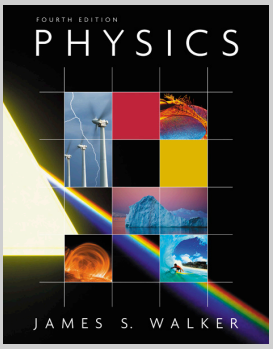



ConcepTest Clicker Questions

Chapter 18

*Physics, 4th Edition*

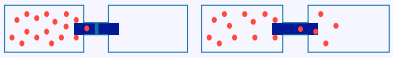
James S. Walker



## *Question 18.1* Free Expansion

A free expansion occurs when a valve is opened allowing a gas to expand into a bigger container. In such an expansion the temperature of the gas will:

a) increase
b) decrease
c) stay the same



## *Question 18.1* Free Expansion

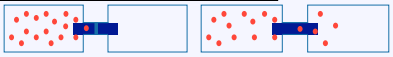
A free expansion occurs when a valve is opened allowing a gas to expand into a bigger container. In such an expansion the temperature of the gas will:

a) increase
b) decrease
c) stay the same

In such a process:
$W = 0$ there is no object to move,
$Q = 0$ there is no heat exchange, therefore
$\Delta U = 0$ by the First Law of Thermodynamics.
Thus, there is no change in the temperature.

Free expansion is an irreversible process—the gas molecules have virtually no chance of returning to the original state.

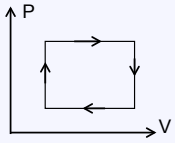
Free expansion is neither adiabatic nor isothermal expansion, even though $\Delta T$ and $Q$ are zero.



## *Question 18.2* Work

In the closed thermodynamic cycle shown in the P-V diagram, the work done by the gas is:

a) positive
b) zero
c) negative

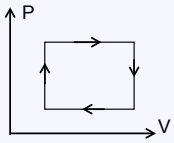



## *Question 18.2* Work

In the closed thermodynamic cycle shown in the P-V diagram, the work done by the gas is:

a) positive
b) zero
c) negative

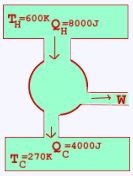
The gas expands at a higher pressure and compresses at a lower pressure. In general, clockwise = positive work; counterclockwise = negative work.




## *Question 18.3* Heat Engine

The heat engine below is:

a) a reversible (Carnot) heat engine
b) an irreversible heat engine
c) a hoax
d) none of the above



## *Question 18.3* Heat Engine

The heat engine below is:

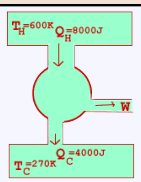
a) a reversible (Carnot) heat engine

b) an irreversible heat engine

c) a hoax

d) none of the above

Carnot $e = 1 - T_C/T_H = 1 - 270/600 = 0.55$.
But by definition $e = 1 - Q_L/Q_H$
$= 1 - 4000/8000 = 0.5$, smaller
than Carnot $e$, thus irreversible.




**Follow-up**: What would you need to change to make it a Carnot engine?