Gravity**, also called **gravitation**, . It is the weakest known force in nature.

Newton's Law of Gravitation

According to Newton's law of gravitation, "Every particle in the universe attracts every other particle with a force whose magnitude is,

- $F \propto (M_1M_2) \ldots . (1)$
- $(F \propto 1/r^2) \ldots . (2)$

On combining equations (1) and (2) we get,

$F \propto M_1M_2/r^2$

$F = G \times [M_1M_2]/r^2 \ldots . (7)$

Or, $f(r) = GM_1M_2/r^2$

The dimension formula of G is $[M^{-1}L^3T^{-2}]$.

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2. **Answer: a**

Explanation:

$\frac{GM}{R^2}\left[1-\frac{d}{R}\right] = \frac{4\times GM}{(4R)^2}$

$1-\frac{d}{R} = \frac{1}{4}$

$\Rightarrow \frac{d}{R} = \frac{3}{4}$

$\Rightarrow d=\frac{3}{4}R$

$\Rightarrow d= \frac{3}{4}$ x 6400

$\Rightarrow$ d=4800 km

So, the correct option is (A): 4800 km

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3. Answer: d

Explanation:

Acceleration due to gravity at height h

$g' = \frac{g}{[1+\frac{h}{R}]^2}$

So weight at given height

$mg' = \frac{mg}{[1+\frac{h}{R}]^2}$

$= \frac{18}{[1+\frac{1}{2}]^2} = 8N$

Therefore, the correct option is (D):$8N$

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4. Answer: c

Explanation:

$T \propto \frac{1}{\sqrt{g}}$

Time period of pendulum is inversely proportional to acceleration due to gravity.

So, the correct answer is (C): A is not correct but R is correct

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5. **Answer: c**

Explanation:

The correct answer is (C) : $\frac{2}{3}mgR_e$

$U = \frac{-GM_em}{r}$

$U_i = \frac{-GM_em}{R_e}$

$U_f = \frac{-GM_em}{(R_e+h)} = \frac{-GM_em}{R_e+2R_e}$
$\frac{-GM_em}{3R_e}$
Increase in internal energy $\Delta U = U_f - U_i$
$= \frac{2}{3}\frac{GM_em}{R_e}$
$\frac{2}{3}\frac{GM_e}{R_e^2}mR_e$
$= \frac{2}{3}mgR_e$

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6. Answer: d

Explanation:

$T = 2\pi\sqrt{\frac{L}{g}}, g' = \frac{GM}{9R^2} = \frac{g}{9} = \frac{\pi^2}{9}$
$2 = 2\pi\sqrt{\frac{L}{\pi^2} \times 9}$

$\Rightarrow 1 = \pi\sqrt{L} \times \frac{3}{\pi} \Rightarrow L = \frac{1}{9}m$

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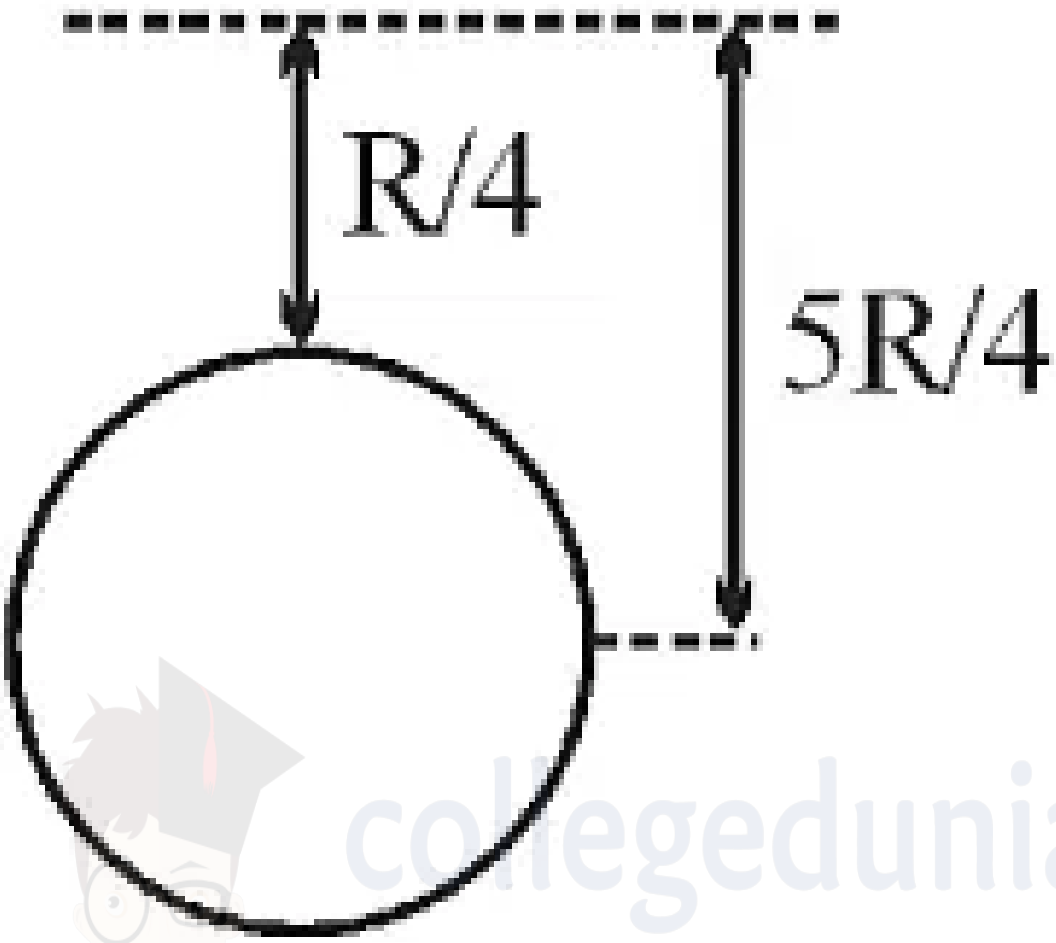
7. Answer: a

Explanation:



$g_{\text{eff}} = \frac{g}{\left(1+\frac{h}{R}\right)^2}; g_{\text{eff}} = \frac{g}{\left(1+\frac{1}{4}\right)^2} = \frac{16g}{25}$

$\text{change} = \frac{g_{\text{eff}}-g}{g} \times 100 = \frac{\frac{16}{25}-1}{1} \times 100$

$= \frac{-9}{25} \times 100 = -36\%$

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8. **Answer: b**

Explanation:

$\frac{dx}{dt} =$ slope ≥ 0 always increasing
(A - II)
$\frac{dx}{dt} < 0$; and at $t \to \infty \frac{dx}{dt} \to 0$
(B - IV)
$\frac{dx}{dt} > 0$ for first half $\frac{dx}{dt} < 0$ for second half.
(C - III)
$\frac{dx}{dt} =$ constant
(D - I)

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---

9. **Answer: a**

Explanation:

The correct option is (A): (A) and (R) are correct and (R) is the correct explanation of (A)

$V_{esc} = \sqrt{\frac{2GM}{R}} = \sqrt{\frac{2G}{R} \times \frac{\rho 4}{3}\pi R^3}$

$V_{esc} \propto R$

As the moon's radius is very small as compared to earth. V_{esc} at the moon is quite low and the gas molecules attains escape velocity at normal temperature on the moon.

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10. Answer: b

Explanation:

The correct option is(B): $2^{\frac{1}{3}}W$

Planet with the mass M has radius as R and Planet with mass 2M has radius as R'

$\rho\frac{4}{3}\pi R^3 = M$

$\rho\frac{4}{3}\pi R'^3 = 2M$

$\Rightarrow R' = 2^{\frac{1}{3}}R$

$= 2\frac{GM}{2^{\frac{2}{3}}R^2} = 2^{\frac{1}{3}}\frac{Gm}{R^2} = 2^{\frac{1}{2}}W$

$W' = 2^{\frac{1}{3}}W$

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