JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS
CLASS :- 11th **PAPER CODE :- CWT-5**
CHAPTER :- WORK POWER ENERGY

ANSWER KEY

1.	(D)	**2.**	(A)	**3.**	(B)	**4.**	(A)	**5.**	(C)	**6.**	(C)	**7.**	(C)
8.	(A)	**9.**	(D)	**10.**	(A)	**11.**	(C)	**12.**	(B)	**13.**	(A)	**14.**	(A)
15.	(A)	**16.**	(C)	**17.**	(A)	**18.**	(A)	**19.**	(A)	**20.**	(B)	**21.**	16
22.	315	**23.**	10	**24.**	125	**25.**	5	**26.**	8	**27.**	6	**28.**	1
29.	10	**30.**	8										

SOLUTIONS

1. (D)

Sol. W_1 = work done by spring on first mass
W_2 = work done by spring on second mass
$W_1 = W_2 = W$ (say)
$W_1 + W_2 = U_i - U_f$

$2W = 0 - \frac{1}{2}Kx^2$

$W = -\frac{Kx^2}{4}$

2. (A)

Sol. $h = \frac{1}{2}gt^2$, $W = mgh = mg\frac{gt^2}{2}$, $W = K_f - K_i$

$\frac{mg^2t^2}{2} = K_f - \frac{1}{2}mu^2$, $K_f = \frac{1}{2}mu^2 + \frac{mg^2t^2}{2}$

Hence Ans. is (A)

3. (B)

Sol. $W_a + W_c = \Delta K = 0$, $W_a - mg$

$\left(\frac{\ell}{2} - \frac{\ell}{2}\cos 60°\right) = 0$

$W_a = \frac{mg\ell}{4} = (0.5)(10)\left(\frac{1}{4}\right) = \frac{5}{4}$ J.

4. (A)

Sol. $(mg\sin\theta)\,x - \int_0^x \mu mg\cos\theta\, dx = 0$

$\sin\theta\, x = \mu_o \cos\theta \int_0^x x\,dx$

$x\tan\theta = \mu_0\frac{x^2}{2}$, $x = \frac{2\tan\theta}{\mu_0}$

5. (C)

Sol. Potential energy depends upon positions of particles

6. (C)

Sol. $\mu mg = Kx$, $U = \frac{1}{2}Kx^2 = \frac{(\mu mg)^2}{2K}$

7. (C)

Sol. $\frac{1}{2}(2m)u^2 = \frac{1}{2}\left(\frac{1}{2}mv^2\right)$ .... (i)

$\frac{1}{2}(2m)(u+1)^2 = \frac{1}{2}mv^2$ ....(ii)

From (i) and (ii) $u = \frac{1}{\sqrt{2}-1}$

8. (A)

Sol. $v = \beta\sqrt{s}$

$\frac{ds}{dt} = \beta\sqrt{s}$,

$\int_0^s \frac{ds}{\sqrt{s}} = \beta\int_0^t dt$

$2\sqrt{s} = \beta t$

$\sqrt{s} = \beta t/2$ ....(A)

W = workdone by all the forces = ΔK

$= \frac{1}{2}mv^2 = \frac{1}{2}m\beta^2 s = \frac{1}{2}m\beta^2\left(\frac{\beta^2t^2}{4}\right)$

9. (D)

Sol. $U \propto x^2$ graph is parabola.

10. (A)

Sol. K.E. + P.E. = positive constant C
E + U = C, E + mgh = C, E = – mgh + C
and U = mgh,
So, answer (A)

11. (C)

Sol. $S_1 = \frac{1}{2}g\,1^2$, $s_2 = \frac{1}{2}g\,2^2$, $S_3 = \frac{1}{2}g\,3^2$

$S_2 - S_1 = \frac{1}{2}g\,3$, $S_3 - S_2 = \frac{1}{2}g\,5$

$W_1 = (mg)S_1$, $W_2 = (mg)(S_2 - S_1)$, $W_3 = (mg)(S_3 - S_2)$

$W_1 : W_2 : W_3 = 1 : 3 : 5$

12. (B)

Sol. $F = T$, $W_F + W_G = 20$

$W_T = 20 \quad \Rightarrow \quad 20 + W_G = 20$

$\Rightarrow \quad W_G = 0$

which is not possible.

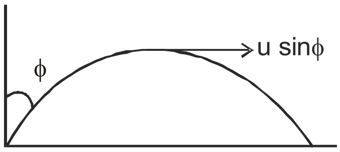
13. (A)

14. (A)

Sol. KE + P.E = K

$P.E = K - \frac{1}{2} mu^2 \sin^2\phi$

$= K - K\sin^2\theta$



$= K \cos^2\phi$

15. (A)

Sol. U + k = E

when U = E

K = 0

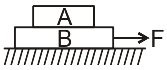
16. (C)

Sol. $F = K_1x_1$, $x_1 = \frac{F}{K_1}$, $W_1 = \frac{1}{2} K_1 x_1^2 = \frac{F^2}{2K_1}$

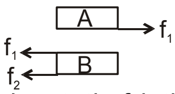
similarly $W_2 = \frac{F^2}{2K_2}$ since $K_1 > K_2$, $W_1 < W_2$

17. (A)

Sol.



Consider the blocks shown in the figure to be moving together due to friction between them. The free body diagrams of both the blocks is shown below.



Work done by static friction on A is positive and on B is negative.

18. (A)

Sol. As ΔKE is same in both the cases, work done will be same.

19. (A)

Sol. $W_S + W_f = \Delta K$

$- \Delta U + W_f = - K_i$

$- U_f - \mu mgx = - K_i$

$\frac{1}{2} K x^2 + \mu mgx = \frac{1}{2} mu^2$

$100 x^2 + 2(0.1)(50)(10) x = 50 \times 4$

$x^2 + x - 2 = 0$

$x = 1$ m

20. (B)

Sol. $W_F + W_S = 0$, $W_F - \Delta U = 0$, $W_F = \Delta U = E$

$E = \frac{1}{2} K_A x_A^2$, $Fx_A = \frac{1}{2} K_A x_A^2$

$\frac{2F}{K_A} = x_A$, $\frac{2F}{K_A} = \sqrt{\frac{2E}{K_A}}$, $K_A = \frac{2F^2}{E}$ ...(i)

similarly $K_B = \frac{2F^2}{E_B}$,

$\because K_A = 2K_B$

$\therefore \frac{2F^2}{E} = 2\left(\frac{2F^2}{E_B}\right)$

$\therefore E_B = 2E$

21. 16

Sol. Joule = (Newton) (Metre) = $\frac{4\,\text{Newton}}{4} \times \frac{4\,\text{Metre}}{4}$

$= \frac{\text{Joulea}}{16}$

Hence 1 Joulea = 16 joule (Joulea is new unit of energy

22. 315

Sol. $\vec{W} = \vec{F}.\vec{d}$ $\quad \vec{d} = 3\hat{i} - 10\hat{j} - 3\hat{k}$

$F = 20\hat{i} - 30\hat{j} + 15\hat{k}$

$\vec{W}$ = 60 + 300 – 45 = 315 **Ans.**

23. 10

Sol. Given

Mass of the body = 5 kg

Force $\vec{F} = 3\hat{i} - 1.5\hat{j}$

Now displacement $\overrightarrow{\Delta s} = \{(\hat{i} + 5\hat{j}) - (2\hat{i} - 3\hat{j})\}$

m = $(-\hat{i} + 8\hat{j})$ m

From Work Energy principle

$W = \vec{F} \cdot \overrightarrow{\Delta s} = \frac{1}{2} m(v^2 - u^2)$

$\Rightarrow \quad v = \sqrt{10}$ m/s

24. 125

Sol. Change in velocity = $\frac{\text{area under F – T graph}}{\text{mass}}$

$= \frac{60 + (-10)}{10} = 5$ m/s

$W_F = \Delta K.E. = \frac{1}{2}(10)\, 5^2 = 125$ J

25. 5

Sol. $W_G + W_f = 0 - 0$

$10 \times 1 + W_f = 0$

$10 - \mu mg\, x = 0$

$10 = (.2)\,(10)\,x\,,\ x = 5$ m

26. 8

Sol. $W_C = -\Delta U$

$= -(U_{final} - U_{initial})$

$= -\left(\frac{1}{2}\times k\times 15^2 - \frac{1}{2}\times k\times 5^2\right)]$

$W_C = 8$ Joule

27. 6

Sol. $\int F dt = \Delta p$

$\Rightarrow \quad \frac{1}{2} \times 4 \times 3 - \frac{1}{2} \times 1.5 \times 2 = p_f - 0$

$\Rightarrow \quad p_f = 6 - 1.5 = \frac{9}{2}$

K.E. $= \frac{p^2}{2m} = \frac{81}{4\times 2\times 2}$;K.E. = 5.06 J **Ans.**

28. 1

Sol. KE $= \frac{P^2}{2m} = 1$

29. 10

Sol. Area under curve $= \frac{1}{2}$ (D) (20) = 40 J

W = work done by resistive force F = – 40 J

$-40 = K_f - K_i$, $K_i = 50$ J,

so $K_f = 50 - 40 = 10$ J

30. 8

Sol. From work energy theorem

for upward motion

$\frac{1}{2}$ m $(16)^2$ = mgh + W (work by air resistance)

for downward motion

$\frac{1}{2}$ m $(8)^2$ = mgh – W

$\frac{1}{2}[(16)^2 + (8)^2] = 2$ gh or h = 8 m