11-75)

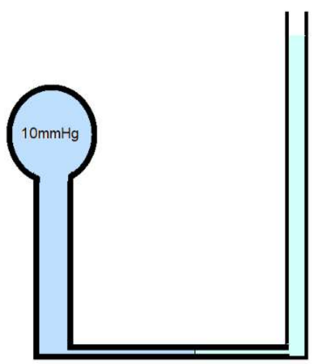
A) We should make the assumption that the bottom of the manometer[1] is level with the sampling point in the patient's body. Then, this is asking how deep a column of water will have a gauge pressure of 10 mmHg. Let's convert that to Pascals:

$$10 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} \times \frac{101{,}000 \text{ Pa}}{1 \text{ atm}} = 1329\text{Pa} \quad .$$

From Pascal's principle,

$$\mathrm{P_{gauge}} = \mathrm{P} - \mathrm{P_{Atm}} = \mathrm{Dgh}$$

$$\mathrm{h} = \frac{\mathrm{P_{gauge}}}{\mathrm{Dg}} = \frac{1329}{1000(10)} = 0.133 \text{ m} \quad .$$



B) Now, let's have the patient sit up, but we'll assume that the gauge pressure of fluid in the head is still 10 mmHg. The pressure at the bottom of the spine is now greater due to the increased depth. Don't forget to convert the spinal fluid density to standard units, 1050 kg/m^3.

$$P_{Gauge} = P_{0\,Gauge} + \mathrm{D}_{Spine}\mathrm{g}\mathrm{h}_{Spine}$$

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$$= 1329 + (1050)10(0.6) = 7629 \; Pa \quad .$$

Again, assuming that the bottom of the spinal column and the water column are at the same level,

$$\mathrm{h} = \frac{\mathrm{P_{Gauge}}}{\mathrm{Dg}} = \frac{7629}{1000(10)} = 0.763 \text{ m} \quad .$$

[1] In your textbook, manometers have a reference branch open to atmosphere, unlike your book's barometer, where the reference end is sealed and evacuated.