WORK DONE BY A CONSTANT FORCE AND VARIABLE FORCE, KINETIC ENERGY AND WORK-ENERGY THEOREM, POWER

1. A block of mass m is pulled along a horizontal surface by applying a force at an angle $\theta$ with the horizontal. If the block travels with a uniform velocity and has a displacement d and the coefficient of friction is $\mu$, then the work done by the applied force is:
   **(a)** $\frac{\mu mgd\, cos\theta}{cos\theta + \mu\, sin\theta}$ (b) $\frac{\mu mgd}{cos\theta + \mu\, sin\theta}$ (c) $\frac{\mu mgd\, sin\theta}{cos\theta - \mu\, sin\theta}$ (d) $\frac{\mu mgd\, cos\theta}{sin\theta + \mu\, cos\theta}$
2. A particle is displaced from a position $3\hat{\imath} + \hat{\jmath} + \hat{k}$ to another position $2\hat{\imath} + 6\hat{\jmath} - 2\hat{k}$ under the action of the force $\hat{\imath} + 2\hat{\jmath} - 3\hat{k}$. The work done by the force in arbitrary unit is:
   (a) 8 **(b)** 18 (c) 24 (d) 30
3. A force $\vec{F} = 3\hat{\imath} + 4\hat{\jmath} - \hat{k}$ displaces a body from a point A (3, 6, 9) to the point B (9, 6, 3). The work done is:
   (a) 6 unit (b) 12 units (c) 20 units **(d)** 24 units
4. A body of mass 4 kg is under a force causes a displacement in it, given by $s = t^3/3$ (in metres). The work done by the force in 4 s is:
   (a) 128 J (b) 256 J **(c)** 512 J (d) 86 J
5. A force acts on a 5 g particle in such a way that position of particle as a function of time is given by $x = 4 + t + t^2$, where x is in metre and t is in sec. The work done during first 4 s is:
   **(a)** 200 mJ (b) 250 mJ (c) 480 mJ (d) 664 mJ
6. A body constrained to move in z-direction is subjected to a force given by $\vec{F} = \hat{\imath} + 4\hat{\jmath} + 8\hat{k}$ N. The work done by this force in moving the body a distance of 20 m along the z-axis is:
   (a) 120 J (b) 140 J **(c)** 160 J (d) 190 J
7. A force F is related to the position of a particle by the relation $F = 3x^2$ N. The work done by the force when the particle moves from x = 1 m to x = 5 m is:
   **(a)** 124 J (b) 260 J (c) 380 J (d) 540 J
8. A body of mass 0.5 kg travels in a straight line with velocity $v = kx^{3/2}$ where $k = 5\ m^{-1/2}s^{-1}$. What is the work done by the net force during its displacement from x = 0 to x = 2 m?
   (a) 25 J **(b)** 50 J (c) 100 J (d) 150 J
9. A gardener pushes a lawn roller through a distance 20 m. If he applies a force of 20 kg-wt in a direction inclined at 60° to the ground, the work done by him is:
   **(a)** 1960 J (b) 196 J (c) 1.96 J (d) 196 kJ
10. The work done in time t on a body of mass m which is accelerated from rest to a speed v in time $t_1$ as a function of time t is given by:
    (a) $\frac{1}{2}m\frac{v}{t_1}t^2$ (b) $m\frac{v}{t_1}t^2$ (c) $\frac{1}{2}\left(\frac{mv}{t_1}\right)^2 t^2$ **(d)** $\frac{1}{2}m\left(\frac{v}{t_1}\right)^2 t^2$
11. The kinetic energy $K$ of a particle moving in a straight line depends on the distance s as $K = as^2$. The force acting on the particle is (where $a$ is a constant):
    **(a)** $2as$ (b) $as$ (c) $2a$ (d) $3as^2$
12. Two bodies of masses m and 9 m are moving with equal kinetic energy. The ratio of their linear momenta is:
    (a) 1: 2 **(b)** 1: 3 (c) 1: 4 (d) 4: 1
13. A car starts from rest and moves on a surface in which the coefficient of friction between the road and the tyres increases linearly with distance (x). The car moves with the maximum possible acceleration. The kinetic energy (E) of the car will depend on x as:

(a) $E \propto \frac{1}{x}$ (b) $E \propto x$ **(c)** $E \propto x^2$ (d) $E \propto \frac{1}{x^2}$

14. Two bodies A and B have masses 20 kg and 5 kg respectively. Each one is acted upon by a force of 4 kg wt. If they acquire the same kinetic energy in times $t_A$ and $t_B$, then the ratio $t_A/t_B$ is:
    (a) 1 **(b)** 2 (c) 2/3 (d) 3
15. If the force acting on a body is inversely proportional to its speed, then its kinetic energy is:
    **(a)** linearly related to time (b) inversely proportional to time (c) inversely proportional to the square of time (d) a constant
16. A body of mass 4m at rest explodes into three fragments. Two of the fragments each of mass m move with speed v in mutually perpendicular directions. Total energy released in the process is:
    (a) $\frac{1}{2}mv^2$ (b) $\frac{1}{3}mv^2$ (c) $mv^2$ **(d)** $\frac{3}{2}mv^2$
17. A bomb of mass 6 kg explodes into two pieces of masses 2 kg and 4 kg. The velocity of mass 2 kg is 10 m/s. The kinetic energy of mass 4 kg in joule is:
    (a) 128 (b) 100 **(c)** 50 (d) 20
18. A particle of mass m at rest is acted upon by a force P for a time t. Its kinetic energy after an interval t is:
    (a) $\frac{P^2t^2}{m}$ (b) $\frac{2P^2t^2}{m}$ **(c)** $\frac{P^2t^2}{2m}$ (d) $\frac{P^2t^2}{4m}$
19. A vehicle of mass m is moving on a rough horizontal road with momentum p. If the coefficient of friction between the tyres and the road be μ, then the stopping distance is:
    **(a)** $\frac{p^2}{2\mu m^2 g}$ (b) $\frac{p^2}{2\mu m}$ (c) $\frac{p}{2\mu m^2 g}$ (d) $\frac{p}{2\mu m g}$
20. A block of mass 2 kg is resting on a smooth horizontal surface. At what angle to the surface a force of 40 N be acted on the body so that it will acquired a kinetic energy of 80 J after moving 4 m?
    (a) 30° (b) 45° **(c)** 60° (d) 120°
21. A particle moves with a velocity $3\hat{\imath} + \hat{\jmath} - \hat{k}$ m/s under the influence of a constant force $\vec{F} = 5\hat{\imath} + 8\hat{\jmath} + 5\hat{k}$ N. The instantaneous power applied to the particle is:
    **(a)** 18 W (b) 30 W (c) 36 W (d) 100 W
22. Two men with weights in the ratio 5:3 run up a staircase in time in the ratio 15:10. The ratio of power of the first to that of second is:
    (a) 30/5 (b) 10/15 (c) 9/10 **(d)** 10/9
23. Power supplied to a particle of mass 2 kg varies with time as $P = 3t^2/2$, where t is in seconds. If velocity of the particle at t = 0 is v = 0, the velocity of particle at t = 2s will be:
    **(a)** 2 m/s (b) 4 m/s (c) 6 m/s (d) 7 m/s
24. A machine gun fires 10 bullets per second into a target. The mass of each bullet is 4 g and the speed 400 m/s. The power delivered to the bullets is: (a) 1.8 kW (b) 3.5 kW **(c)** 3.2 kW (d) 575 W
25. A body is initially at rest. It undergoes one dimensional motion with constant acceleration. The power delivered to it at time t is proportional to:
    (a) $t^2$ **(b)** $t$ (c) $t^{1/2}$ (d) $t^{2/3}$
26. A force F acting on a body depends on its displacement s as $F \propto s^{-1/3}$. The power delivered by F will depend on displacement as:
    (a) $s^{2/5}$ (b) $s^{1/3}$ (c) $s$ **(d)** $s^0$