Old-Exam-Ch-13

T072

Q19: A spaceship is going from the Earth (mass = M_e) to the Moon (mass = M_m) along the line joining their centers. At what distance from the centre of the Earth will the net gravitational force on the spaceship be zero? (Assume that $M_e = 81\ M_m$ and the distance from the centre of the Earth to the center of the Moon is 3.8×10^5 km). (Ans: 3.4×10^5 km)

Q20: A 1000 kg satellite is in a circular orbit of radius = $2R_e$ about the Earth. How much energy is required to transfer the satellite to an orbit of radius = $4R_e$? (R_e = radius of Earth = 6.37×10^6 m, mass of the Earth = 5.98×10^{24} kg) (Ans: 7.8×10^9 J.)

Q21: At what altitude above the Earth's surface would the gravitational acceleration be $a_g/4$? (where a_g is the acceleration due to gravitational force at the surface of Earth and R_e is the radius of the Earth).(Ans: R_e)

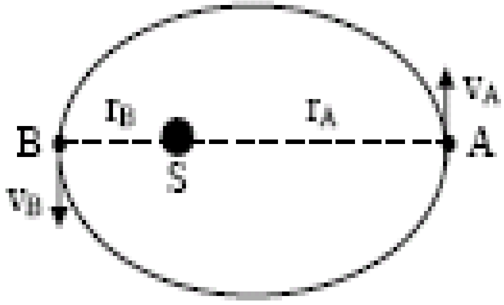
Q22: The gravitational acceleration on the surface of a planet, whose radius is 5000 km, is 4.0 m/s^2. The escape speed from the surface of this planet is: (Ans: 6.3 km/s)

T071

Q4: At what distance above the surface of Earth (radius = R) is the magnitude of the gravitational acceleration equal to g/16? (Where g = gravitational acceleration at the surface of Earth). (Ans: 3 R)

Q5: A satellite moves around a planet (of mass M) in a circular orbit of radius = 9.4×10^6 m with a period of 2.754×10^4 s. Find M. (Ans: 6.5×10^{23} kg)

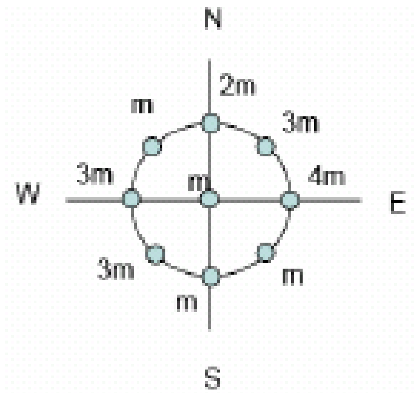
Q6: A rocket is launched from the surface of a planet of mass $M=1.90 \times 10^{27}$ kg and radius $R = 7.15 \times 10^7$ m. What minimum initial speed is required if the rocket is to rise to a height of 6R above the surface of the planet? (Neglect the effects of the atmosphere). (Ans: 5.51×10^4 m/s)



Q7: Fig. 4 shows a planet traveling in a counterclockwise direction on an elliptical path around a star S located at one focus of the ellipse. The speed of the planet at a point A is vA and at B is vB. The distance AS = rA while the distance BS = r_B. The ratio vA/vB is: (Ans: (r_B/r_A))

T062

Q27. Eight balls of different masses are placed along a circle as shown in Fig. 8 The net force on a ninth ball of mass *m* in the center of the circle is in the direction of: A) NE



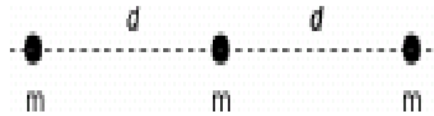
Q28. The escape velocity of an object of mass 200 *kg* on a certain planet is 60 *km/s*. When the object is on the surface of the planet, the gravitational potential energy of the object-planet system is: A) -3.6×10^{11} *J*

Q29. : A planet has two moons of masses $m_1 = m$ and $m_2 = 2m$ and orbit radii $r_1 = r$ and $r_2 = 2r$, respectively. The ratio of their periods T_1/T_2 is: A) 0.35

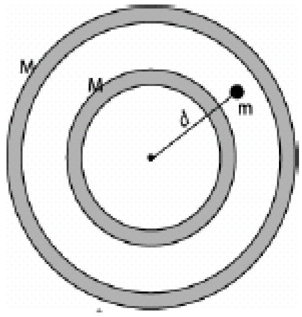
Q30.: A satellite in a circular orbit around Earth has a kinetic energy of 1.0×10^8 *J*. The mechanical energy of the stellite-Earth system is: A) -1.0×10^8 *J*

T061

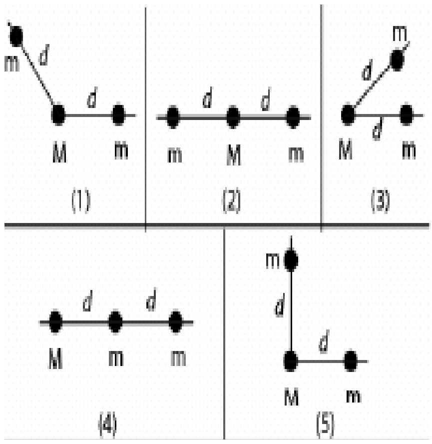
Q19. Three identical particles each of mass *m* are placed on a straight line separated by a distance *d* as shown in Fig. 10. To remove the particle at the center to a point far away (where $U = 0$), the work that must be done by an external agent is given by: A) $2Gm^2/d$



Q20. Two uniform concentric spherical shells each of mass M are shown in Fig. 11. The magnitude of the gravitational force exerted by the shells on a point particle of mass m located a distance d from the center, outside the inner shell and inside the outer shell, is: A) GMm/d^2



Q21. Fig. 12 shows five configurations of three particles, two of which have mass m and the other one has mass M. The configuration with the least (minimum) gravitational force on M, due to the other two particles is: A) 2



Q22. A satellite of mass m and kinetic energy K is in a circular orbit around a planet of mass M. The gravitational potential energy of this satellite-planet system is: A) $-2K$

T052

Q19: Three identical particles each of mass m are distributed along the circumference of a circle of radius R as shown in Fig 7. The gravitational force of m_2 on m_1 is 1.0×10^{-6} N. The magnitude of the net gravitational force on m_1 due to m_2, m_3 is (Ans: 1.4×10^{-6} N)

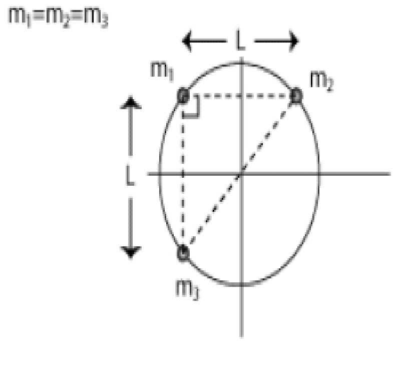


Figure 7

Q20: Calculate the mass of the Sun using the fact that Earth is rotating around the Sun in a circular orbit of radius 1.496×10^{11} m with a period of one year (1 year $= 3.156 \times 10^7$ s).(Ans: 1.99×10^{30} kg).

Q21: Calculate the work require to move an Earth satellite of mass m from a circular orbit of radius $2R_E$ to one of radius $3R_E$. (Consider M_E = mass of Earth, R_E = radius of Earth, G = universal Gravitational constant) (Ans: $G M_E m /(12 R_E)$).

Q22: A 100-kg rock from outer space is heading directly toward Earth. When the rock is at a distance of ($9R_E$) from the Earth's surface, its speed is 12 km/s. Neglecting the effects of the Earth's atmosphere on the rock, find the speed of the rock just before it hits the surface of Earth.(Ans: 16 km/s)

T051

Q19: Calculate the magnitude and direction of net gravitational force on particle of mass *m* due to two particles each of mass *M*, where *m* =1000 kg and *M* =10000 kg and are arranged as shown in the Fig. 5.(Ans: 4.3×10^{-5} N directed towards negative x-axis)

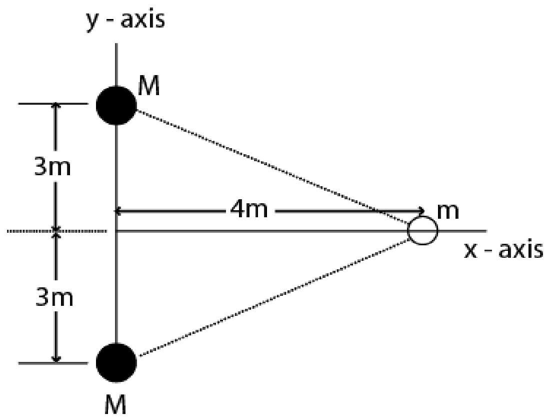


Figure 5

Q20: One of the moons of planet Mars completes one revolution around Mars in 1.26 days. If the distance between Mars and the moon is 23460 km, calculate the mass of Mars.(Ans: 6.45×10^{23} kg)

Q21: A satellite of is in a circular orbit around a planet. If the kinetic energy of the satellite is 1.87×10^9 J, what is the mechanical energy of the satellite? (Ans: - 1.87×10^9 J)

Q22: A projectile was fired straight upward from Earth's surface with an initial speed v_i such that it reaches a maximum height of $2R_E$ above the Earth surface (take $g = 9.80$ m/s^2 and $R_E = 6.37 \times 10^6$ m). The initial speed v_i is (Ans: 10.5 km/s)

T042

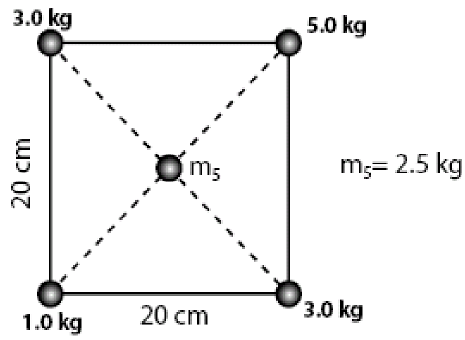


Figure 3

Q4: Four point masses are at the corners of a square whose side is 20 cm long (see Fig 3). What is the magnitude of the net gravitational force on a point mass m5 = 2.5 kg located at the center of the square? (Ans:1 3.3×10^{-8} N)

Q5: An object is fired vertically upward from the surface of the Earth (Radius = R) with an initial speed of $(V_{esc})/2$, where (V_{esc} = escape speed). Neglecting air resistance, how far above the surface of Earth will it reach? (Ans: R/3)

Q6: What is the escape speed on a spherical planet whose radius is 3200 km and whose gravitational acceleration at the surface is 4.00 m/s^2? (Ans: 5.06 km/s)

Q7: A planet requires 300 (Earth) days to complete its circular orbit about its sun (mass M = 6.0×10^{30} kg). The orbital speed of the planet is: (Ans: 4.6×10^4 m/s)

T041

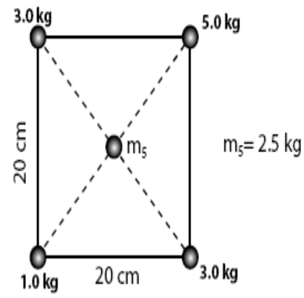


Figure 3

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