Work, Energy and Power

Objective : Solving problem based on Work, KE, PE and power

1. Two spheres whose radii are in the ratio 1 : 2 are moving with their velocities in the ratio 3 : d) If their densities are in the ratio 3 : 2, the ratio of their kinetic energies is
   a) 27 : 64 b) 1 : 1 c) 27 : 256 d) 9 : 64

2. A body is projected from the ground at an angle 30° with the horizontal. Ratio of PE to KE when it is a height of 1/5th of its maximum height is
   a) 1 : 19 b) 2 : 15 c) 2 : 13 d) 1 : 17

3. A machine has an efficiency of 75%. It consumes 16 J of energy to lift up a body of mass 2 kg through a certain height. When the body is released from this height, the velocity attained by it as it reaches the ground is
   a) $\sqrt{24}$ ms^{-1} b) $\sqrt{12}$ ms^{-1} c) $\sqrt{18}$ ms^{-1} d) $\sqrt{9}$ ms^{-1}

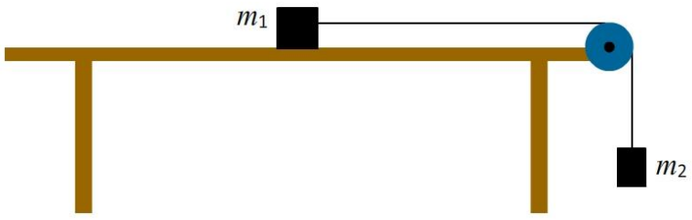
4. A man who is running has half the kinetic energy of a boy of half his mass. When the man speeds up by 1ms^{-1} his kinetic energy becomes equal to that of the boy. Initial speed of the man is
   a) $\sqrt{2}$ ms^{-1} b) $(\sqrt{2}-1)$ ms^{-1} c) 2 ms^{-1} d) $(\sqrt{2}+1)$ ms^{-1}

5. A body of weight 40 N is projected vertically up. At an intermediate point its P.E, K.E are 80 J, 120 J respectively. Its time of flight is (assume g = 10 ms^{-2})
   a) 2 s b) 3 s c) 4 s d) 1 s

6. A particle moves on rough horizontal ground with an initial velocity u. If 3/4th of its kinetic energy is lost due to friction in a time t then the coefficient of friction between the particle and the ground is
   a) $\frac{u}{2gt}$ b) $\frac{u}{4gt}$ c) $\frac{3u}{4gt}$ d) $\frac{u}{gt}$

7. A body of mass m has kinetic energy equal to one-fourth kinetic energy of another body of mass m/d) If the speed of the heavier body is increased by 4 ms^{-1}, its new kinetic energy becomes equal to the kinetic energy of the lighter body. Initial speed of the heavier body is
   a) 8 ms^{-1} b) 6 ms^{-1} c) 4 ms^{-1} d) 2 ms^{-1}

8. Two bodies m_1 and m_2 of masses 2kg and 4 kg are connected by a string as shown in the figure. Coefficient of kinetic friction between m_1 and the table is 0.5. When released from rest, their common speed as they each body covers a distance of distance 0.4 m is (g = 10 s^{-2})



   a) 2ms^{-1} b) 3ms^{-1} c) zero d) 1ms^{-1}

9. A projectile is fired from the top of a tower of height h with an initial speed of u at an unknown angle. On reaching the ground its speed would be
   a) $\sqrt{u^2-2gh}$ b) $u+\sqrt{2gh}$ c) u d) $\sqrt{u^2+2gh}$

10. Potential energy of a body of mass 1kg, free to move along the x – axis is given by $V(x)=\left(\frac{x^4}{4}-\frac{x^2}{2}\right)$

    If total mechanical energy of the body is 2J, then the maximum speed of the body (in ms^{-1}) is
    a) $\frac{3}{\sqrt{2}}$ b) $\sqrt{2}$ c) $\frac{1}{\sqrt{2}}$ d) 2

11. A car of mass m is driven with an acceleration a along a straight level road against a constant external resistive force R. When velocity of the car is v, the rate at which engine of the car is doing work will be
    a) Rv b) mav c) $(R+ma)v$ d) $(ma-R)v$

12. A motor boat moves in a river with velocity $\boldsymbol{v}=7\hat{i}+2\hat{j}-5\hat{k}$ ms^{-1} If the resisting force due to water is $\boldsymbol{F}=9\hat{i}+3\hat{j}-3\hat{k}$ N , then power of the motor boat is
    a) 13 W b) 69 W c) 12 W d) 84 W

13. A cord is used to lower a block, of mass M, vertically through a distance d at a constant acceleration of g/d) The work done by the cord on the block is
    a) Mgd /4 b) – Mgd/4 c) 3 Mgd /4 d) -3 Mgd /4

14. A simple pendulum of length 1m has a bob of mass 100 g. It is displaced through an angle of 60° from the vertical and released. Kinetic energy of the bob when it passes through the mean position is (g = 10 ms^{-2})

a) 0.025 J b) 0.5 J c) 1.0 J d) 1.4 J

15. Two identical cylindrical vessels with their bases at the same level contain liquid of density ρ. The height of the liquid in the vessels is at h_1 and h_2 respectively. The cylinders are now interconnected. If the area of the base of each cylinder is A then the work done by the gravity as the level of liquid become equal in the cylinders is

a) $A\rho g\left(\frac{h_1-h_2}{2}\right)$ b) $\frac{A\rho g\left(h_1-h_2\right)^2}{2}$ c) $A\rho g\left(\frac{h_1-h_2}{4}\right)$ d) $A\rho g\left(\frac{h_1-h_2}{4}\right)^2$

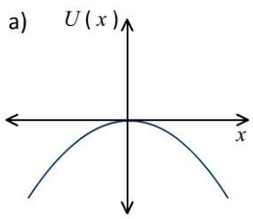
16. A body of mass m is moved from rest along a straight line by an engine delivering constant power P. The velocity of the body at an instant of time t is

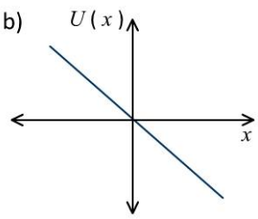
a) $\sqrt{\frac{2Pt}{m}}$ b) $\frac{2Pt}{m}$ c) $\sqrt{\frac{Pt}{2m}}$ d) $\frac{Pt}{2m}$

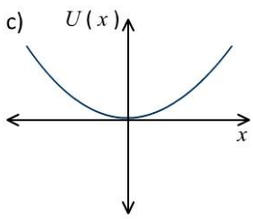
17. The time of ascent and descent of a particle thrown up vertically is t_1 and t_2 respectively. If air is assumed to exert a constant force on the particle opposite to the direction of motion then
    a) $t_1 > t_2$
    b) $t_1 = t_2$
    c) $t_1 < t_2$
    d) May be any one of the above depending on the weight of the particle

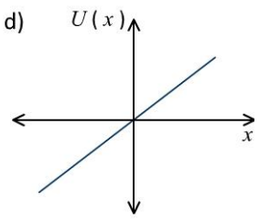
18. A particle moves along a straight line such that its retardation is proportional to its displacement. The loss in its kinetic energy for a displacement x is proportional to
    a) x b) x^2 c) $\ln x$ d) e^x

19. A particle is placed at the origin and a force $F(x) = kx$ (k is a positive constant) acts on it. If $U(0) = 0$, the graph of variation of $U(x)$ is given by (U is the potential energy of the particle)

a) 

b) 

c) 

d) 

20. A car of mass m and a truck of mass M are initially in motion. They are brought to rest under different conditions. Choose the correct statements from the following *(more than one option may be correct)*
    a) If car and truck have same initial momentum and are subjected to same retardation, they come to rest in the same interval of time
    b) If car and truck have same initial kinetic energy and are subjected to same breaking force, they cover same distance as they are brought to rest
    c) If car and truck have same initial velocity and are subjected to same retardation, they come to rest in the same interval of time
    d) If car and truck have same initial momentum and are to be brought to rest in the same distance then the breaking force of truck should be equal to that of the car

Answers

1. a
2. a
3. b
4. d
5. a
6. a
7. c
8. a
9. d
10. d
11. c
12. d
13. d
14. b
15. b
16. a
17. b
18. b
19. a
20. b, c