Physics 30 - Lesson 3A
Work, Energy, Power

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1) / 4

a) work = area of a force-distance graph

$W = 3.5N \cdot 16.0m$ ✓

$\boxed{W = 56J}$ ✓

b)

$W = \frac{1}{2}ab + lw$ ✓

$W = \frac{1}{2}(-4.0)(3.0) + (-4.0)(5.0)$

$\boxed{W = -26J}$ ✓

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2) / 4

$W = F\Delta d = 2.2\times10^4 N(7.6m)$ ✓ ✓

$W = 1.7\times10^5 J$ ✓

✓

Work is positive since the object is being raised

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3) / 6

a) up

$F = 685N + 915N = 160N$ ✓

$W = F\Delta d = 1600N(15.2m)$ ✓

$\boxed{W = +2.43\times10^4 N\cdot m}$ ✓

b) down

$F = 685N$ ✓

$W = F\Delta d = 685N(-15.2m)$ ✓

$\boxed{W = -1.04\times10^4 N\cdot m}$ ✓

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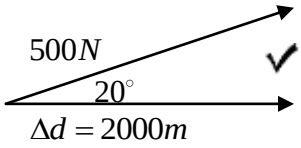
4) / 4



✓

$W = F\Delta d\cos\theta \times 2 \leftarrow$ *two locamotives* ✓

$W = 5000N(2000m)\cos 20\times 2$ ✓

$\boxed{W = 1.88\times10^7 J}$ ✓

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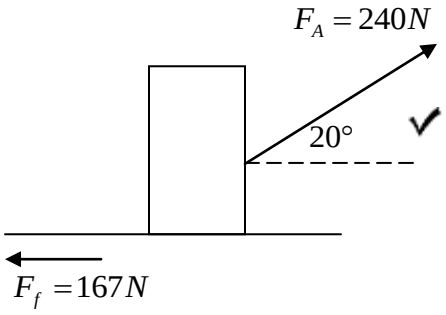
5) / 6



✓

F_A $W = F_A\Delta d\cos\theta$ ✓

$W = 240N(8.00m)\cos 20°$ ✓

$\boxed{W = 1.80\times10^3 N\cdot m}$ ✓

F_f $W = F_f\Delta d$

$W = -167N\cdot 8.00m$ ✓

$\boxed{W = -1.34\times10^3 N\cdot m}$ ✓

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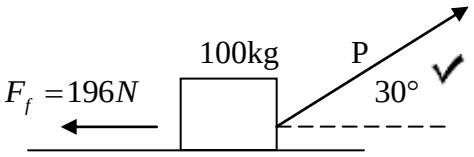
6)

/5



If $W_{net} = 0 \rightarrow F_{net} = 0$ ✓

$F_{net} = 0 = P\cos 30° - F_f = 0$ ✓

$P = \dfrac{F_f}{\cos 30°} = \dfrac{196N}{\cos 30°}$ ✓

$\boxed{P = 226N}$ ✓

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7) A) $W = F\,\Delta d = F_g \Delta d = 155kg(9.81m/s^2)\cdot 120m$ ✓ ✓

$\boxed{W = 1.82\times 10^5 J}$ ✓

B) From diagram

$3T = weight$ ✓

/8

$T = \dfrac{F_g}{3} = \dfrac{mg}{3} = \dfrac{155(9.81)}{3} = \boxed{507N}$ ✓ ✓

C) Work on scaffold = work done by window washer

$W = F\,\Delta d$

$\Delta d = \dfrac{W}{F} = \dfrac{1.82\times 10^5 J}{570N} = \boxed{360m}$ ✓ ✓

or 3 ropes × 120m = $\boxed{360m}$

Kinetic / Potential Problems

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1) $E_k = \dfrac{1}{2}mv^2 = \dfrac{1}{2}(65.0kg)(5.70m/s)^2$ ✓ ✓

/3 $\boxed{E_k = 913J}$ ✓

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2) $E_p = mgh = 55.0kg(9.81m/s^2)(443m)$ ✓ ✓

/3 $\boxed{E_p = 239kJ}$ ✓

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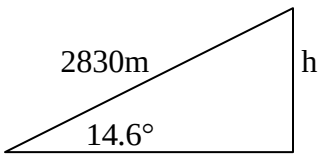
3) $h = 2830(\sin 14.6°) = 713.4m$ ✓

$E_p = mgh = 75.0kg(9.81m/s^2)(713.4m)$ ✓ ✓

/4 $\boxed{E_p = 525kJ}$ ✓



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4) $k = \frac{F}{x} = \frac{120N}{0.045m} = 2.7\times10^3 N/m$

/6 $E_p = \frac{1}{2}kx^2 = \frac{1}{2}(2.67\times10^3 \frac{N}{m})(0.045m)^2$

$\boxed{E_p = 2.7J}$

5) $E_p = \frac{1}{2}kx^2 = \frac{1}{2}(25N/m)(0.096m)^2$

/3 $\boxed{E_p = 0.12J}$

Power

1) Standard Unit = Watt

$kWh = kW \times h \rightarrow$ unit of energy

/3 $P \times t = E$

2) $P = \frac{W}{t} = \frac{F\Delta d}{t} = \frac{(2.5\times10^4 N)(60.0m)}{12.0s}$

/3 $\boxed{P = 125kW}$

3) F_A F_g

$F_A = F_g = mg = 5000kg(9.81m/s^2) = 49050N$

$t = \frac{W}{P} = \frac{F\Delta d}{P} = \frac{49050N(2.5m)}{10000W}$

/4 $\boxed{t = 12.3s}$

4) $mass\ rate = 1.2 \text{ x } 10^6 \text{ kg/s} = \frac{1.2 \text{ x } 10^6 \text{ kg}}{1s}$

$h = 50m$

$P = ?$

$P = \frac{\Delta E}{t} = \frac{\Delta E_p}{t} = \frac{mgh}{t}$

/4 $P = \frac{(1.2 \times 10^6 \text{ kg})(9.81m/s^2)(50.0m)}{1s}$

$\boxed{P = 5.9 \times 10^8 W}$

5) $W_{net} = E_{Total} - E_{heat} = P \cdot t - E_{heat}$

$W_{net} = 3.5\times10^3 W(10\min)(60s) - (500\times10^3 J)$

/3 $\boxed{W_{net} = 1.6MJ}$