Work Power Energy

1. For conservative force

1) Work done is independent of the path

2) Work done in a closed loop is zero

3) Work done against conservative force is stored is the form of potential energy

4) All the above

2. Two springs have their force constants k_1 and k_2 and they are stretched to the same extension. If $k_2 > k_1$ work done is

1) Same in both the springs 2) More in spring K_1

3) More in spring K_2 4) None

3. Two springs have their force constants k_1 and k_2 (K_2>K_1). When they are stretched by the same force, work done is

1) Same in both the springs 2) More in spring K_1

3) More in spring K_2 4) None

4. A lorry and a car moving with same KE are brought to rest by applying the same retarding force. Then

1) Lorry will come to rest in a shorter distance

2) Car will come to rest in a shorter distance

3) Both come to ret in the same distance

4) None

5. A lorry and a car moving with same momentum are brought to rest by applying the same retarding force. Then

1) Lorry will come to rest in a shorter distance2) Car will come to rest in a shorter distance

3) Both come to ret in the same distance 4) None

6. When a wound spring is dissolved in an acid, the temperature of the acid

1) Increases 2) Decreases 3) Remains same 4) None

7. A body is moved along a straight line by a machine delivering constant power. The distance moved by the body in time't' is proportional to

1) $t^{1/2}$ 2) $t^{3/4}$ 3) $t^{3/2}$ 4) t

8. **A) Work done by frictional force is always negative.**

B) A body at rest can have mechanical energy.

C) Mechanical energy of freely falling body decrease gradually.

1) Only A is true   2) Only B is true

3) Only C is true   4) All the three one true

9. **Match the pairs in two lists given below.**

List - I	List - II
a) Gravitational force	**e) Decreases**
b) Fractional force	**f) Conservative force**
c) KE of a dropped body	**g) Non-Conservative force**
d) PE of a dropped	**h) Increases body**

1) a-f , b-h , c-g, d-e   2) a-f, b-g,c-h,d-e

3) a-f,b-g,c-e,d-h   4) a-h, b-g,c-f,d-e

10. **A body is allowed to fall from a height h above the ground. Then match the following.**

List - I	List - II
a) PE=KE	**e) At height h/2**
b) PE=2KE	**f) Constant at any point**
c) KE = 2PE	**g) At height 2h/3**
d) PE +KE	**h) At height h/3**

1) a-e, b-g,c-h,d-f   2) a-g,b-e,c-f,d-h

3) a-f, b-g,c-e,d-h   4) a-e,b-h,c-g,d-f

11. **A): When a person is walking horizontally with a suitcase on his head, no work is done by him against gravitational force.**

R): Gravitational force on suitcase acts vertically downwards and motion is in horizontal direction, hence dot product becomes zero.

1) Both (A) and (R) are true and (R) is the correct explanation of (A).

2) Both (A) & (R) are true but (R) is not correct explanation of (A).

3) (A) is true and (R) is false.

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

12. A) Work done by gravitational force in moving a body is path independent.

R) Gravitational force is non conservative force.

1) Both (A) and (R) are true and (R) is the correct explanation of (A).

2) Both (A) & (R) are true but (R) is not correct explanation of (A).

3) (A) is true and (R) is false.

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

13. A block of mass 'm' is lowered with the help of a rope of negligible mass through a distance 'd' with an acceleration of $\frac{g}{3}$. Work done by the rope on the block is

1) $\frac{2Mgd}{3}$ 2) $-\frac{2Mgd}{3}$ 3) $\frac{Mgd}{3}$ 4) $-\frac{Mgd}{3}$

14. A force $\bar{F}=(5\hat{i}-3\hat{j}+2\hat{k})N$ moves a particle from $\bar{r}_1=(2\hat{i}+7\hat{j}+4\hat{k})m$ to $\bar{r}_2=(5\hat{i}+2\hat{j}+8\hat{k})m$. The work done by the force is

1) 18J 2) 28J 3) 38J 4) 48J

15. A uniform chain of length 2 m is kept on a table such that a length of 60 cm hangs freely from the edge of the table. The total mass of the chain is 4 kg. What is the work done in pulling the entire chain on to the table? (g = 10 m/s^2)

1) 7.2J 2) 3.6J 3) 120J 4) 1200J

16. n identical cubes each of mass 'm' and side '*l*' are on the horizontal surface. Then the minimum amount of work done to arrange them one on the other is

1) nmg*l* 2) $\frac{mgl\,n^2}{2}$ 3) $\frac{mgl\,n(n-1)}{2}$ 4) $\frac{mgl\,n(n+1)}{2}$

17. A rectangular block of dimensions 6m x 4m x 2m and of density 1.5 gm/c.c is lying on horizontal ground with the face of largest area in contact with the ground. The work done in arranging it with its smallest area in contact with the ground is, (g=10ms^{-2})

1) 2880 kJ 2) 1440 kJ 3) 3800 kJ 4) 720 kJ

18. A ladder 'AB' of weight 300N and length 5m is lying on a horizontal surface. Its centre of gravity is at a distance of '2m' from end A. A weight of 80N is attached at end B. The work done in raising the ladder to the vertical position with end 'A' in contact with the ground is

1) 500J 2) 1000J 3) 1150J 4) 1900J

19. Force acting on a particle is $\left(2\hat{i}+3\hat{j}\right)N$. Work done by this force is zero, when a particle is moved along the line 3y+kx = 5. Here the value of k is

1) 2 2) 4 3) 6 4) 8

20. A body of mass 6kg is under a force which causes displacement in it which is given by $s=\frac{t^2}{4}m$, where't' is time. The work done by the force in 2s is

1) 12J 2) 9 J 3) 6 J 4) 3 J

21. A particle of mass 100g is thrown vertically upwards with a speed of 5 m/s. The work done by the force of gravity during the time the particle goes up is (g = $10ms^{-2}$)

1) – 0.5J 2) –1.25J 3) 1.25J 4) 0.5J

22. A particle is projected at 60^0 to the horizontal with a kinetic energy K. The kinetic energy at the highest point is

1) K 2) Zero 3) K/4 4) K/2

23. If the kinetic energy of a body is four times its momentum, its velocity is

1) 2 ms^{-1} 2) 4 ms^{-1} 3) 8 ms^{-1} 4) 16 ms^{-1}

24. A 1.0 HP motor pumps out water from a well of depth 20m and fills a water tank of volume 2238 litres at a height of 10m from the ground. The running time of the motor to fill the empty tank is (g = 10 ms^{-2})

1) 5 min 2) 10 min 3) 15 min 4) 20 min

25. A ball is projected vertically down with an initial velocity from a height of 20m on to a horizontal floor. During the impact it loses 50% of its energy and rebounds to the same height. The velocity of projection is (g = $10ms^{-2}$)

1) 20 ms^{-1} 2) 15 ms^{-1} 3) 10 ms^{-1} 4) 5 ms^{-1}

26. A stone is projected vertically up to reach a maximum height 'h'. The ratio of its kinetic to potential energies at a height $\frac{4h}{5}$ will be

1) 5: 4 2) 4: 5 3) 1: 4 4) 4: 1

27. A block of mass 'm' is connected to one end of a spring of 'spring constant' k. The other end of the spring is fixed to a rigid support. The mass is released slowly so that the total energy of the system is then constituted by only the potential energy, then'd' is the maximum extension of the spring. Instead, if the mass is released suddenly from the same initial position, the maximum extension of the spring now is: (g–acceleration due to gravity)

1) $\frac{mg}{k}$ 2) $\frac{mg}{3k}$ 3) 2d 4) 4d

28. A motor of power P_0 is used to deliver water at a certain rate through a given horizontal pipe. To increase the rate of flow of water through the same pipe n times, the power of the motor is increased to P_1. The ratio of P_1 to P_0 is

1) n : 1 2) n^2 : 1 3) n^3 : 1 4) n^4 : 1

29. One–fourth chain is hanging down from a table. Work done to bring the hanging part of the chain on to the table is (mass of chain=M and length = L)

1) $\frac{MgL}{32}$ 2) $\frac{MgL}{16}$ 3) $\frac{MgL}{8}$ 4) $\frac{MgL}{4}$

30. A ladder 'AB' 2.5m long and of weight 150N with its centre of mass at a distance 1m from end 'A' is on the ground. A 40N weight is attached to the end B. The work to be done to arrange the ladder in vertical position with end 'A' contact with the ground is

1) 190J 2) 250J 3) 285J 4) 475J

31. A body of mass m is accelerated uniformly from rest to a speed v in a time T. The instantaneous power delivered to the body as a function of time, is given by

1) $\frac{mV^2}{T^2}t$ 2) $\frac{mV^2}{T^2}t^2$ 3) $\frac{1}{2}\frac{mv^2}{T^2}t$ 4) $\frac{1}{2}\frac{mv^2}{T^2}t^2$

32. A locomotive of mass m starts moving so that its velocity varies as v=K$\sqrt{S}$, where K is a constant and S is the distance traversed. The total work done by all the forces acting on the locomotive during the first t second after the start of motion is

1) $\frac{1}{2}mK^4t^2$ 2) $\frac{1}{4}mK^4t^2$ 3) $\frac{1}{8}mK^4t^2$ 4) $\frac{1}{16}mK^4t^2$

33. A particle of mass 'm' is projected with a velocity 'u' at an angle 'α' with the horizontal. Work done by gravity during its descent from its highest point to, the position where its velocity vector makes an angle $\frac{\alpha}{2}$ with the horizontal is,

1) $\frac{1}{2}$ mu^2 tan^2

2) $\frac{1}{2}mu^2\tan^2\frac{\alpha}{2}$

3) $\frac{1}{2}mu^2\cos^2\alpha\, Tan^2\frac{\alpha}{2}$

4) $\frac{1}{2}mu^2\cos^2\frac{\alpha}{2}\sin^2\alpha$

34. A uniform chain of mass 'm' and length 'L' is kept on a horizontal table with half of its length hanging from the edge of the table. Work done in pulling the chain on to the table so that only $\frac{1}{5}$th of its length now hangs from the edge is,

1) $\frac{mgl}{8}$ 2) $\frac{mgl}{50}$ 3) $\frac{mgl}{18}$ 4) $\frac{21mgl}{200}$

35. A small block of mass 'm' is kept on a rough inclined surface of inclination θ fixed in an elevator. The elevator goes up with a uniform velocity V and the block does not slide on the wedge. The work done by the force of friction on the block in a time't' will be

1) Zero 2) mgvt cos$^2\theta$ 3) mgvt sin$^2\theta$ 4) mgvt sin2θ

36. A rectangular plank of mass 'm_1' and height 'a' is on a horizontal surface. On the top of it another rectangular plank of mass 'm_2' and height 'b' is placed. The potential energy of the system is

1) $(m_1+m_2)\frac{(a+b)}{2}g$

2) $\left[\frac{m_1+m_2}{2}.a+m_2\frac{b}{2}\right]g$

3) $\left[\left(\frac{m_1}{2}+m_2\right)a+m_2\frac{b}{2}\right]g$

4) $\left[\left(\frac{m_1}{2}+m_2\right)a+m_1\frac{b}{2}\right]g$

37. A box of mass 50kg at rest is pulled up on an inclined plane 12m long and 2m high by a constant force of 100N. When it reaches the top of the inclined plane if its velocity is 2ms^{-1}, the work done against friction in Joules is (g = 10ms^{-2})

1) 50 2) 100 3) 150 4) 200

38. Two identical cylindrical vessels each of area of cross – section A are on a level ground. Each contains a liquid of density ''. The heights of liquid columns are h_1 and h_2. If the two vessels are connected by means of a narrow pipe at the bottom, the work done by gravity in equalizing the liquid levels is

1) $\frac{A\rho g(h_1-h_2)^2}{2}$ 2) $\frac{A\rho g}{2}(h_1^2-h_2^2)$ 3) $\frac{A\rho g}{4}(h_1^2-h_2^2)$ 4) $\frac{A\rho g}{4}(h_1-h_2)^2$

39. An open knife edge of mass M is dropped from a height 'h' on a wooden floor. If the blade penetrates a distance's' into the wood, the average resistance offered by the wood to the blade is

1) Mg 2) $Mg\left(1+\frac{h}{s}\right)$ 3) $Mg\left(1-\frac{h}{s}\right)$ 4) $Mg\left(1+\frac{h}{s}\right)^2$

40. A shell of mass 'm' moving horizontally explodes in to two equal pieces at the instant its momentum is '3p'. One of the fragments attains a linear momentum of '4p' in upward direction. The kinetic energy gained by the system immediately after explosion is

1) $\frac{25p^2}{m}$ 2) $\frac{16p^2}{m}$ 3) $\frac{41p^2}{m}$ 4) $\frac{73p^2}{2m}$

41. A spring of force constant 'k' is stretched by a small length 'x'. The work done in stretching it further by a small length 'y' is

1) $\frac{1}{2}k(x^2+y^2)$ 2) $\frac{1}{2}k(x+y)^2$ 3) $\frac{1}{2}k(y^2-x^2)$ 4) $\frac{1}{2}ky(2x+y)$

42. A body is projected vertically up with certain velocity. At a point 'P' in its path, the ratio of its potential to kinetic energies is 9: 16. The ratio of velocity of projection to velocity at 'P' is

1) 3: 4 2) 5: 4 3) 9: 25 4) 25: 16

43. When a body is projected vertically up, at a point 'P' in its path, the ratio of potential to kinetic energies is 3: 4. If the same body were to be projected with two times the initial velocity, the ratio of potential to kinetic energies at the same point is

1) 3: 25 2) 3: 28 3) 1: 20 4) 1: 25

44. A unifrom chain of length 'L' is placed on a smooth table of height 'h' (h > L) with a length '' hanging from the edge of the table. The chain begins to slide down the table. When the end of the chain is about to leave the edge of the table its velocity is

1) $\sqrt{\frac{g(L+\ell)}{L}}$ 2) $\sqrt{\frac{g(L-\ell)}{L}}$ 3) $\sqrt{\frac{g(L^2-\ell^2)}{L}}$ 4) $\sqrt{2g(L-\ell)}$

45. A bullet of mass 10 gm is fired horizontally with a velocity of 1000 ms^{-1} from a height of 50m above the ground. If the bullet reaches the ground with a velocity of 500 ms^{-1}, the work done against air resistance in Joules is (g = 10ms^{-2})

1) 5005 2) 3755 3) 3750 4) 17.5

Key

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

Hints

13. $W = -m(g-a).d \quad = -m\left(g-\frac{g}{3}\right).d$

$W = -\frac{2}{3}mgd$

14. $\bar{S} = \bar{r}_2 - \bar{r}_1 \quad \bar{S} = 3\bar{i} - 5\bar{j} + 4\bar{k}$

$\bar{F} = 5\bar{i} - 3\bar{j} + 2\bar{k}$

$W = \bar{F}.\bar{S} = 15 + 15 + 8 = 38\text{ J}$

15. $W = \frac{m.g.l}{2n^2} = 3.6\text{Joules}$

16. $PE_i = (nm).g.\frac{l}{2}$

$PE_f = (nm).g\left(\frac{nl}{2}\right)$

$W = P.E_f - P.E_i \Rightarrow W = \frac{mgl}{2}n(n-1)$

17. $m = d.V = 1.5 \text{ x } 1000 \text{ x } 48$

$P.E_i = mg.\left(\frac{2}{2}\right)$ and $P.E_f = mg.\left(\frac{6}{2}\right)$

$W = P.E_f - P.E_i = 1440\text{ KJ}$

18. $W = 300 \text{ x } 2 + (80 \text{ x } 5) = 1000\text{ J}$

19. $\bar{F} = 2\bar{i} + 3\bar{j}$

$\text{Tan}\theta = \frac{3}{2} = m_1$

$3y + kx = 5 \Rightarrow Y = -\frac{K}{3}x + 5$

$m_2 = -\frac{K}{3} \quad m_1 \times m_2 = -1$

$\frac{3}{2}\times-\frac{k}{3}=-1\Rightarrow K=2$

20. $S=\frac{t^2}{4}\qquad V=\frac{2t}{4}=\frac{t}{2}$

$u=0\qquad V=1ms^{-1}$

$W=\frac{1}{2}mv^2=\frac{1}{2}6.1^2=3J$

21. $W=-mgh=-\frac{1}{2}mu^2=-\frac{1}{2}\times0.1\times5^2=-1.25J$

22. $\frac{1}{2}mu^2=K\qquad K^1=\frac{1}{2}mu^2\cos^2\theta$

$K^1=K.\cos^2\theta=K.\cos^2 60$

$K^1=\frac{K}{4}$

23. $\frac{1}{2}mv^2=4mv$

$v=8\,ms^{-1}$

24. $P=\frac{mgh}{t}\; 746=\frac{2238\times10\times30}{t}$

$t=900s=15\min$

25. $mgh=\frac{1}{2}\left[\frac{1}{2}mu^2+mgh\right]$

$u=\sqrt{2gh}=\sqrt{2\times10\times20}=20\;ms^{-1}$

26. $P.E=mg.\frac{4h}{5}$

$P.E=mgh-mg\frac{4h}{5}=\frac{mgh}{5}$

$\therefore K.E.:P.E=1:4$

27. $k=\frac{mg}{d}$

$mgx = \frac{1}{2}kx^2$ or

$x = \frac{2mgd}{k} = \frac{2mg}{mg}d = 2d$

28. $P = \frac{1}{2}Ad\upsilon^3$

$\upsilon = \frac{V_t}{A}$

$P \alpha V_t^3$

$P^1 = n^3P$

29. $W = \frac{mgl}{2n^2} = \frac{mgl}{2 \text{ x } 4^2} = \frac{mgl}{32}$

30. $W = 150\times1 + 40\times2.5 = 150 + 100 = 250J$

31. $P = F.V = ma(at) = ma^2t$

$P = m\left(\frac{V_1}{t_1}\right)^2.t$

32. $a = \frac{dv}{dx}. v = \frac{k}{2\sqrt{s}}.k\sqrt{s} = \frac{k^2}{2}$

$F = ma =$ and $S = \frac{1}{2}at^2$

$W = \frac{m.a^2t^2}{2} = m.\frac{K^4}{8}t^2$

33. $K\gamma_i = 0$ $\tan\frac{\alpha}{2} = \frac{v_r}{u\cos\alpha}$

$v_y = u.\cos\alpha.\tan\left(\frac{\alpha}{2}\right)$

$kV_f = \frac{1}{2}mu^2\cos^2\alpha\tan^2\left(\frac{\alpha}{2}\right)$

$W = ky_f - ky_i = \frac{1}{2}mu^2\cos^2\alpha\tan^2\left(\frac{\alpha}{2}\right)$

34. $W = mg\frac{l}{2}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ $W = \frac{21mgl}{200}$

35. $W_f = f \times s \qquad = f \sin\theta.Vt$

$= mg \sin\theta.\sin\theta.v.t \quad W_f = mg.\sin^2\theta.vt$

36. $u_1 = m_1 g\left(\frac{a}{2}\right)$

$u_2 = m_2 g\left(a + \frac{b}{2}\right)$

$\therefore u_{total} = \left[\left(\frac{m_1}{2} + m_2\right)a + m_2.\frac{b}{2}\right]g$

37. $W_f = F \times L - \left[mgh + \frac{1}{2}m\upsilon^2\right]$

$= 100 \times 12 - \left[50 \times 10 \times 2 + \frac{1}{2} \times 50 \times 2^2\right] = 100J$

38. $u_1 = \frac{A\rho g}{2}\left[h_1^2 + h_2^2\right] \; u_2 = A\rho g\left[\frac{h_1 + h_2}{2}\right]^2$

$W = u_1 - u_2 = \frac{A\rho g}{4}\left[h_1 - h_2\right]^2$

39. $Mg(h+s) = F.S$

$F = Mg\left[1 + \frac{h}{s}\right]$

40. $(3p)\bar{i} = (4P).\bar{j} + \bar{P}_2 \Rightarrow \left|\bar{P}_2\right| = 5P$

Gain in K.ε

$= \frac{16P^2}{m} + \frac{25P^2}{m}\frac{9P^2}{2m} = \frac{73P^2}{2m}$

41. $W = \frac{1}{2}K(x+y)^2 - \frac{1}{2}Kx^2$

$W = \frac{K}{2}.y(2x+y)$

42. $\frac{h}{H-h} = \frac{9}{16} \qquad H = \frac{25h}{9} \; \frac{u}{\upsilon} = \sqrt{\frac{H}{H-h}} = \frac{5}{4}$

43. $\frac{P}{k}=\frac{3}{4}$ $\quad u^1 = 2u,\ \ n = 2$

$$\frac{P^1}{k^1}=\frac{P}{n^2\left(P+K\right)-P}=\frac{3}{2^2\left(3+4\right)-3}=\frac{3}{25}$$

44. $PE_1 = \left(Mx\frac{l}{L}\right).g.\frac{l}{2}$ and $PE_2 = Mg\frac{L}{2}$

$$K.E. = P.E_2 - P.E_1$$

$$\frac{1}{2}Mv^2 = Mg\frac{L}{2}-\frac{Mgl^2}{2L} \Rightarrow v=\sqrt{\frac{g\left(L^2-l^2\right)}{L}}$$

45. Work done against air Resistance

$$=\frac{1}{2}m\left(u^2+2gh\right)-\frac{1}{2}mv^2 = 3755\text{ J}$$