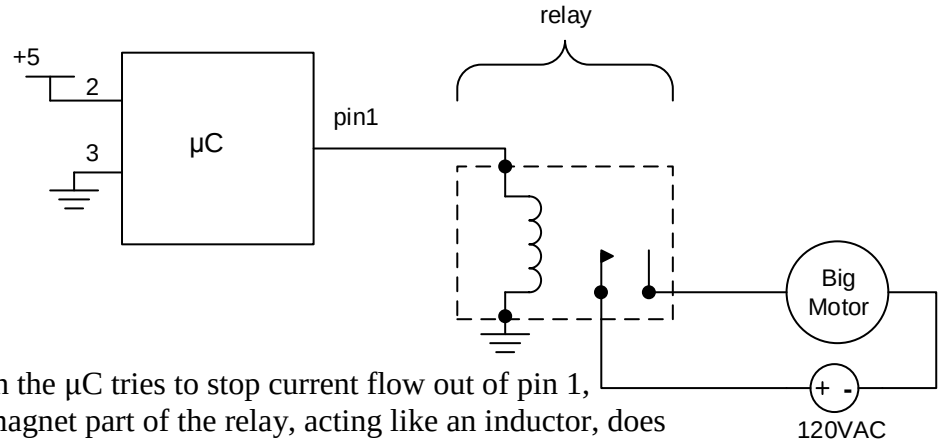
1. A relay is a momentary switch activated by an electromagnet (i.e., an inductor) allowing a small current low voltage source (like a microcontroller) to control heavy-duty sources (like an AC muter). In the circuit below, a microcontroller (abbrev. µC) turns on a relay by making pin 1= 5V at t=0 sec. At t=1 sec it turns the relay off by trying to stop current flow out of pin 1 (internally disconnecting it).



At t=1 when the µC tries to stop current flow out of pin 1, the electromagnet part of the relay, acting like an inductor, does

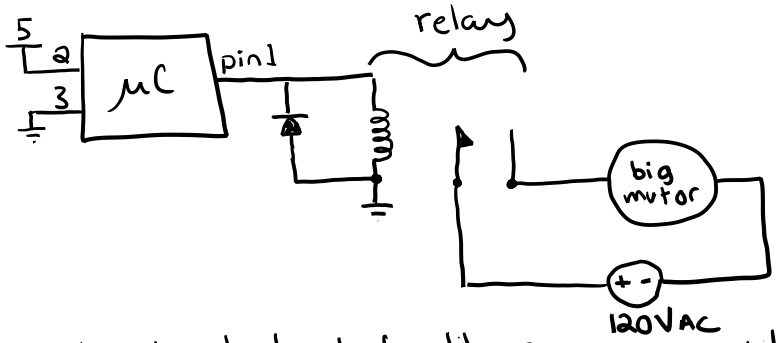
a) Nothing
b) Tries to make the voltage at pin large and positive
c) Tries to make the voltage at pin large and negative
d) Tries to make the voltage at pin large and equal to zero

By math
$V = Li'$ so if i' is very large and negative then V is large and negative

By intuition
The inductor wants to keep current flowing down so it must create a voltage to try to pull it out of the µC. To "pull it out" it goes large and negative.

2. Could the action described in the preceding paragraph damage the µC? If so, how could you use a <u>diode</u> to help? A diode, —▶|—, is a device that only allows current to flow in the direction of the arrow (i.e. it looks like a short to current flowing in the direction of the arrow, but an open current flowing in reverse).

Yes it could damage the µC; the voltage could be huge (perhaps > several hundred volts).
To fix this, try this:



Normally the diode looks like an open, until pin suddenly turns off. Then $V_{pin} < 0$ and the diode becomes an open, keeping V_{pin} from going much less than 0.

Note: In reality, most relays require about 100mA of current to work, but µC can only supply about 10mA so an additional current amplifier is needed. That is typically a FET, a type of transistor you'll meet in EE 355.