

# First Law of Thermodynamics: Exercises

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For the following processes, calculate the change in internal energy of the system:

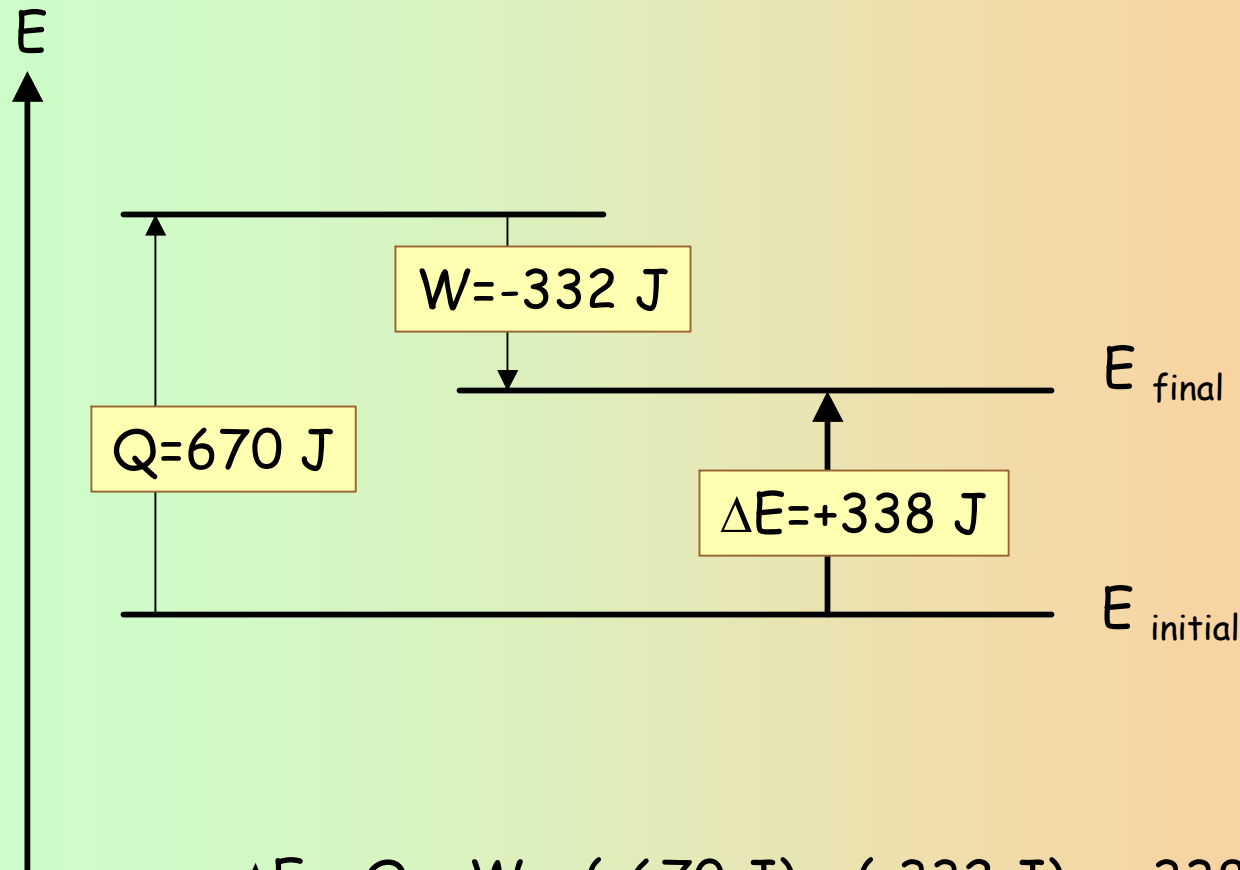
a) A balloon is heated by adding 670 J of heat. It expands, doing 332 J of work on the atmosphere

b) A 10-g sample of water is cooled from 20°C to 10°C; the specific heat of water is 4180 J/kg °C

c) A chemical reaction releases 8.65 kJ of heat and does no work on the surroundings

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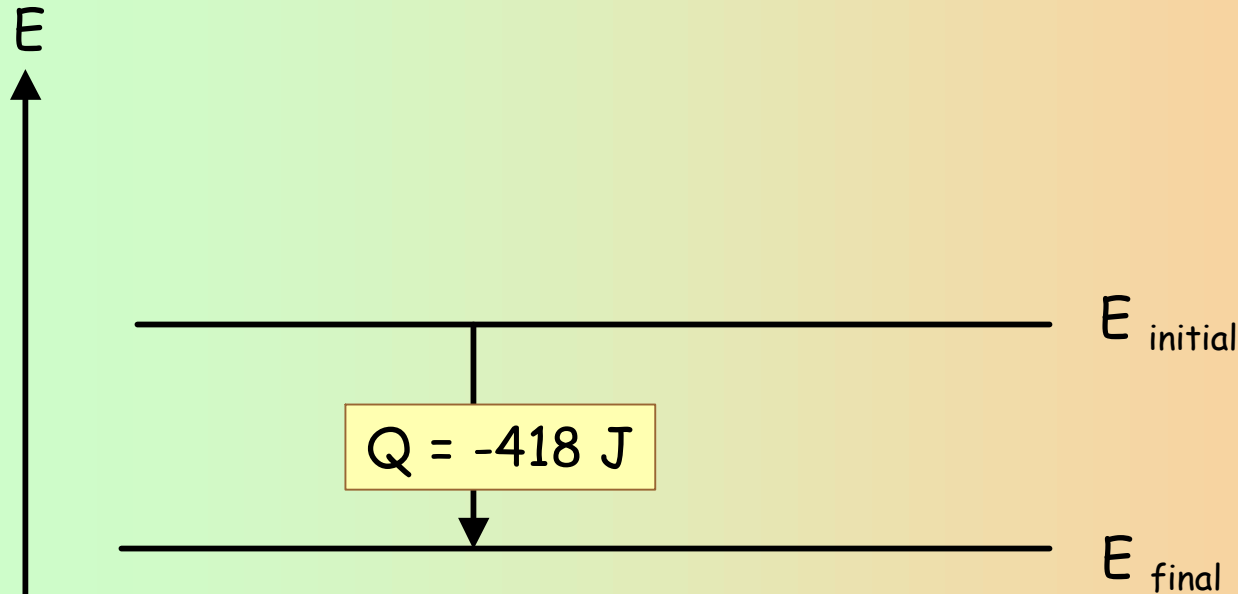
a) A balloon is heated by adding 670 J of heat. It expands, doing 332 J of work on the atmosphere



$$\Delta E = Q + W = (+670 \text{ J}) + (-332 \text{ J}) = +338 \text{ J}$$

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b) A 10-g sample of water is cooled from 20°C to 10°C; the specific heat of water is 4180 J/kg °C

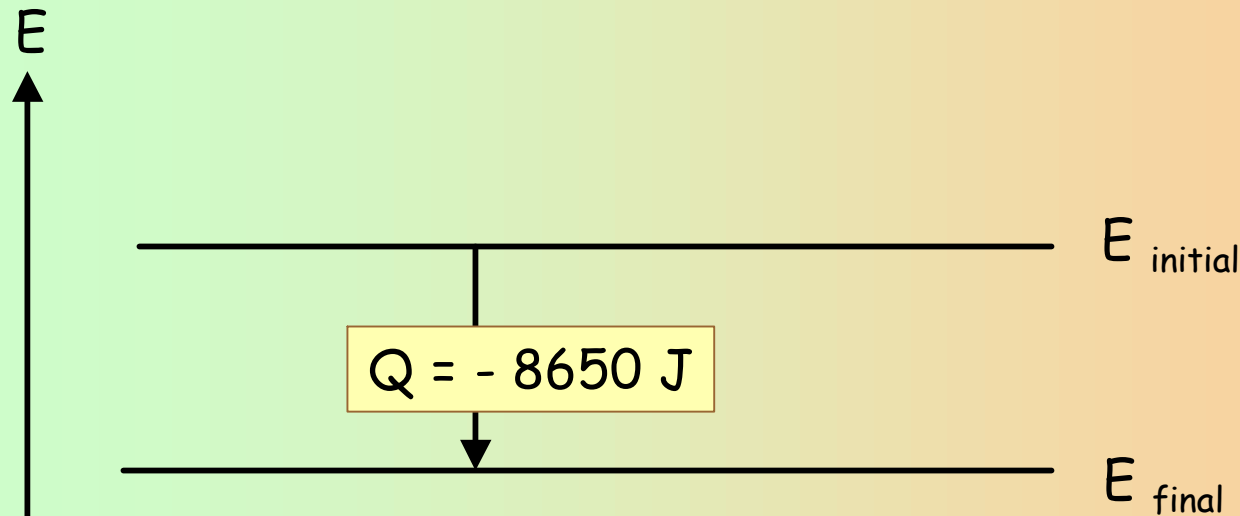


$$\Delta E = Q$$

$$Q = (0.01 \text{ kg}) * (4180 \frac{\text{J}}{\text{kg } ^\circ\text{C}}) * (10 \text{ } ^\circ\text{C} - 20 \text{ } ^\circ\text{C}) = -418 \text{ J}$$

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c) A chemical reaction releases 8.65 kJ of heat and does no work on the surroundings



Heat released to the surroundings

The surroundings gain energy

The system loses energy

In the system:  $E_{\text{final}} < E_{\text{initial}}$