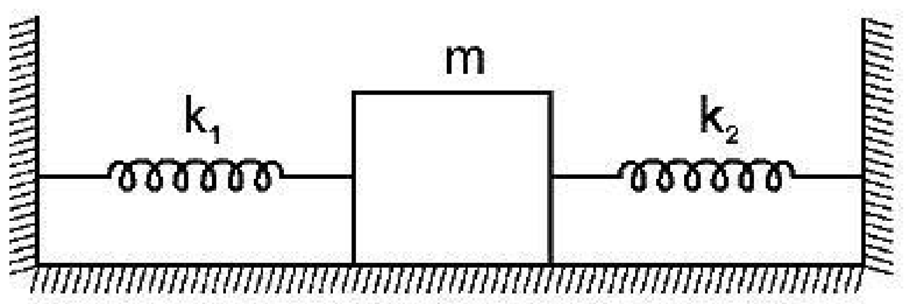
DPP No. 7

SYLLABUS : WORK POWER & ENERGY

1. A rope ladder with a length ℓ carrying a man of mass m at its end is attached to the basket of balloon with a mass M. The entire system is in equilibrium in the air. As the man climbs up the ladder into the balloon, the balloon descends by a height h. Then the potential energy of the man :

(A) Increases by mg $(\ell - h)$
(B) Increases by mgℓ
(C) Increases by mgh
(D) Increases by mg $(2\ell - h)$

2. A block of mass m is attached to two unstretched springs of spring constants k_1 and k_2 as shown in figure. The block is displaced towards right through a distance x and is released. Find the speed of the block as it passes through the mean position shown.

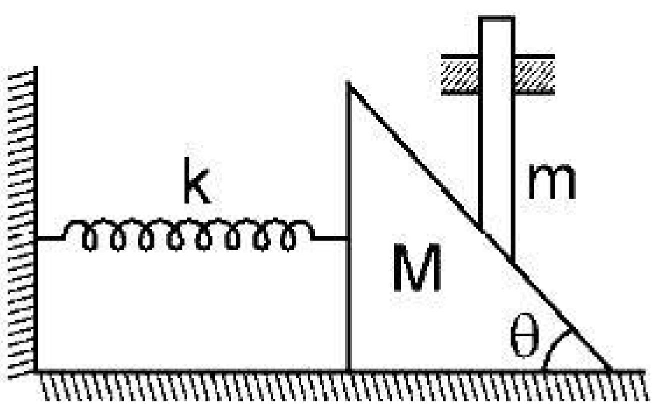


(A) $\sqrt{\frac{k_1 + k_2}{m}}\,x$
(B) $\sqrt{\frac{k_1 k_2}{m(k_1 + k_2)}}\,x$
(C) $\sqrt{\frac{k_1^2 k_2^2}{m(k_1^2 + k_2^2)}}\,x$
(D) $\sqrt{\frac{k_1^3 k_2^3}{m(k_1^3 + k_2^3)}}$

3. A spring when stretched by 2 mm its potential energy becomes 4 J. If it is stretched by 10 mm, its potential energy is equal to

(A) 4 J
(B) 54 J
(C) 415 J
(D) 100 J

4. A wedge of mass M fitted with a spring of stiffness 'k' is kept on a smooth horizontal surface. A rod of mass m is kept on the wedge as shown in the figure. System is in equilibrium and at rest Assuming that all surfaces are smooth, the potential energy stored in the spring is :



(A) $\frac{mg^2 \tan^2\theta}{2K}$
(B) $\frac{m^2 g \tan^2\theta}{2K}$
(C) $\frac{m^2 g^2 \tan^2\theta}{2K}$
(D) $\frac{m^2 g^2 \tan^2\theta}{K}$

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

(A) $\sqrt{2}$ m/s (B) $(\sqrt{2} - 1)$m/s (C) $\frac{1}{(\sqrt{2}-1)}$ m/s (D) $\frac{1}{\sqrt{2}}$ m/s

6. A rod of length 1m and mass 0.5 kg hinged at one end, is initially hanging vertical. The other end is now raised slowly until it makes an angle 60° with the vertical. The required work is : (use g = 10 m/s^2)

(A) $\frac{5}{2}$ J (B) $\frac{5}{4}$ J (C) $\frac{17}{8}$ J (D) $\frac{5\sqrt{3}}{4}$ J

7. A projectile is fired from the top of a 40 m high cliff with an initial speed of 50 m/s at an unknown angle. Find its speed when it hits the ground. (g = 10 m/s^2)

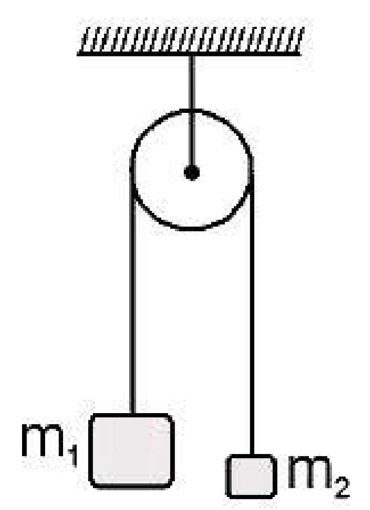
(A) $5\sqrt{33}$ m/s (B) $10\sqrt{25}$ m/s (C) $10\sqrt{33}$ m/s (D) $15\sqrt{33}$ m/s

8. Calculate the velocity of the bob of a simple pendulum at its mean position if it is able to rise to a vertical height of 10 cm. Given : g = 980 cm s^{-2}.

(A) 1 m s^{-1} (B) 3.40 m s^{-1}

(C) 2.40 m s^{-1} (D) 1.40 m s^{-1}

9. The heavier block in an Atwood machine has a mass twice that of the lighter one. The tension in the string is 16.0 N when the system is set into motion. Find the decrease in the gravitational potential energy during the first second after the system is released from rest.



Atwood Machine

(A) 1 g = 19.6 J (B) 2 g = 19.6 J (C) 2 g = 15 J (D) 2 g = 10.6 J

10. 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 :

(A) $t^{1/2}$ (B) $t^{3/4}$ (C) $t^{3/2}$ (D) t^2

11. A car of mass 'm' is driven with a constant acceleration 'a' along a straight level road against a constant external resistive force 'R'. When the velocity of the car is 'V', the rate at which the engine of the car is doing work will be

(A) RV (B) maV (C) (R + ma)V (D) (ma – R)V

12. A block of mass m is moving with a constant acceleration 'a' on a rough horizontal plane. If the coefficient of friction between the block and plane is μ.The power delivered by the external agent at a time t from the beginning is equal to :

(A) ma^2t (B) μmgat (C) μm(a + μg) gt (D) m(a + μg) at

13. An electric motor creates a tension of 4500 N in hoisting cable and reels it at the rate of 2 m/s. What is the power of electric motor ?

(A) 9 W (B) 9 KW (C) 225 W (D) 9000 H.P.

14. A labourer lifts 100 stones to a height of 6 metre in two minute. If mass of each stone be one kilogram, calculate the average power. Given : g = 10 m s^{-2}.

(A) 10 W (B) 30 W (C) 50 W (D) 75 W

15. A man of mass 70 kg climbs up a vertical staircase at the rate of 1 ms^{-1}. What is the power developed by the man? [g = 10 m/sec^2]

(A) 100 W (B) 250 W (C) 500 W (D) 700 W

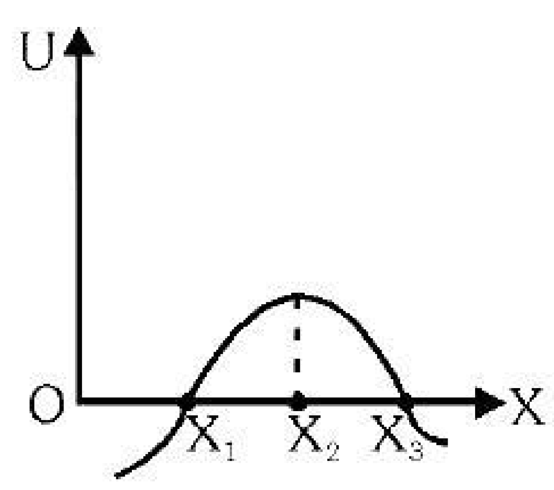
16. An engine develops 10 kW of power. How much time will it take to lift a mass of 200 kg through a height of 40 m? Given : g = 10 ms^{-2}.

(A) 2 second (B) 6 second (C) 8 second (D) 16 second

17. In a factory an engine of 5.3HP is to be used to lift 4000 kg of coal through a distance of 12 m. calculate the time taken by engine to do this.

(A) 1 min (B) 2 min (C) 3 min (D) 7 min

18. In the figure shown the potential energy (U) of a particle is plotted against its position 'x' from origin. Then which of the following statement is correct. A particle at :



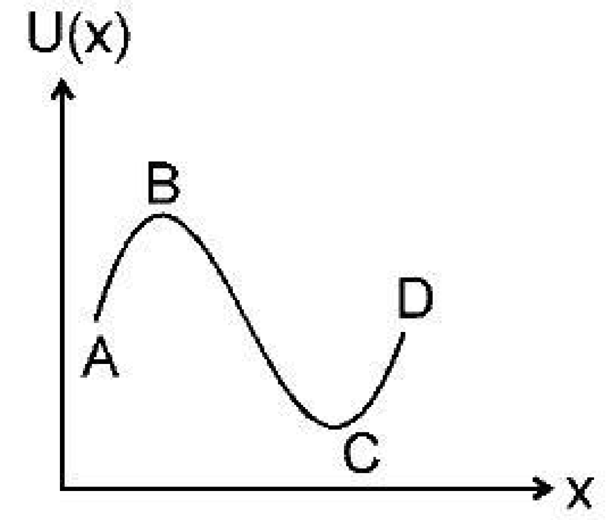
(A) x_1 is in stable equilibrium (B) x_2 is in stable equilibrium

(C) x_3 is in stable equilibrium (D) None of these

19. The potential energy of a particle in a field is $U = \frac{a}{r^2} - \frac{b}{r}$, where a and b are constant. The value of r in terms of a and b where force on the particle is zero will be :

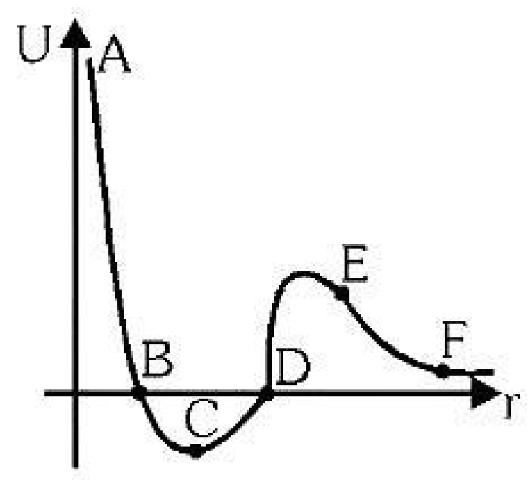
(A) $\frac{a}{b}$ (B) $\frac{b}{a}$ (C) $\frac{2a}{b}$ (D) $\frac{2b}{a}$

20. The potential energy of a particle varies with distance x as shown in the graph. The force acting on the particle is zero at



(A) C (B) B (C) B and C (D) A and D.

21. The given plot shows the variation, the potential energy (U) of interaction between two particles with the separating distance (r) between them. Which of the above statements are correct ?



(1) B and D are equilibrium points

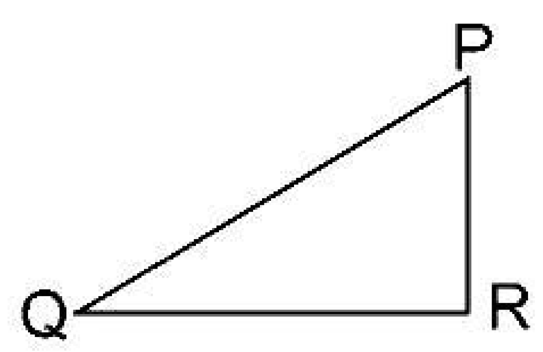
(2) C is a point of stable equilibrium points

(3) The force of interaction between the two particles is attractive between points C and D and repulsive between points D and E on the curve.

(4) The force of interaction between the particles is repulsive between points E and F on the curve.

(A) 1 and 3 (B) 1 and 4 (C) 2 and 4 (D) 2 and 3

22. For the path PQR in a conservative force field (fig.), the amount of work done in carrying a body from P to Q & from Q to R are 5 J & 2 J respectively . The work done in carrying the body from P to R will be -



(A) 7 J (B) 3 J (C) $\sqrt{21}$ J (D) zero

23. A particle is taken from point A to point B under the influence of a force field. Now it is taken back from B to A and it is observed that the work done in taking the particle from A to B is not equal to the work done in taking it from B to A. If W_{nc} and W_c is the work done by non-conservative forces and conservative forces present in the system respectively, ΔU is the change in potential energy, Δk is the change in kinetic energy, then

(A) $W_{nc} - \Delta U = \Delta k$ (B) $W_c = -\Delta U$ (C) $W_{nc} + W_c = \Delta k$ (D) $W_{nc} - \Delta U = -\Delta k$

24. A block of mass 250 g is kept (does not sticks to spring) on a vertical spring of spring constant 100 N/m fixed from below (block is in equilibrium). The spring is now compressed to have a length 10 cm shorter than its natural length and the system is released from this position. How high does the block rise from this position ? Take g = 10 m/s^2.

(A) 20 cm (B) 30 cm (C) 40 cm (D) 50 cm

25. A light spring of length 20 cm and force constant 2 N/cm is placed vertically on a table. A small block of mass 1 kg falls on it. The length h from the surface of the table at which the block will have the maximum velocity is :

(A) 20 cm (B) 15 cm (C) 10 cm (D) 5cm

ANSWER KEY

1.	(A)	**2.**	(A)	**3.**	(D)	**4.**	(C)	**5.**	(C)
6.	(B)	**7.**	(C)	**8.**	(D)	**9.**	(B)	**10.**	(C)
11.	(C)	**12.**	(D)	**13.**	(B)	**14.**	(C)	**15.**	(D)
16.	(C)	**17.**	(B)	**18.**	(D)	**19.**	(C)	**20.**	(C)
21.	(C)	**22.**	(A)	**23.**	(ABC)	**24.**	(A)	**25.**	(B)