IITIAN'S SPECTRUM
Prudent Minds, Promising Path
IIT JEE/NEET FOUNDATION

Founder-Director
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B.Tech (IIT)

PHYSICS

DPS-6

DAILY PRACTICE SHEET

Class XI

Gravitation

INSTRUCTIONS

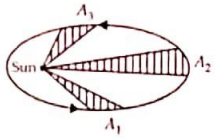
- DPS contains 45 topicwise questions and 5 exam section questions.
- Each question has four options out of which only one option is correct.
- Mark the correct answer in the OMR Sheet given at the end of the DPS.
- Each question carries 4 marks.
- For every incorrect answer deduct 1 mark.

Time : 50 minutes
Marks : 200

Date: .....

Kepler's Law

1. A planet, moving around the sun sweeps area A_1 in 2 days, A_2 in 3 days and A_3 in 6 days. Then the relation between A_1, A_2 and A_3 is



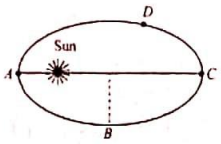
(a) $3A_1 = 2A_2 = A_3$ (b) $2A_1 = 3A_2 = 6A_3$
(c) $3A_1 = 2A_2 = 6A_3$ (d) $6A_1 = 3A_2 = 2A_3$

2. Average distance of the earth from the sun is L_1. If one year of the earth = D days, one year of another planet whose average distance from the sun is L_2 will be

(a) $D\left(\frac{L_2}{L_1}\right)^{1/2}$ days (b) $D\left(\frac{L_2}{L_1}\right)^{3/2}$ days
(c) $D\left(\frac{L_2}{L_1}\right)^{2/3}$ days (d) $D\left(\frac{L_2}{L_1}\right)$ days

3. A planet revolves around the sun in an elliptical orbit as shown in figure. The linear speed of the planet will be maximum at point

(a) D
(b) B
(c) A
(d) C



4. The period of revolution of planet A around the sun is 8 times that of planet B. The distance of planet A from the sun is how many times that of planet B from the sun?

(a) 4 (b) 5 (c) 2 (d) 3

5. The distance of two planets from the sun are 10^{13} m and 10^{12} m respectively. The ratio of time periods of the planets is

(a) $\sqrt{10}$ (b) $10\sqrt{10}$ (c) 10 (d) $1/\sqrt{10}$.

6. If a graph is plotted between T^2 and r^3 for a planet, then its slope will be

(a) $\frac{4\pi^2}{GM}$ (b) $\frac{GM}{4\pi^3}$ (c) $4\pi GM$ (d) GM

7. A saturn year is 29.5 times the earth year. How far is the saturn from the sun if the earth is 1.5×10^8 km away from the sun?

(a) 1.4×10^6 km (b) 1.4×10^7 km
(c) 1.4×10^8 km (d) 1.4×10^9 km

8. A planet revolves around the sun in an elliptical orbit of eccentricity e. If T is the time period of the planet, then the time spent by the planet between the ends of the minor axis and major axis close to the sun is

(a) $\frac{T\pi}{2e}$ (b) $T\left(\frac{2e}{\pi} - 1\right)$
(c) $\frac{Te}{2\pi}$ (d) $T\left(\frac{1}{4} - \frac{e}{2\pi}\right)$

Acceleration Due to Gravity of the Earth

9. At what height above the earth's surface, the value of g becomes $g/2$? (R = radius of the earth)

(a) $(\sqrt{2}-1)R$ (b) $\sqrt{2}R$
(c) $(\sqrt{2}+1)R$ (d) $R/\sqrt{2}$

10. A body weighs W newton at the surface of the earth. Its weight at a height equal to half the radius of the earth will be

(a) $\frac{W}{2}$ (b) $\frac{2W}{3}$ (c) $\frac{4W}{9}$ (d) $\frac{W}{4}$

11. If g_0, g_h and g_d be the acceleration due to gravity at the earth's surface, at a height h and at a depth d respectively, then
(a) $g_0 > g_h$ and $g_0 > g_d$ (b) $g_0 < g_h$ and $g_0 < g_d$
(c) $g_0 > g_h$ and $g_0 < g_d$ (d) $g_0 < g_h$ and $g_0 > g_d$

12. The acceleration due to gravity g and density of the earth ρ are related by which of the following relations?
(where G is the gravitational constant and R_E is the radius of the earth)
(a) $\rho = \frac{4\pi G R_E}{3g}$ (b) $\rho = \frac{3g}{4\pi G R_E}$
(c) $\rho = \frac{3G}{4\pi g R_E}$ (d) $\rho = \frac{4\pi g R_E}{3G}$

13. A body weighs 250 N on the surface of the earth. How much will it weigh half way down to the centre of the earth?
(a) 125 N (b) 150 N (c) 175 N (d) 250 N

14. The acceleration due to gravity at the poles and the equator is g_p and g_e respectively. If the earth is a sphere of radius R_E and rotating about its axis with angular speed ω, then $g_p - g_e$ is given by
(a) $\frac{\omega^2}{R_E}$ (b) $\frac{\omega^2}{R_E^2}$ (c) $\omega^2 R_E^2$ (d) $\omega^2 R_E$

15. The depth at which the value of acceleration due to gravity becomes $\frac{1}{n}$ times the value at the surface is
(R is the radius of the earth.)
(a) $\frac{R}{n}$ (b) $\frac{R}{n^2}$ (c) $\frac{R(n-1)}{n}$ (d) $\frac{Rn}{(n-1)}$

16. The height of the point vertically above the earth's surface at which the acceleration due to gravity becomes 1% of its value at the surface is (R is the radius of the earth)
(a) $8R$ (b) $9R$ (c) $10R$ (d) $20R$

Gravitational Potential Energy

17. If a body of mass m has to be taken from the surface of the earth to a height $h = R$, then the amount of energy required is (R = radius of the earth)
(a) mgR (b) $\frac{mgR}{3}$ (c) $\frac{mgR}{2}$ (d) $\frac{mgR}{12}$

18. The change in the gravitational potential energy when a body of mass m is raised to a height nR above the surface of the earth is (R = radius of the earth)
(a) $\left(\frac{n}{n+1}\right)mgR$ (b) $\left(\frac{n}{n-1}\right)mgR$
(c) $nmgR$ (d) $\frac{mgR}{n}$

19. The earth's radius is R and acceleration due to gravity at its surface is g. If a body of mass m is sent to a height $h = R/5$ from the earth's surface, the potential energy increases by
(a) mgh (b) $(4/5)mgh$
(c) $(5/6)mgh$ (d) $(1/4)mgh$

20. The potential energy of 4-particles each of mass 1 kg placed at the four vertices of a square of side length 1 m is
(a) +4.0G (b) −7.5G (c) −5.4G (d) +6.3G

21. The mass of the earth is 6×10^{24} kg and that of the moon is 7.4×10^{22} kg. The potential energy of the system is -7.79×10^{28} J. The mean distance between the earth and moon is ($G = 6.67 \times 10^{-11}$ N m^2 kg^{-2})
(a) 3.8×10^8 m (b) 3.37×10^6 m
(c) 7.60×10^4 m (d) 1.9×10^2 m

22. A particle of mass M is situated at the centre of a spherical shell of same mass and radius R. The gravitational potential at a point situated at $\frac{R}{2}$ distance from the centre will be
(a) $-\frac{3GM}{R}$ (b) $-\frac{2GM}{R}$
(c) $-\frac{GM}{R}$ (d) $-\frac{4GM}{R}$

23. Work done in taking a mass from one point to another in a gravitational field depends on
(a) the end points only
(b) the path followed
(c) the velocity of the mass
(d) both the length of the path and the end points

24. At what height from the surface of the earth, the total energy of the satellite is equal to its potential energy at a height of $2R$ from the surface of the earth? (R = radius of the earth)
(a) $\frac{R}{4}$ (b) $\frac{R}{2}$
(c) $2R$ (d) $4R$

Escape Speed

25. The escape velocity of a body from the earth is v_e. If the radius of the earth contracts to $(1/4)^{th}$ of its value, keeping the mass of the earth constant, the escape velocity will be
(a) doubled (b) halved
(c) tripled (d) unaltered

26. A body is projected up from the surface of the earth with velocity $\left(\frac{3}{4}\right)^{th}$ of its escape velocity. If R be the radius of earth, the height it reaches is
(a) $\frac{3R}{10}$ (b) $\frac{9R}{7}$ (c) $\frac{8R}{5}$ (d) $\frac{9R}{5}$

27. The escape velocity from the earth is 11.2 km/s. The escape velocity from a planet having twice the radius and the same mean density is (in km/s)
(a) 11.2 (b) 5.6
(c) 15 (d) 22.4

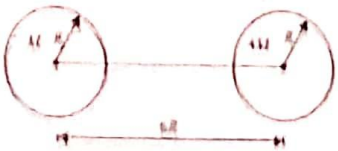
28. A planet in a distant solar system is 10 times more massive than the earth and its radius is 10 times smaller. Given that the escape velocity from the earth is 11 km s^{-1}, the escape velocity from the surface of the planet would be
(a) 0.11 km s^{-1} (b) 1.1 km s^{-1}
(c) 11 km s^{-1} (d) 110 km s^{-1}

29. The escape velocity of a sphere of mass m is given by (G = Universal gravitational constant; M_e = Mass of the earth and R_e = Radius of the earth)

(a) $\sqrt{\frac{2GM_e m}{R_e}}$ (b) $\sqrt{\frac{2GM_e}{R_e}}$

(c) $\sqrt{\frac{GM_e}{R_e}}$ (d) $\sqrt{\frac{2GM_e + R_e}{R_e}}$

30. Two uniform solid spheres of equal radii R, but mass M and $4M$ have a centre to centre separation $6R$, as shown in figure. A projectile of mass m is projected from the surface of the sphere of mass M directly towards the centre of the second sphere. The minimum speed of the projectile so that it reaches the surface of the second sphere is



(a) $\sqrt{\frac{4}{5}\frac{GM}{R}}$ (b) $\sqrt{\frac{5}{4}\frac{GM}{R}}$

(c) $\sqrt{\frac{3}{5}\frac{GM}{R}}$ (d) $\sqrt{\frac{5}{3}\frac{GM}{R}}$

31. The moon has a mass of $\frac{1}{81}$ that of the earth and a radius of $\frac{1}{4}$ that of the earth. The escape speed from the surface of the earth is 11.2 km s^{-1}. The escape speed from the surface of the moon is

(a) 1.25 km s^{-1} (b) 2.49 km s^{-1}

(c) 3.7 km s^{-1} (d) 5.6 km s^{-1}

32. A projectile is fired vertically upwards from the surface of earth with a velocity of kv_e, where v_e is the escape velocity and $k < 1$. Neglecting air resistance, the maximum height to which it will rise, measured from the centre of the earth, is (R_E = radius of the earth)

(a) $\frac{R_E}{1-k^2}$ (b) $\frac{R_E}{k^2}$ (c) $\frac{1-k^2}{R_E}$ (d) $\frac{k^2}{R_E}$

Satellites and Weightlessness

33. A satellite A of mass m is at a distance r from the centre of earth. Another satellite B of mass $2m$ is at a distance $2r$ from the earth's centre. Their time periods are in the ratio of

(a) 1 : 2 (b) 1 : 16

(c) 1 : 32 (d) $1 : 2\sqrt{2}$

34. The energy required to move a satellite of mass m from an orbit of radius $2R$ to $3R$ around the earth of mass M is

(a) $\frac{GMm}{12R}$ (b) $\frac{GMm}{R}$ (c) $\frac{GMm}{8R}$ (d) $\frac{GMm}{2R}$

35. A satellite of mass m revolving in a circular orbit of radius r around the earth has kinetic energy E. Then its angular momentum will be

(a) $\sqrt{\frac{E}{mr^2}}$ (b) $\frac{E}{2mr^2}$

(c) $\sqrt{2Emr^2}$ (d) $\sqrt{2Emr}$

36. Two satellites of the earth, S_1 and S_2 are moving in the same orbit. The mass of S_1 is four times the mass of S_2. Which one of the following statements is true?

(a) The potential energies of the earth and satellite in the two cases are equal.

(b) S_1 and S_2 are moving with the same speed.

(c) The kinetic energies of the two satellites are equal.

(d) The time period of S_1 is four times that of S_2.

37. A satellite of mass m is in a circular orbit of radius $2R_E$ about the earth. The energy required to transfer it to a circular orbit of radius $4R_E$ is (where M_E and R_E is the mass and radius of the earth respectively)

(a) $\frac{GM_E m}{2R_E}$ (b) $\frac{GM_E m}{4R_E}$

(c) $\frac{GM_E m}{8R_E}$ (d) $\frac{GM_E m}{16R_E}$

38. The time period of an artificial satellite in a circular orbit of radius R is 2 days and its orbital velocity is v_o. If time period of another satellite in a circular orbit is 16 days then

(a) its radius of orbit is $4R$ and orbital velocity is v_o.

(b) its radius of orbit is $4R$ and orbital velocity is $\frac{v_o}{2}$.

(c) its radius of orbit is $2R$ and orbital velocity is v_o.

(d) its radius of orbit is $2R$ and orbital velocity is $\frac{v_o}{2}$.

39. A geostationary satellite is orbiting the earth at a height of $6R$ from the earth's surface (R is the earth's radius). What is the period of rotation of another satellite at height of $2.5R$ from the earth's surface?

(a) $6\sqrt{2}$ hours (b) 10 hours

(c) $\frac{5\sqrt{5}}{\sqrt{3}}$ hours (d) $5\sqrt{5}$ hours

40. An asteroid of mass m is approaching the earth, initially at a distance $10R_E$ with speed v_i. It hits the earth with a speed v_f (R_E and M_E are radius and mass of the earth), then

(a) $v_f^2 = v_i^2 + \frac{2Gm}{R_E}\left(1 + \frac{1}{10}\right)$

(b) $v_f^2 = v_i^2 + \frac{2GM_E}{R_E}\left(1 + \frac{1}{10}\right)$

(c) $v_f^2 = v_i^2 + \frac{2GM_E}{R_E}\left(1 - \frac{1}{10}\right)$

(d) $v_f^2 = v_i^2 + \frac{2Gm}{R_E}\left(1 - \frac{1}{10}\right)$

41. The orbit of geostationary satellite is circular, the time period of satellite depends on (i) mass of the satellite (ii) mass of the earth (iii) radius of the orbit (iv) height of the satellite from the surface of the earth

(a) (i) only (b) (i) and (ii)

(c) (i), (ii) and (iii) (d) (ii), (iii) and (iv)

42. The mass of a spaceship is 1000 kg. It is to be launched from the earth's surface out into free space. The value of g and R (radius of the earth) are 10 m/s^2 and 6400 km respectively. The required energy for this work will be

(a) 6.4×10^8 J (b) 6.4×10^9 J

(c) 6.4×10^{10} J (d) 6.4×10^{11} J

43. An astronaut experiences weightlessness in a space satellite. It is because

(a) the gravitational force is small at that location in space.

(b) the gravitational force is large at that location in space.

(c) the astronaut experiences no gravity.

(d) the gravitational force is infinitely large at that location in space.

44. If an artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of the escape velocity from the earth, the height of the satellite above the surface of the earth is (where R = radius of the earth)

(a) $2R$ (b) $\frac{R}{2}$

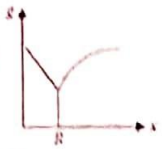
(c) R (d) $\frac{R}{4}$

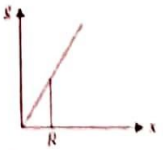
45. Two satellites of masses M and $9M$ are orbiting a planet in a circular orbit of radius r. Their frequency of revolution will be in the ratio of

(a) 1 : 9 (b) 1 : 3 (c) 1 : 1 (d) 3 : 1

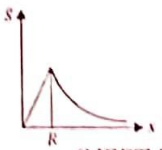
EXAM SECTION

46. Variation of acceleration due to gravity (g) with distance x from the centre of the earth is best represented by ($R \rightarrow$ Radius of the earth)

(a) 

(b) 

(c) 

(d) 

(NEET Phase II 2016)

47. A satellite of mass m is orbiting the earth (of radius R) at a height h from its surface. The total energy of the satellite in terms of g_0, the value of acceleration due to gravity at the earth's surface, is

(a) $\frac{mg_0R^2}{2(R+h)}$ (b) $-\frac{mg_0R^2}{2(R+h)}$

(c) $\frac{2mg_0R^2}{R+h}$ (d) $-\frac{2mg_0R^2}{R+h}$

(NEET Phase II 2016)

48. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is

(a) 1 : 4 (b) $1:\sqrt{2}$ (c) 1 : 2 (d) $1:2\sqrt{2}$

(NEET Phase I 2016)

49. A satellite S is moving in an elliptical orbit around the earth. The mass of the satellite is very small compared to the mass of the earth. Then,

(a) the linear momentum of S remains constant in magnitude.

(b) the acceleration of S is always directed towards the centre of the earth.

(c) the angular momentum of S about the centre of the earth changes in direction, but its magnitude remains constant.

(d) the total mechanical energy of S varies periodically with time. *(AIPMT 2015)*

50. A remote-sensing satellite of the earth revolves in a circular orbit at a height of 0.25×10^6 m above the surface of the earth. If the earth's radius is 6.38×10^6 m and $g = 9.8$ m s^{-2}, then the orbital speed of the satellite is

(a) 9.13 km s^{-1} (b) 6.67 km s^{-1}

(c) 7.76 km s^{-1} (d) 8.56 km s^{-1} *(AIPMT 2015)*

OMR SHEET

Use HB pencil only and darken each circle completely.
Mark only one choice for each question as indicated.

Correct marking ● ⓑ ⓒ ⓓ
Wrong marking ⊗ ⓐ ◑ ⊙

1. ⓐ●ⓒⓓ	7. ⓐ●ⓒⓓ	13. ⓐ●ⓒⓓ	19. ⓐ●ⓒⓓ	25. ⓐ●ⓒⓓ	31. ⓐ●ⓒⓓ	37. ⓐ●ⓒⓓ	43. ⓐ●ⓒⓓ	49. ⓐ●ⓒⓓ
2. ⓐ●ⓒⓓ	8. ⓐ●ⓒⓓ	14. ⓐ●ⓒⓓ	20. ⓐ●ⓒⓓ	26. ⓐ●ⓒⓓ	32. ⓐ●ⓒⓓ	38. ⓐ●ⓒⓓ	44. ⓐ●ⓒⓓ	50. ⓐ●ⓒⓓ
3. ⓐ●ⓒⓓ	9. ⓐ●ⓒⓓ	15. ⓐ●ⓒⓓ	21. ⓐ●ⓒⓓ	27. ⓐ●ⓒⓓ	33. ⓐ●ⓒⓓ	39. ⓐ●ⓒⓓ	45. ⓐ●ⓒⓓ	
4. ⓐ●ⓒⓓ	10. ⓐ●ⓒⓓ	16. ⓐ●ⓒⓓ	22. ⓐ●ⓒⓓ	28. ⓐ●ⓒⓓ	34. ⓐ●ⓒⓓ	40. ⓐ●ⓒⓓ	46. ⓐ●ⓒⓓ	
5. ⓐ●ⓒⓓ	11. ⓐ●ⓒⓓ	17. ⓐ●ⓒⓓ	23. ⓐ●ⓒⓓ	29. ⓐ●ⓒⓓ	35. ⓐ●ⓒⓓ	41. ⓐ●ⓒⓓ	47. ⓐ●ⓒⓓ	
6. ⓐ●ⓒⓓ	12. ⓐ●ⓒⓓ	18. ⓐ●ⓒⓓ	24. ⓐ●ⓒⓓ	30. ⓐ●ⓒⓓ	36. ⓐ●ⓒⓓ	42. ⓐ●ⓒⓓ	48. ⓐ●ⓒⓓ	

SELF CHECK

No. of questions attempted .....

No. of questions correct .....

Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.