ULTIMATE KCET CRASH COURSE 2026

PHYSICS

Work, Energy and power

DPP: 1

Q1 If K_i and K_f are the initial and final values of kinetic energy of a body respectively, then the work done by the net force on the body is equal to

(A) $\frac{K_f K_i}{K_f - K_i}$

(B) $K_f + K_i$

(C) $\frac{K_f + K_i}{2}$

(D) $K_f - K_i$

Q2 A force of 50 N acting on a body at an angle with the horizontal. If 150 J of work is done by displacing itthrough 6 m, then is θ is

(A) 0° (B) 60°

(C) 45° (D) 30°

Q3 A body of mass 1 kg begins to move under the action of a time dependent force $\vec{F} = (\hat{i} + 2t^2\hat{j})N$, where$\hat{i}$ *and* $\hat{j}$ are unit vectors along z and y axis. 2 The power developed by above force at time t = 3 second will be

(A) 337.5 W (B) 228.5 W

(C) 422.5 W (D) 126.5 W

Q4 A stone of mass 2 kg is projected upward with kinetic energy of 98 *J*. The height at which the kinetic energy of the stone becomes half its original value is

(A) 5 m

(B) 2.5m

(C) 1.5 m

(D) 0.5 m

Q5 If the potential energy of system consisting of two molecules separated by distance r is given by, $U = \frac{A}{r^{12}} - \frac{B}{r^6}$ then at equilibrium position, its potential energy is equal to;

(A) $\frac{A^2}{4B}$ (B) $-\frac{B^2}{4A}$

(C) $\frac{2B}{A}$ (D) 3 A

Q6 A hot filament liberates an electron with zero initial velocity. The anode potential is 1200 V. The speed of the electron when it strikes the anode is

(A) 2.5×10^8 ms^{-1}

(B) 1.5×10^5 ms^{-1}

(C) 2.5×10^6 ms^{-1}

(D) 2.1×10^7 ms^{-1}

Q7 A spring of spring constant 5 $\times 10^3$ Nm^{-1} is stretched initially by 5 cm from the unstretched position. Then, the work required to stretch it further by another 5 cm is

(A) 12.50 N-m

(B) 18.75 N-m

(C) 25.00 N-m

(D) 6.25 N-m

Q8 The momentum of a body is increased by 20%. The percentage increase in kinetic energy is

(A) 54% (B) 44%

(C) 100% (D) 50%

Q9 A body of mass (4 m) is lying in xy-plane at rest. It suddenly explodes into three pieces. Two pieces each of mass m move perpendicular to each other with equal speeds v. The total kinetic energy generated due to explosion is

(A) mv^2 (B) $\frac{3}{2}mv^2$

(C) $2mv^2$ (D) $4mv^2$

Q10 what is the angle between $\vec{A} = 5\hat{i} - 5\hat{j}$ and $\vec{B} = 5\hat{i} - 5\hat{j}$?

(A) 90° (B) 45°

(C) 0° (D) 60°

Q11 A body of mass 1 kg is thrown upwards with a velocity 20 ms^{-1}. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction? (Take, g = 10 ms^{-2})

(A) 20 J (B) 30 J

(C) 40 J (D) 10 J

Q12 A body is allowed to fall freely under gravity from a height of 10 m. If it loses 25% of its energy on impact with the ground, to what height will it rise after one impact?

(A) 2.5 m (B) 5.0 m

(C) 7.5 m (D) 9.0 m

Q13 A body at rest can have:

(A) Speed (B) Energy

(C) Momentum (D) Velocity

Q14 A particle is displaced from point P(3 m, 4 m, 5 m) to a point Q(2 m, 3 m, 4 m) under a constant force $\vec{F} = (3\hat{i} + 4\hat{j} + 5\hat{k})$. The work done by the force in this process is

(A) + 10 J (B) + 4 J

(C) – 8 J (D) – 12 J

Q15 A body of mass 2 kg is thrown up vertically with K.E. of 490 joules. If the acceleration due to gravity is 9.8 m/s^2, then the height at which the K.E. of the body becomes half its original value is given by

(A) 50 m (B) 25 m

(C) 12.5 m (D) 10 m

Q16 A particle falls from a height h upon a fixed horizontal plane and rebounds. If e is the coefficient of restitution, the total distance travelled before rebounding has stopped is

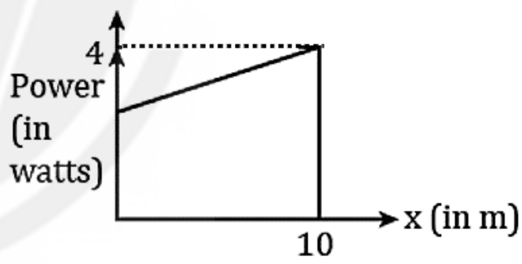
(A) $h\left(\frac{1+e^2}{1-e^2}\right)$

(B) $h\left(\frac{1-e^2}{1+e^2}\right)$

(C) $\frac{h}{2}\left(\frac{1-e^2}{1+e^2}\right)$

(D) $\frac{h}{2}\left(\frac{1+e^2}{1-e^2}\right)$

Q17 A particle A of mass 10/7 kg is moving in the positive direction of x-axis. At initial position x =0, its velocity is 1ms^{-1}, then its velocity at x = 10 m is (use the graph given)



(A) 4 ms^{-1} (B) 2 ms^{-1}

(C) $3\sqrt{2}ms^{-1}$ (D) $\frac{100}{3}ms^{-1}$

Q18 The kinetic energy of a body is increased by 300%. The momentum of the body would increase by:

(A) 50% (B) 100%

(C) 150% (D) 300%

Q19 A body of mass 1 kg starts from rest and moves with uniform acceleration. In 2 seconds, its velocity is 10 m/s . The power exerted on the body in one second is

(A) 20 W (B) 25 W

(C) 50 W (D) 100 W

Q20 Which of the following statements is true for work done by conservative forces?

(A) It does not depend on path

(B) It is equal to the difference of initial and final potential energy function

(C) It can be recovered completely

(D) All of the above

Q21 A child is standing with folded hands at the centre of a platform rotating about its central axis. The kinetic energy of the system is K. The child now stretches his arms so that the moment of inertia of the system becomes doubled. The kinetic energy of the system now is

(A) 2 K (B) $\frac{K}{2}$

(C) $\frac{K}{4}$ (D) 4 K

Q22 Which of the following is a true representation of the Work-Energy theorem for a variable force?

(A) $\int dK = \int F \cdot dx$

(B) $\Delta K = W$

(C) $K_1 - K_2 = \int_1^2 F \cdot dx$

(D) All of the above

Q23 A force of 20 N is applied on a body of mass 5 kg resting on a horizontal plane. The body gains a kinetic energy of 10 J after it moves a distance 2 m. The frictional force is

(A) 10 N (B) 15 N

(C) 20 N (D) 30 N

Q24 A crate is pushed horizontally with 100 N across a 5 m floor. If the frictional force between the crate and the floor is 40 N, then the kinetic energy gained by the crate is

(A) 200J (B) 240 J

(C) 250J (D) 300J

Q25 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* $W_A' < W_B'$

Q26 A force $\vec{F} = (5\hat{i} + 3\hat{j})$ newtons is applied over a particle which displaces it from origin to the point $\vec{r} = (2\hat{i} - 1\hat{j})$ metres. The work done on the particle is

(A) –7 J (B) +13 J

(C) +7 J (D) –11 J

Q27 A body of mass 1 kg is thrown upwards with a velocity $20\ ms^{-1}$. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction? $(g = 10\ ms^{-2})$

(A) 20 J

(B) 30 J

(C) 40 J

(D) 10 J

Q28 A position dependent force $F = 7 - 2x + 3x^2$ acts on a small body of mass 2 kg and displaces it from $x = 0$ to $x = 5$ m. Work done in joule is

(A) 35 (B) 70

(C) 135 (D) 270

Q29 A stationary particle explodes into two particles of masses m_1 and m_2 which move in opposite directions with velocities v_1 and v_2. The ratio of their kinetic energies E_1 / E_2 is

(A) m_1 / m_2

(B) 1

(C) m_1v_2 / m_2v_1

(D) m_2 / m_1

Q30 Sand is being dropped from a stationary dropper at a rate of $0.5 kgs^{-1}$ on a conveyor belt moving with a velocity of 5 ms^{-1}. The power needed to keep the belt moving with the same velocity will be:

(A) 1.25 W (B) 2.5 W

(C) 6.25 W (D) 12.5 W

Answer Key

Q1	D	Q16	A
Q2	B	Q17	A
Q3	A	Q18	B
Q4	B	Q19	B
Q5	B	Q20	D
Q6	D	Q21	B
Q7	B	Q22	D
Q8	B	Q23	B
Q9	B	Q24	D
Q10	C	Q25	B
Q11	A	Q26	C
Q12	C	Q27	A
Q13	B	Q28	C
Q14	D	Q29	D
Q15	C	Q30	D

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

According to work-energy theorem, the work done by the net force on the body is equal to the change in its kinetic energy i.e.,

$W = k_f - k_i$

Video Solution:

Q2 Text Solution:

Work done, $W = FS\cos\theta$ or $\cos\theta = \frac{W}{FS}$

Here, $F = 50$ N, $S = 6$ m, $W = 150$ J

$\therefore \cos\theta = \frac{150}{50\times6} = \frac{150}{300} = \frac{1}{2}$ or θ

$= \cos^{-1}\left(\frac{1}{2}\right) = 60^\circ$

Video Solution:

Q3 Text Solution:

Refer to video Solutions

Video Solution:

Q4 Text Solution:

$E_k = \frac{1}{2}mv^2 = 98$

$(\because v^2 - u^2 = 2gh)$

$v^2 = \frac{2\times98}{m} = 98 = 2gh$

$h = \frac{v^2}{2g} = \frac{98}{2\times9.8} = 5m$

$E_k = \frac{1}{2}m(2gh)$ and $E_k{}' = \frac{1}{2}m(2gh') = \frac{E_k}{2}$

$h' = \frac{h}{2} = \frac{5}{2} = 2.5m$

Video Solution:

Q5 Text Solution:

At equilibrium, $\frac{dU}{dr} = 0$:

$$U(r) = \frac{A}{r^{12}} - \frac{B}{r^6},$$

$$\frac{dU}{dr} = -\frac{12A}{r^{13}} + \frac{6B}{r^7} = 0$$

$$\Rightarrow r^6 = \frac{2A}{B}.$$

Substitute this r back into U:

$U_{\text{eq}} = \frac{A}{\left(\frac{2A}{B}\right)^2} - \frac{B}{\frac{2A}{B}} = \frac{AB^2}{4A^2} - \frac{B^2}{2A}$

$= \frac{B^2}{4A} - \frac{2B^2}{4A} = -\frac{B^2}{4A}.$

Video Solution:

Q6 Text Solution:

Given, $V = 1200\ V$, $(K.E)\ i = 0$; qV

$= (K.E)_f - (K.E)$

$\Rightarrow \frac{1}{2}mv_f^2 = qV \Rightarrow v_f^2 = \frac{2qV}{m}$

$= \frac{2\times1.6\times10^{-19}\times1200}{= 4.43 \times 10149.1\times10^{-31}}$

$= 4.43 \times 10^{14}$

$v_f = \sqrt{4.43\times10^{14}} = 2.1\times10^7\ \text{ms}^{-1}$

Video Solution:

Q7 Text Solution:

$W_1 = \frac{1}{2}kx_1^2 = \frac{1}{2}\times5\times10^3\times\left(5\times10^{-2}\right)^2$

$= 6.25J$

$W_2 = \frac{1}{2}K(x_2 + x_2)^2$

$= \frac{1}{2}\times5\times10^3\left(5\times10^{-2} + 5\times10^{-2}\right)^2$

$= 25J$

Net Work Done $W_2 - W_1$

$= 25 - 6.25 = 18.75J = 18.75N - m$

Video Solution:

Q8 Text Solution:

Increase in $KE = \frac{p^2}{2m}$

New momentum $p + \frac{P}{5} = \frac{6p}{5}$

$KE_f = \frac{\left(\frac{6}{5}p\right)^2}{2m} = \frac{36}{25}\frac{p^2}{2m}$

$\Delta KE = \frac{36}{25}\cdot\frac{p^2}{2m} - \frac{p^2}{2m} = \frac{11p^2}{25\times2m}$

Percentage increase = 44 %

Video Solution:

Q9 Text Solution:

Initial momentum = $p_i = 0$

Final momentum,

$p_f = 0 = mvi + mvi + p_3$

$\Rightarrow P_3 = mv\sqrt{2}$

$Total\ KE = \frac{p_3^2}{2\times2m} + \frac{1}{2}mv^2 + \frac{1}{2}mv^2$

$= \frac{2m^2v^2}{4m} + mv^2$

$= \frac{3mv^2}{2}$

Video Solution:

Q10 Text Solution:

Let θ be the angle between $\vec{A}$ and $\vec{B}$

$$\therefore \cos\theta = \frac{\vec{A}.\vec{B}}{|\vec{A}||\vec{B}|} = \frac{(5\hat{i}-5\hat{j}).(5\hat{i}-5\hat{j})}{\sqrt{(5)^2+(-5)^2}\sqrt{(5)^2+(-5)^5}}$$

$$= \frac{50}{\sqrt{50}\sqrt{50}} = 1$$

$$\theta = \cos^{-1}(1) = 0^\circ$$

Video Solution:

Q11 Text Solution:

Initially body posseses only kinetic energy and after attaining a height, the kinetic energy is zero.

Therefore, loss of energy = KE - PE

$$= \frac{1}{2}mc^2 - mgh$$

$$= \frac{1}{2} \times 1 \times 400 - 1 \times 18 \times 10$$

$$= 200 - 180 = 20J$$

Video Solution:

Q12 Text Solution:

Height b = 10 m. Potential energy at this height = mgb. On reaching the ground, KE = mgb. Since the body loses 25% of energy due to impact, kinetic energy of the body after one impact = 0.75 mgh. If v_1 is the initial upward velocity after the impact, we have

$$\frac{1}{2}mv_1^2 = 0.75mgb = \frac{3}{4}mgb \ or \ v_1^2 = 1.5gb$$

The height b_1 to whihc the body will rise is

$$b_1 = \frac{v_1^2}{2g} = \frac{1.5gb}{2g} = 0.75b = 0.75 \times 10$$

$$= 7.5m (\because b = 10m)$$

Video Solution:

Q13 Text Solution:

If a body is at rest, its position does not change and the velocity does not change, the velocity becomes zero.

Therefore,

$\frac{dx}{dt} = 0$

We now know that momentum is equal to the product of mass and velocity.

Here,

$v = 0 \Rightarrow mv = 0 \text{ but } m \neq 0$

Hence momentum becomes 0 as well.

However, if the body is at a certain height due to gravity, even while it is at rest, it still has some potential energy, which will be transformed to kinetic energy when released. As a result, even when the body is at rest, it might have energy.

Hence, "Energy" is the correct answer.

Video Solution:

Q14 Text Solution:

$\vec{s} = \vec{Q} - \vec{P}$

$= (2\hat{i} + 3\hat{j} + 4\hat{k})m - (3\hat{i} + 4\hat{j} + 5\hat{k})m$

$= -1\hat{i} - 1\hat{j} - 1\hat{k}$

$W = \vec{F} \cdot \vec{s}$

$= (3\hat{i} + 4\hat{j} + 5\hat{k})(-1\hat{i} - 1\hat{j} - 1\hat{k})$

$= -3 - 4 - 5 = -12J$

Video Solution:

Q15 Text Solution:

$m = 2kg$

$k.e = 490J$

$g = 9.8ms^{-2}$

$h = ?(K.E)^1 = \left(\frac{K.E}{2}\right)$

$WKT \text{ by } L.C.E$

$mgh = \frac{K.E}{2}$

$2 \times 9.8 \times h = \frac{490}{2}$

$h = \frac{490}{2 \times 2 \times 9.8}$

$h = 12.5m$

Video Solution:

Q16 Text Solution:

$h_n = he^{2n}$

$where \text{ 'n' } is \text{ } the \text{ } number \text{ } of \text{ } times \text{ } it$
$rebounds, \text{ } and \text{ 'h' } is \text{ } the \text{ } initial \text{ } height$
$h_n \text{ } is \text{ } the \text{ } height \text{ } attained \text{ } after \text{ } nth$
$rebound$

Video Solution:

Q17 Text Solution:

Area under P-x graph

$= \int Pdx = \left(m\frac{dv}{dt}\right)vdx = \int_1^v mv^2 dv$

$= \left[\frac{mv^3}{3}\right]_1^v = \frac{10}{7\times3}\left(v^3 - 1\right)$

From the graph, area $= \frac{1}{2}\left(2+4\right)\times 10$

$= 30$

$\therefore \quad \frac{10}{7\times3}\left(v^3-1\right) = 30 \quad \text{or } v = 4 \text{ m s}^{-1}.$

Video Solution:

Q18 Text Solution:

Kinetic energy k = $\frac{p^2}{2m}$

where , P is momentum and m is mass.

$k_1 = k, \quad k_2 = k + 300\%\ of\ k = 4k$

$\Rightarrow \frac{P_2}{P_1} = \sqrt{\frac{k_2}{k_1}} = \sqrt{\frac{4k}{k}} = 2$

$P_2 = P_1 + 100\%\ of\ P_1$

$Hence\ ,\ momentum\ will\ increase\ by\ 100\%$

Video Solution:

Q19 Text Solution:

$P = \frac{W}{t}$

$W = \text{change in} KE$

$\therefore \quad W = \frac{1}{2}m\left(v^2 - u^2\right) = \frac{1}{2}\times 1\times 10^2 = 50J$

$\therefore \quad P = \frac{50}{2} = 25\text{W}$

Video Solution:

Q20 Text Solution:

For conservative forces:

Work done does not depend on path, work done can be recovered completely.

W = Initial PE – Final PE

Video Solution:

Q21 Text Solution:

According to the principle of conservation of angular momentum, Iω = constant As I is doubled, ω becomes half

Now KE of rotation, $K = \frac{1}{2}I\omega^2$

Since I is doubled and ω is halved, KE will become half i.e. $\frac{K}{2}$.

Video Solution:

Q22 Text Solution:

The work energy theorem states that that the net work done by the forces on an object equals the change in its kinetic energy.

Work done $(W) = \Delta K = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$

Where m is the mass of the object, v is the final velocity of the object and u is the initial velocity of the object.

Work-energy theorem for a variable force:

$\int_{K_i}^{K_f} dK = \int_{x_i}^{x_f} F dx$

$\Rightarrow \Delta K = \int_{x_i}^{x_f} F dx$

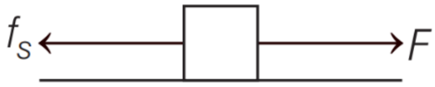
All the given options are correct as they are all different forms of representing the work-energy theorem for a variable force.

Video Solution:

Q23 Text Solution:

Given, force

$m = 5$ kg



Net force on the body,

$F_{net} = F - f_s$ [where, f_s = friction]

Work done by displacing is given as

$W = F_{net} \times$ displacement

$= (F - f_s)2$

$= (20 - f_s)2$

$W = 40 - 2f_s$

According to work-energy theorem,

Work done = gain in kinetic energy

$40 - 2f_s = 10$

$2f_s = 40 - 10 = 30$

$\Rightarrow f_s = \frac{30}{2} = 15$ N

Video Solution:

Q24 Text Solution:

Here, F = 100N, s=5m, frictional force, f = 40 N

As $F - f = ma$

$\therefore 100 - 40 = ma$ or $a = \frac{60}{m}$ ......(i)

As $v^2 - u^2 = 2as$

$\therefore v = \sqrt{2as}$ $(\because u = 10)$ ......(ii)

Kinetic energy gained by the crate is

$K = \frac{1}{2}mv^2 = \frac{1}{2}m(2as)$ (using (ii))

$= \frac{1}{2}m\left(2 \times \frac{60}{m} \times 5\right) = 300J$ (Using (i))

Video Solution:

Q25 Text Solution:

$k_A > k_B, x$

$\therefore \frac{1}{2}k_A x^2 > \frac{1}{2}k_B x^2 \text{ or } W_A > W_B$

Forces are the same

$\therefore k_A x_A = k_B x_B \text{ As } k_A > k_B, \text{ So } x_A < x_B$

$W_A' = \frac{1}{2}(k_A x_A)x_A \text{ and } W_B'$

$= \frac{1}{2}(k_B x_B)x_B; \therefore W_A' < W_B'$

Video Solution:

Q26 Text Solution:

W = F.S

$=(5\hat{i}+3\hat{j}).(2i-1\hat{j})$

$= 5\times 2 + 3\times(-1)$

$= 10 - 3 = 7$

Video Solution:

Q27 Text Solution:

The enery lost due to air friction is equal to difference in initial kinetic energy and final potential energy.

Initially body possesses only kinetic energy and after attaining a height the kinetic energy is zero.

Therefore, loss of energy =KE−PE

Loss of energy=$\frac{1}{2}mV^2 - mgh$

$= m\left(\frac{1}{2}V^2 - gh\right)$

$= 1\left(\frac{1}{2}\times(20)^2 - 10\times 18\right)$

$= 200 - 180$

$= 20J$

Video Solution:

Q28 Text Solution:

$W = \int F.dx$

Video Solution:

Q29 Text Solution:

$E = \frac{P^2}{2m} \Rightarrow E \propto \frac{1}{m}$

$\frac{E_1}{E_2} = \frac{m_2}{m_1}$

Video Solution:

Q30 Text Solution:

$$P=\vec{F}\cdot\vec{v}=v\frac{dP}{dt}=v\cdot\frac{d}{dt}\left(mv\right)$$

$$=v^2\left(\frac{dm}{dt}\right)=0.5\times25=12.5W$$

Video Solution: