Unit 5

Answers: Work, Energy and Power

Quick checks

1 **c** $W = Fd\cos 60^\circ = 50 \times 20 \times 0.5 = 500$

2 **d** $K = \frac{1}{2}mv^2$ v v^2

3 **b**

4 **b**

5 **a**

6 **c** $W = Fd\cos 90^\circ = 0$

7 **c** $2000 \times 60 = 120\,000$ $m = \dfrac{120\,000}{10 \times 10} = 1200$

8 **a** $F = ma$ $v = at$ $P = Fv = ma^2t \propto t$

9 **b** $W = \int_0^s ks\,ds = \frac{1}{2}ks^2 \propto s^2$

10 **a**

11 **a** $0.5(1 - \cos 60^\circ) = 0.25$ $\Delta U = mgh = 0.8 \times 9.8 \times 0.25 = 1.96$

12 **a** $0.06 \times 8 = 0.48$

13 **b** $W = \Delta K$

14 **a** $E_k = \frac{1}{2}mv^2$

15 **c**

16 **b** $3 \times 2 = 6$ $6/4 = 1.5$

13.

$F\cos\theta$ $F\sin\theta$ $F\cos\theta$

$W = (F\cos\theta)d = Fd\cos\theta = \vec{F}\cdot\vec{d}$ $W = Fd$

$W = 0$

$W =$

$200 \times 500 =$

14.

$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$

$-fh$ $\frac{1}{2}mv^2 = mgh - fh$

fh

15. $K_f +$

$U_f = K_i + U_i + W_f$ $-W_f$

$W_f = -fs$

$$\tfrac{1}{2}mv_B^2 = mg(h_A - h_B) \quad \Rightarrow \quad v_B = \sqrt{2 \times 9.8 \times 45} = \mathbf{29.7} \approx 30$$

16. $K = \frac{1}{2}mv^2$ v^2

$$K = p^2/2m \propto p^2$$

17. $v^2 = 2gx$

mgx $mg(h - x)$

$P = Fv$

$F = P/v$

18.

$\mu = F/R$

$a = \dfrac{v - u}{t} = \dfrac{0 - 2.40}{3.52} = -0.682$ $F = ma = 68.5 \times (-0.682) =$

19.

$K + U =$

$P \sin 60^\circ$

$P \cos 60^\circ$ $R = 150 - P\cos 60^\circ = 150 - 0.5P$

$P \sin 60^\circ = 0.20(150 - 0.5P) \quad \Rightarrow \quad 0.866P + 0.1P = 30 \quad \Rightarrow \quad P = 31.06$

$= (P \sin 60^\circ)d = 31.06 \times 0.866 \times 20 =$

20.

$u_1 > u_2$

$u_1 - u_2 = v_2 - v_1$ v_1 v_2

$v = 60/3.6 = 16.67$ $F = P/v = 650\,000/16.67 = 39\,000$

$mg \sin\theta = 1.5 \times$

$10^5 \times 9.8 \times \frac{1}{100} = 14\,700$ $= 39\,000 - 14\,700 = 24\,300 \quad \approx$

21.

$$K_1/K_2 = m_2/m_1 \;\; K = \frac{40}{4} \times 100 =$$

$$p^2/2m$$

22. $\frac{1}{2} \times 0.1 \times 20^2 = 20$

$\frac{3}{4} \times 20 =$

23. $h =$ 0.25 $\frac{1}{2}mv^2 = mgh$

$$v = \sqrt{2 \times 9.8 \times 0.25} = \mathbf{2.21}$$

24. $\vec{d} = \vec{r}_2 - \vec{r}_1 = -\hat{i} + \hat{j} \;\; W = \vec{F} \cdot \vec{d} = (1)(-1) + (1)(1) =$

25. $W = \int_0^5 (3x^2 - 2x + 7)\,dx = \left[x^3 - x^2 + 7x\right]_0^5 = 125 - 25 + 35 =$

26. $P = Fv = 200 \times 20 =$

$mg\sin\theta = 1000 \times 9.8 \times \frac{1}{20} = 490$ $P = (200 + 490) \times 20 = 13\,800$

27. $u_A = +4$ $u_B = -3$

$$v = \frac{40 \times 4 + 60 \times (-3)}{40 + 60} = \frac{160 - 180}{100} = \mathbf{-0.2}$$

28. $v = 72/3.6 = 20$ $20 \times \frac{1}{100} = 0.2$

$= mg \times () = 2.0 \times 10^5 \times 9.8 \times 0.2 = 3.92 \times 10^5$

$= fv = 1.28 \times 10^4 \times 20 = 256$ $= 392 + 256 =$

29. $K \propto 1/m \;\; K = \frac{4}{206}E = \frac{2E}{103}$

30. $4 \times 10^4 \times 3 = 6 \times 10^4 \times v \qquad v = 2$

$\frac{1}{2} \times 4 \times 10^4 \times 9 = 1.8 \times 10^5 \qquad \frac{1}{2} \times 6 \times 10^4 \times 4 = 1.2 \times 10^5$

$$= \frac{1.2}{1.8} = \frac{2}{3}$$

$m_1/(m_1 + m_2)$

31. $0.010 \times 100 = 0.200 \times v \qquad v = 5$

$\frac{1}{2}v^2 = gh$

$$h = \frac{v^2}{2g} = \frac{25}{19.6} = \mathbf{1.28}$$

32. $F \times 12.5 = \frac{1}{2} \times 2000 \times 10^2 = 100\,000 \qquad F =$

$mg \sin\theta = 2000 \times 9.8 \times \frac{1}{10} = 1960$

$P = 2160 \times 10 = 21\,600$

33. $2.40 \times 1.50 =$

$-0.600 \times 1.50 =$

$3.60 - 0.900 =$

34. $E = Pt = 100 \times 3600 =$

$\frac{1}{2} \times 70 \times v^2 = 3.6 \times 10^5 \qquad v = \sqrt{10\,286} =$

35. $Fs = \frac{1}{2}m(v^2 - u^2) = \frac{1}{2} \times 0.420 \times (36 - 4) = 6.72$

$s = 6.72/40.0 =$

36. $s = \frac{1}{2}at^2 \quad a = \dfrac{2 \times 11}{25} = 0.88 \qquad m = F/a = 80/0.88 =$

$v = at = 4.4$

$s = 4.4 \times 5 =$

37. $k = 75 \qquad = 7500 \qquad -\frac{1}{2}kx^2$

$\frac{1}{2} \times 6.0 \times 9 = 27$

$\frac{1}{2} \times 7500 \times x^2 = 27 \quad \Rightarrow \quad x = \sqrt{0.0072} = \mathbf{0.085}$

38. $P = Fv = 165 \times 9.00 = 1485 \qquad = 742.5/746 =$