## Graphical questions

**1.** (c) At time $t_1$ the velocity of ball will be maximum and it goes on decreasing with respect to time.

At the highest point of path its velocity becomes zero, then it increases but direction is reversed

This explanation match with graph (c).

**2.** (a) Work done = area between the graph and position axis

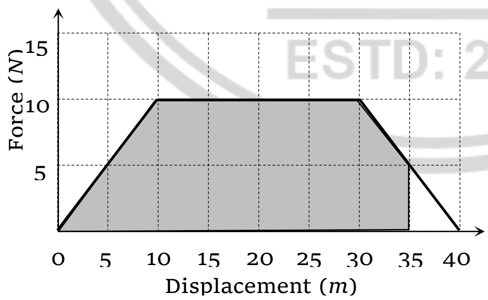
$W = 10 \times 1 + 20 \times 1 - 20 \times 1 + 10 \times 1 = 20 erg$

**3.** (a) Spring constant $k = \frac{F}{x}$ =Slope of curve

$\therefore k = \frac{4-1}{30} = \frac{3}{30} = 0.1 kg/cm$

**4.** (b) As the area above the time axis is numerically equal to area below the time axis therefore net momentum gained by body will be zero because momentum is a vector quantity.

**5.** (c)




Work done = (Shaded area under the graph between

$x = 0$ to $x = 35\ m) = 287.5 J$

**6.** (a) Work done = Area covered in between force displacement curve and displacement axis

= Mass × Area covered in between acceleration-displacement curve and displacement axis.

= $10 \times \frac{1}{2}(8 \times 10^{-2} \times 20 \times 10^{-2})$

= $8 \times 10^{-2} J$

**7.** (c) Work done = Gain in potential energy

Area under curve = *mgh*

$\Rightarrow \frac{1}{2} \times 11 \times 100 = 5 \times 10 \times h$

$\Rightarrow h = 11m$

**8.** (d) Initial K.E. of the body = $\frac{1}{2}mv^2 = \frac{1}{2} \times 25 \times 4 = 50J$

Work done against resistive force

= Area between *F-x* graph

= $\frac{1}{2} \times 4 \times 20 = 40J$

Final K.E. = Initial K.E. – Work done against resistive force

=$50 - 40 = 10J$

**9.** (d) Area between curve and displacement axis

= $\frac{1}{2} \times (12 + 4) \times 10$= 80 *J*

In this time body acquire kinetic energy = $\frac{1}{2}mv^2$

by the law of conservation of energy

$\frac{1}{2}mv^2 = 80J$

$\Rightarrow \frac{1}{2} \times 0.1 \times v^2 = 80$

$\Rightarrow v^2 = 1600$

$\Rightarrow v = 40\ m/s$

**10.** (a) Work done = Area under curve and displacement axis

= Area of trapezium

= $\frac{1}{2}$×(sum of two parallel lines) × distance between them

$= \frac{1}{2}(10 + 4) \times (2.5 - 0.5)$

$= \frac{1}{2} 14 \times 2 = 14\ J$

As the area actually is not trapezium so work done will be more than 14 *J i.e.* approximately 16 *J*

**11.** (a) As particle is projected with some velocity therefore its initial kinetic energy will not be zero.

As it moves downward under gravity then its velocity increases with time K.E. $\propto v^2 \propto t^2$ (As $v \propto t$)

So the graph between kinetic energy and time will be parabolic in nature.

**12.** (a) From the graph it is clear that force is acting on the particle in the region *AB* and due to this force kinetic energy (velocity) of the particle increases. So the work done by the force is positive.

**13.** (d) $F = \frac{-dU}{dx} \Rightarrow dU = -Fdx$

$$\Rightarrow U = -\int_0^x (-Kx + ax^3)dx = \frac{kx^2}{2} - \frac{ax^4}{4}$$

∴We get $U$ = 0 at $x$ = 0 and $x$ = $\sqrt{2k \rightleftarrows / \rightleftarrows a}$

and also $U$ = negative for $x > \sqrt{2k \rightleftarrows / \rightleftarrows a}$.

So $F$ = 0 at $x$ = 0

*i.e.* slope of $U - x$ graph is zero at $x$ = 0.

**14.** (b) Work done = Area enclosed by $F - x$ graph

$= \frac{1}{2} \times (3+6) \times 3 = 13.5J$

**15.** (c) As slope of problem graph is positive and constant upto certain distance and then it becomes zero.

So from $F = \frac{-dU}{dx}$, up to distance *a*, $F$ = constant (negative) and becomes zero suddenly.

**16.** (d) Work done = change in kinetic energy

$W = \frac{1}{2}mv^2 \; \therefore \; W \propto v^2$graph will be parabolic in nature

**17.** (a) Potential energy increases and kinetic energy decreases when the height of the particle increases it is clear from the graph (*a*).

**18.** (c) $P = \sqrt{2mE}$ it is clear that $P \propto \sqrt{E}$

So the graph between $P$ and $\sqrt{E}$ will be straight line.

but graph between $\frac{1}{P}$ and $\sqrt{E}$ will be hyperbola

**19.** (b) When particle moves away from the origin then at position $x = x_1$ force is zero and at $x > x_1$, force is positive (repulsive in nature) so particle moves further and does not return back to original position.

*i.e.* the equilibrium is not stable.

Similarly at position $x = x_2$ force is zero and at $x > x_2$, force is negative (attractive in nature)

So particle return back to original position *i.e.* the equilibrium is stable.

**20.** (c) $F = \frac{-dU}{dx}$ it is clear that slope of *U* – *x* curve is zero at point *B* and *C*. ∴ *F* = 0 for point *B* and *C*

**21.** (a) Work done = area under curve and displacement axis

$$=1 \times 10 - 1 \times 10 + 1 \times 10 = 10\ J$$

**22.** (a) When the length of spring is halved, its spring constant will becomes double. (because $k \propto \frac{1}{x} \propto \frac{1}{L} \therefore k \propto \frac{1}{L}$)

Slope of force displacement graph gives the spring constant (*k*) of spring.

If *k* becomes double then slope of the graph increases *i.e.* graph shifts towards force-axis.

**23.** (a) Kinetic energy $E = \frac{1}{2}mv^2 \Rightarrow E \propto v^2$

graph will be parabola symmetric to *E*-axis.

**24.** (c) Change in momentum = Impulse

= Area under force-time graph

$\therefore mv$ = Area of trapezium

$$\Rightarrow mv = \frac{1}{2}\left(T + \frac{T}{2}\right)\ F_0$$

$$\Rightarrow mv = \frac{3T}{4}F_0 \Rightarrow F_0 = \frac{4mu}{3T}$$

**25.** (c) When body moves under action of constant force then kinetic energy acquired by the body K.E. = $F \times S$

$\therefore$ KE $\propto$ S (If $F$ = constant)

So the graph will be straight line.

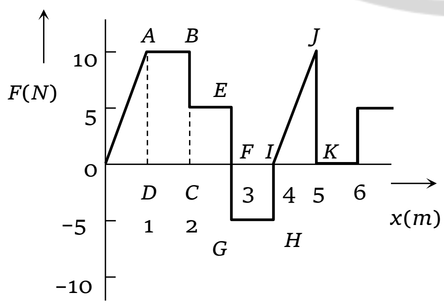
**26.** (a) When the distance between atoms is large then interatomic force is very weak. When they come closer, force of attraction increases and at a particular distance force becomes zero. When they are further brought closer force becomes repulsive in nature.

This can be explained by slope of $U - x$ curve shown in graph (a).

**27.** (b) Work done = area under *F-x* graph

= area of rectangle *ABCD* + area of rectangle *LCEF*

+ area of rectangle *GFIH* + area of triangle *IJK*




$$= (2-1)\times(10-0) + (3-2)(5-0) + (4-3)(-5-0) + \frac{1}{2}(5-4)(10-0) = 15J$$

**28.** (a) $U = -\int F dx = -\int kx\ dx = -k\frac{x^2}{2}$

This is the equation of parabola symmetric to *U* axis in negative direction