CBSE

WORK ENERGY AND POWER WS 6

Class 11 - Physics

Section A

1. A 75.0-kg painter climbs a ladder that is 2.75 m long leaning against a vertical wall. The ladder makes an angle of 30° with the wall. How much work does gravity do on the painter? **[1]**

   a) -1950 J
   b) -1850 J
   c) -2050 J
   d) -1750 J

2. The potential energy of particle in a force field is U = $\frac{A}{r^2} - \frac{B}{r}$, where A and B are positive constants and r is the distance of particle from the centre of the field. For stable equilibrium, the distance of the particle is **[1]**

   a) $\frac{2A}{B}$
   b) $\frac{A}{B}$
   c) $\frac{B}{A}$
   d) $\frac{B}{2A}$

3. **Assertion (A):** Water at the foot of the waterfall is always at different temperatures from that at the top. **[1]**
   Reason (R): The potential energy of water at the top is converted into heat energy during falling.

   a) Both A and R are true and R is the correct explanation of A.
   b) Both A and R are true but R is not the correct explanation of A.
   c) A is true but R is false.
   d) A is false but R is true.

4. **State True or False:** **[1]**
   (a) For gravitational potential energy, the zero of potential energy is chosen to be ground. **[1]**

5. What type of energy stored in (i) the wound spring of a watch (ii) a stretched bow while ready to project an arrow? **[1]**

6. Mountain roads rarely go straight up but wind up gradually. Why? **[1]**

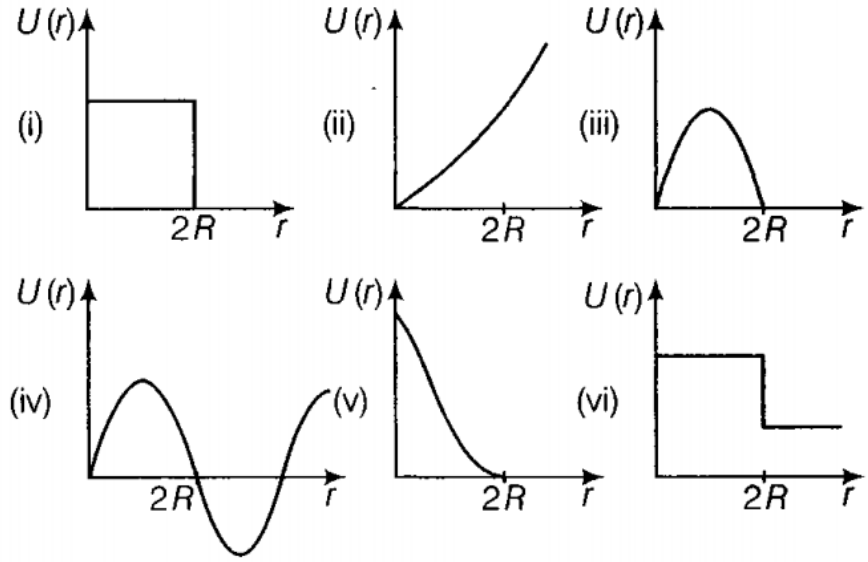
7. Can the P.E. of a body be negative? **[1]**

8. A uniform rectangular parallelopiped of mass m having sides l, 2I, and 4l is placed in turn on each of its three sides on a horizontal surface. What is the potential energy of the parallelopiped in each of these positions? Which position will be the most stable? **[1]**

9. Draw a graph showing the variation of potential energy of an object thrown vertically upward by a boy with respect to its height. **[1]**

Section B

10. Which of the following potential energy curves in figure cannot possibly describe the elastic collision of two billiard balls? Here, r is the distance between centres of the balls. **[2]**



11. A pump on the ground floor of a building can pump up water to fill a tank of volume 30 m^3 in 15 min. If the tank is 40 m above the ground, and the efficiency of the pump is 30%, how much electric power is consumed by the pump? **[2]**

12. Chemical, gravitational and nuclear energies are nothing but potential energies for different types of forces in nature. Explain the statement clearly with examples. **[2]**

13. What happens to the potential energy when **[2]**

    a. two protons are brought close together

    b. one proton and one electron are brought close together?

14. Define potential energy. Give its units and dimensional formula. **[2]**

15. By convention, the forces which fall off to zero at large distances, the potential energy at infinity is taken to be zero. With this choice, is the potential energy positive for **[2]**

    a. electron-positron bound state

    b. planet satellite system and

    c. electron-electron system?

16. A chain is held on frictioness table with $\frac{1}{n}$th of its length hanging over the edge. If the chain has a length l and a mass m, how much work is required to pull the hanging part back on the table? **[2]**

17. What are three main forms of potential energy? Explain by giving illustrations. **[2]**

18. A girl of mass 40 kg sits in a swing formed by a rope of 6 m length. A person pulls the swing to a side so that the rope makes an angle of 60^o with the vertical. What is the gain in potential energy of the girl? **[2]**

Section C

19. **Fill in the blanks:** **[3]**

    (a) Two springs A and B are identical except that A is stiffer than B. If they are stretched by the same force, then the work expended in spring A is _____ than in spring B. **[1]**

    (b) A conservative force is equal to the negative gradient of _____. **[1]**

    (c) The _____ energy of a body is defined as the energy possessed by the body by virtue of its position or configuration in some field. **[1]**

20. Calculate work done in raising a stone of mass 5 kg of specific gravity 3 immersed in water from a depth of 6 m to 1 m below surface of water (g =10 ms^{-2}). **[3]**

21. Estimate the amount of energy released in the nuclear fusion reaction **[3]**

$_1H^2 + _1H^2 \longrightarrow _2He^3 + _0n^1$

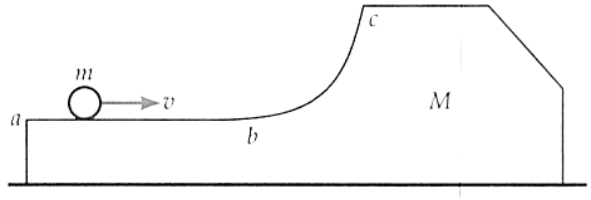
Given that $M(_1H^2) = 2.0141$ u,

$M(_2He^3) = 3.0160$ u

Mn = 1.0087 u, where 1 u = 1.661×10^{-27} kg

Express your answer in units of MeV.

22. A body of mass M = 9.8 kg with a small disc of mass m = 0.2 kg placed on its horizontal Surface ab, rests on a smooth horizontal plane, as shown in Fig. The disc can move freely along the smooth groove abc of mass M. To what height (relative to the initial position) will the disc rise after separating from the body of mass M when initial velocity v = 5 ms^{-1} is given to it in the horizontal direction? **[3]**



Section D

23. A balloon filled with helium rises against gravity increasing its potential energy. The speed of the balloon also increases as it rises. How do you reconcile this with the law of conservation of mechanical energy? You can neglect the viscous drag of air and assume that the density of air is constant. **[5]**

24. Discuss the conservation of energy in an elastic spring. Hence write an expression for the maximum speed of a body of mass m oscillating at its one end. **[5]**

25. Define potential energy and conservative force. Write two relations between them. **[5]**

26. The potential energy of a^2 kg particle free to move along the x-axis is given by **[5]**

$U(x) = \left(\frac{x}{b}\right)^4 - 5\left(\frac{x}{b}\right)^2$ J

where b = 1 m. Plot this potential, identifying the extremum points. Identify the regions where the particle may be found and its maximum speed given that the total mechanical energy is

i. 36 J

ii. -4 J