5 Work, Energy and Power

Conceptual MCQs

1. A force $\vec{F} = (5\vec{i} + 3\vec{j} + 2\vec{k})N$ is applied over a particle which displaces it from its origin to the point $\vec{r} = (2\vec{i} - \vec{j})m$. The work done on the particle in joule is

(a) +10 (b) +7 (c) −7 (d) +13

2. You lift a heavy book from the floor of the room and keep it in the book-shelf having a height 2 m. In this process you take 5 seconds. The work done by you will depend upon

(a) mass of the book and time taken

(b) weight of the book and height of the book-shelf

(c) height of the book-shelf and time taken

(d) mass of the book, height of the book-shelf and time taken

3. An object of mass 1 kg has a momentum of 10 kg m/sec then the kinetic energy of the object will be

(a) 100 J (b) 50 J (c) 1000 J (d) 200 J

4. A rock of mass m dropped to the ground from a height h. A second rock with mass 2 m is dropped from the same height. When second rock strikes the ground, its kinetic energy is

(a) twice that of the first rock

(b) four times that of the first rock

(c) the same as that of the first rock

(d) half that of the first rock

5. The magnitude of work done by a force :

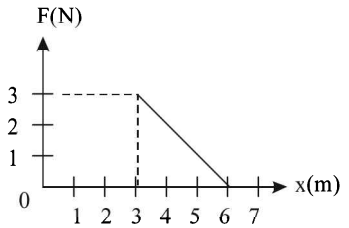
(a) depends on frame of reference

(b) does not depend on frame of reference

(c) cannot be calculated in non-inertial frames.

(d) both (a) and (b)

6. A force F acting on an object varies with distance x as shown here. The force is in N and x in m. The work done by the force in moving the object from x = 0 to x = 6 m is



(a) 18.0 J (b) 13.5 J (c) 9.0 J (d) 4.5 J

7. Natural length of a spring is 60 cm, and its spring constant is 4000 N/m. A mass of 20 kg is hung from it. The extension produced in the spring is, (Take $g = 9.8\ m/s^2$)

(a) 4.9 cm (b) 0.49 cm (c) 9.4 cm (d) 0.94 cm

8. When a long spring is stretched by 2 cm, its potential energy is U. If the spring is stretched by 10 cm, the potential energy stored in it will be

(a) 25 U (b) U/5 (c) 5 U (d) 10 U

9. Figure shows four situations in which a force is applied to a block. In all four cases, the force has the same magnitude, and the displacement of the block is to the right and of the same magnitude. Which of the following cases work done by the applied force on the block is zero?

(a) (i) (b) (ii) (c) (iii) (d) (iv)

10. A body of mass 10 kg moves with a velocity v of 2 m/s along a circular path of radius 8 m. The power produced by the body will be

(a) 10 J/s (b) 98 J/s (c) 49 J/s (d) zero

11. A body of mass m moving with velocity 3 km/h collides with a body of mass 2m at rest. Now the coalesced mass starts to move with a velocity

(a) 1 km/h (b) 2 km/h (c) 3 km/h (d) 4 km/h

12. In an explosion, a body breaks up into two pieces of unequal masses. In this

(a) both parts will have numerically equal momentum

(b) lighter part will have more momentum

(c) heavier part will have more momentum

(d) both parts will have equal kinetic energy

13. A tennis ball is released from height h above ground level. If the ball makes inelastic collision with the ground, to what height will it rise after third collision?

(a) he^6 (b) e^2h

(c) e^3h (d) None of these

14. Two identical balls A and B moving with velocities +0.5 m/s and –0.3 m/s respectively, collide head on elastically. The velocities of the balls A and B after collision, will be, respectively

(a) +0.5 m/s and +0.3 m/s (b) – 0.3 m/s and +0.5 m/s

(c) +0.3 m/s and 0.5 m/s (d) –0.5 m/s and +0.3 m/s

15. For inelastic collision between two spherical rigid bodies

(a) the total kinetic energy is conserved

(b) the total mechanical energy is not conserved

(c) the linear momentum is not conserved

(d) the linear momentum is conserved

Application Based MCQs

16. The work done in pulling up a block of wood weighing 2 *kN* for a length of 10*m* on a smooth plane inclined at an angle of 15° with the horizontal is [sin15° = 0.2588]

(a) 4.36 *kJ* (b) 5.17 *kJ* (c) 8.91 *kJ* (d) 9.82 *kJ*

17. Two springs A and B are identical but A is harder than B($k_A > k_B$). Let W_A and W_B represent the work done when the springs are stretched through the same distance and W'_A and W'_B are the work done when these are stretched by equal forces, then which of the following is true

(a) $W_A > W_B$ and $W'_A = W'_B$

(b) $W_A > W_B$ and $W'_A < W'_B$

(c) $W_A > W_B$ and $W'_A > W'_B$

(d) $W_A < W_B$ and $W'_A < W'_B$

18. Two masses of 1g and 9g are moving with equal kinetic energies. The ratio of the magnitudes of their respective linear momenta is

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

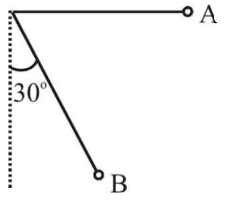
19. A particle moves in a straight line with retardation proportional to its displacement. Its loss of kinetic energy for any displacement *x* is proportional to

(a) x (b) e^x (c) x^2 (d) $\log_e x$

20. An inelastic ball is dropped from a height of 100 m. Due to earth, 20% of its energy is lost. To what height the ball will rise?

(a) 80m (b) 40m (c) 60m (d) 20m

21. A simple pendulum is released form *A* as shown. If *m* and *l* represent the mass of the bob and length of the pendulum, the gain in kinetic energy at *B* is



(a) $\frac{mgl}{2}$ (b) $\frac{mgl}{\sqrt{2}}$

(c) $\frac{\sqrt{3}}{2}mgl$ (d) $\frac{2}{\sqrt{3}}mgl$

22. Two bodies *A* and *B* have masses 20 *kg* and 5 *kg* respectively. Each one is acted upon by force of 4 *kg wt*. If they acquire the same kinetic energy in times t_A and t_B, then the ratio $\frac{t_A}{t_B}$ is

(a) 1/2 (b) 2 (c) 2/5 (d) 5/6

23. A particle of mass m_1 is moving with a velocity v_1 and another particle of mass m_2 is moving with a velocity v_2. Both of them have the same momentum but their different kinetic energies are E_1 and E_2 respectively. If $m_1 > m_2$, then

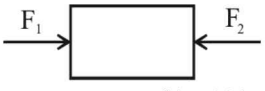
(a) $E_1 = E_2$ (b) $E_1 < E_2$

(c) $\frac{E_1}{E_2} = \frac{m_1}{m_2}$ (d) $E_1 > E_2$

24. A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is 6 ms^{-1}. The kinetic energy of the other mass is

(a) 324 J (b) 486 J (c) 256 J (d) 524 J

25. A body of mass *M* is moving with a uniform speed of 10*m/s* on frictionless surface under the influence of two forces F_1 and F_2. The net power of the system is



(a) $10 F_1F_2 M$ (b) $10(F_1 + F_2) M$

(c) $(F_1 + F_2) M$ (d) Zero

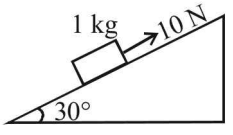
26. A body of mass '*m*', accelerates uniformly from rest to 'v_1' in time 't_1'. The instantaneous power delivered to the body as a function of time '*t*' is

(a) $\frac{mv_1t^2}{t_1}$ (b) $\frac{mv_1^2t}{t_1^2}$ (c) $\frac{mv_1t}{t_1}$ (d) $\frac{mv_1^2t}{t_1}$

27. 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 the table ?

(a) 12 J (b) 3.6 J (c) 7.2 J (d) 1200 J

28. A block of mass 1 kg is pushed up a surface inclined to horizontal at an angle of 30° by a force of 10 N parallel to the inclined surface as shown in the figure.



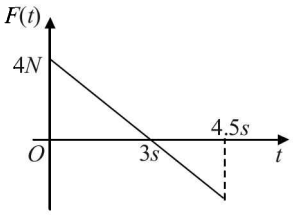
The coefficient of friction between block and the incline is 0.1. If the block is pushed up by 10 m along the incline, then the work against gravity is (Take $g = 10\ m\ s^{-2}$)

(a) 10 J (b) 50 J (c) 100 J (d) 150 J

29. A ball is dropped from a height of 1 m. If coefficient of restitution between surface and ball is 0.6, the ball rebounds to a height of

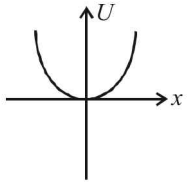
(a) 0.6 m (b) 0.4 m (c) 1 m (d) 0.36 m

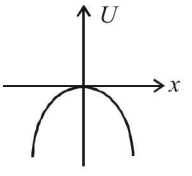
30. A block of mass 2 kg is free to move along the x-axis. It is at rest and from t = 0 onwards it is subjected to a time-dependent force $F(t)$ in the x direction. The force $F(t)$ varies with t as shown in the figure. The kinetic energy of the block after 4.5 seconds is

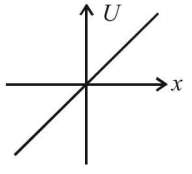


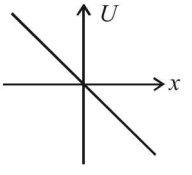
(a) 4.50 J (b) 7.50 J (c) 5.06 J (d) 14.06 J

31. A particle is acted by a force $F = kx$, where k is a +ve constant. Its potential energy at $x = 0$ is zero. Which curve correctly represents the variation of potential energy of the block with respect to x

(a) 

(b) 

(c) 

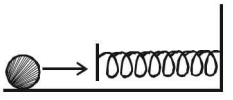
(d) 

32. A bullet fired into a fixed target loses 20% of its kinetic energy in penetrating 1 cm. The total distance penetrated by the bullet before it comes to rest is

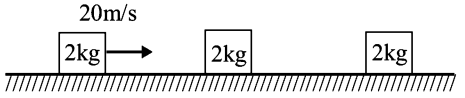
(a) 4 cm (b) 5 cm (c) 8 cm (d) 6 cm

33. A mass of 0.5 kg moving with a speed of 1.5 m/s on a horizontal smooth surface, collides with a nearly weightless spring of force constant k = 50 N/m. The maximum compression of the spring would be

(a) 0.5 m
(b) 0.15 m
(c) 0.12 m
(d) 1.5 m



34. A block of mass 2 kg collide with identical stationary block head on elastically with velocity of 20 m/s. After collision second block collide with the third block of mass 2 kg initially at rest. If they collide head on perfectly inelastically then the velocity of their combination will be



(a) 5 m/s (b) 4 m/s (c) 10 m/s (d) 20 m/s

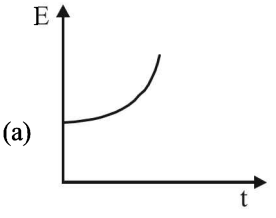
35. A 10 H.P. motor pumps out water from a well of depth 20 m and fills a water tank of volume 22380 litres at a height of 10 m from the ground. The running time of the motor to fill the empty water tank is ($g = 10 ms^{-2}$)

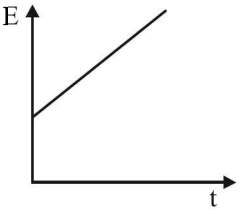
(a) 5 minutes (b) 10 minutes
(c) 15 minutes (d) 20 minutes

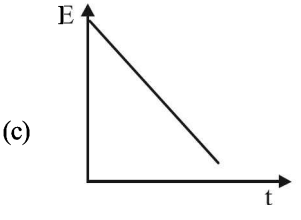
36. A body of mass 4 kg moving with velocity 12 m/s collides with another body of mass 6 kg at rest. If two bodies stick together after collision, then the loss of kinetic energy of system is

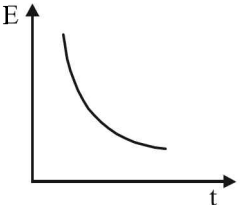
(a) zero (b) 288 J (c) 172.8 J (d) 144 J

37. A particle is dropped from a height h. A constant horizontal velocity is given to the particle. Taking g to be constant every where, kinetic energy E of the particle w. r. t. time t is correctly shown in

(a) 

(b) 

(c) 

(d) 

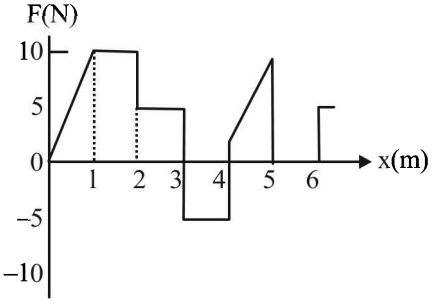
38. A force of $(5 + 3x)$ N acting on a body of mass 20 kg along the x-axis displaces it from $x = 2m$ to $x = 6m$. The work done by the force is

(a) 20 J (b) 48 J (c) 68 J (d) 86 J

39. A uniform rod of mass m and length l is held inclined at an angle of 60° with the vertical. What will be the potential energy of the rod in this position ?

(a) zero (b) $\frac{mgl}{4}$ (c) $\frac{mgl}{2}$ (d) mgl

40. The relationship between the force F and position x of a body is as shown in figure. The work done in displacing the body form x = 1 m to x = 5 m will be



(a) 30 J (b) 15 J (c) 25 J (d) 20 J

Skill Based MCQs

41. A running man has half the kinetic energy of that of a boy of half of his mass. The man speeds up by 1m/s so as to have same K.E. as that of the boy. The original speed of the man will be

(a) $\sqrt{2}\ m/s$ (b) $\left(\sqrt{2}-1\right)m/s$

(c) $\frac{1}{\left(\sqrt{2}-1\right)}m/s$ (d) $\frac{1}{\sqrt{2}}m/s$

42. A ball is projected vertically upwards with a certain initial speed. Another ball of the same mass is projected at an angle of 60° with the vertical with the same initial speed. At highest points of their journey, the ratio of their potential energies will be

(a) 1 : 1 (b) 2 : 1 (c) 3 : 2 (d) 4 : 1

43. A sphericla ball A of mass 4 *kg*, moving along a straight line strikes another spherical ball *B* of mass 1*kg* at rest. After the collision, *A* and *B* move with velocities $\upsilon_1\ ms^{-1}$ and $\upsilon_2\ ms^{-1}$ respectively making angles of 30° and 60° with respect to the original direction of motion of *A*. The ratio $\frac{\upsilon_1}{\upsilon 2}$ will be

(a) $\sqrt{3}/4$ (b) $4/\sqrt{3}$ (c) $1/\sqrt{3}$ (d) $\sqrt{3}$

44. The potential energy of a 1 kg particle free to move along the x-axis is given by $V(x)=\left(\frac{x^4}{4}-\frac{x^2}{2}\right)J$.

The total mechanical energy of the particle is 2 J. Then, the maximum speed (in m/s) is

(a) $\frac{3}{\sqrt{2}}$ (b) $\sqrt{2}$ (c) $\frac{1}{\sqrt{2}}$ (d) 2

45. A 2 kg block slides on a horizontal floor with a speed of 4m/s. It strikes a uncompressed spring, and compresses it till the block is motionless. The kinetic friction force is 15N and spring constant is 10,000 N/m. The spring compresses by

(a) 8.5 cm (b) 5.5 cm (c) 2.5 cm (d) 11.0 cm

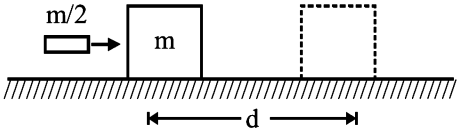
46. A body of mass m kg is ascending on a smooth inclined plane of inclination $\theta\left(\sin\theta=\frac{1}{x}\right)$ with constant acceleration of a m/s^2. The final velocity of the body is v m/s. The work done by the body during this motion is

(Initial velocity of the body = 0)

(a) $\frac{1}{2}mv^2(g+xa)$ (b) $\frac{mv^2}{2}\left(\frac{g}{2}+a\right)$

(c) $\frac{2mv^2x}{a}(a+gx)$ (d) $\frac{mv^2}{2ax}(g+xa)$

47. A block of mass m rests on a rough horizontal surface (Coefficient of friction is μ). When a bullet of mass m/2 strikes horizontally, and get embedded in it, the block moves a distance d before coming to rest. The initial velocity of the bullet is $k\sqrt{2\mu gd}$, then the value of k is



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

48. A bullet of mass *m* moving horizontally with a velocity *v* strikes a block of wood of mass *M* and gets embedded in the block. The block is suspended from the ceiling by a massless string. The height to which block rises is

(a) $\frac{v^2}{2g}\left(\frac{m}{M+m}\right)^2$ (b) $\frac{v^2}{2g}\left(\frac{M+m}{m}\right)^2$

(c) $\frac{v^2}{2g}\left(\frac{m}{M}\right)^2$ (d) $\frac{v^2}{2g}\left(\frac{M}{m}\right)^2$

49. A body of mass 0.5 kg travels in a straight line with velocity $v = kx^{3/2}$ where $k = 5m^{-1/2}s^{-1}$. The work done by the net force during its displacement from $x = 0$ to $x = 2$ m is

(a) 1.5 J (b) 50 J (c) 10 J (d) 100 J

50. A body of mass 5 kg is moving with a momentum of 10 kg m/s. A force of 0.2 N acts on it in the direction of motion of the body for 10 second. The increase in its kinetic energy is

(a) 4.4 J (b) 3.8 J (c) 3.2 J (d) 2.8 J

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