Chapter 5 Work, Energy, Power Notes Answers

Check Your Understanding 1

1. Ans
   (a) W.d = F.d = 50 J
   (b) W.d = $F\cos 30.s = 43.3$ J
   (c) W.d = $F\cos 150.s = -43.3$ J
   (d) W.d = $F\cos 90.s = 0$

2. By conservation of energy, $\frac{1}{2}m(v_f^{\ 2} - v_i^{\ 2}) = mg\Delta h$

   $\frac{1}{2}(v^2 - 10^2) = 9.81(10-7)$

   $v = 12.6 \text{ m s}^{-1}$

3. Force of 3-kg mass along the slope = $mg\sin\theta = 3(9.81)\sin 30$
   Which is greater than weight of 1-kg mass.
   Thus, 1-kg mass will move upwards.

   Loss in GPE of 3-kg mass = gain in GPE of 1-kg mass and total gain in KE

   $3(9.81)(1\sin 30) = 1(9.81)(1) + \frac{1}{2}(3+1)v^2$

   $v = 1.57 \text{ m s}^{-1}$

4. (a) loss in GPE = $mgh = 0.100(9.81)(20) = 19.62$ J

   gain in KE = $\frac{1}{2}(0.100)15^2 = 11.25$ J

   thus, w.d against drag = 19.62 – 11.25 = 8.37 J

   (b) W.d = $F_{ave}.s$

   $F_{ave} = \frac{8.37}{20} = 0.42$ N

5. by conservation of energy, loss in GPE = gain in EPE

   $mg\Delta h = \frac{1}{2}kx^2$

   $12(9.81)(3+1.3)\sin 30 = \frac{1}{2}k(1.3^2)$

   $k = 279 \text{ N m}^{-1}$

Check Your Understanding 2

1. useful power = $mg\frac{\Delta h}{t} = mgv = (1800)(9.81)(5) = 88290$ W (75%)

   total power = $\frac{88290}{75} \times 100 = 1.18 \times 10^5$ W

2. (a) $a = \frac{F_{net}}{m} = \frac{2000 - 800}{400} = 3 \text{ m s}^{-2}$

   (b) $v = u + at = 0 + 3(5) = 15 \text{ m s}^{-1}$

   $KE = \frac{1}{2}mv^2 = \frac{1}{2}(400)(15^2) = 4.5 \times 10^3$ J

   (c) ave P = $\frac{\Delta E}{t} = \frac{4.5 \times 10^3}{5} = 9 \times 10^3$W

3. At maximum speed, a = 0, $F_{2 \text{ engine}} = F_{drag} = kv = 10v$

   $P_{2 \text{ engines}} = F_{2 \text{ engines}}.v = k10^2 = 50 \text{ kW} \times 2$

   $k = 1000$

   when one engine is working,

   $P_{1 \text{ engine}} = 50 \times 10^3 \text{ W} = F_{1 \text{ engine}}.v = kv^2 = 1000v^2$

   $v = 7.1 \text{ m s}^{-1}$

4. (a) $72 \text{ km h}^{-1} = 20 \text{ m s}^{-1}$

   per second, distance moved along slope = 20 m

   per second, height gain = $\frac{1}{100} \times 20 = 0.2$ m

   per second, gain in GPE = mgh = $2 \times 10^5 (9.81)(0.2) = 3.92 \times 10^5$ J

   (b) per second, work done against friction = f.d = $1.28 \times 10^4 \times 20 \text{ m} = 2.56 \times 10^5$ J

   total power = $(3.92 + 2.56) \times 10^5$ J/s