3 Differential Amp

Here's the circuit on Falstad, for my own study materials: https://tinyurl.com/y2ovwmg9

5.1 Gain

Gain is R2/R1 for this type of amp. So:

$$G = R2/R1$$
$$G = 1M/10K$$
$$G = 100$$

For this problem I name the junction points between the circuit inputs and op-amp inputs as Aj and Bj.

3.2 Input impedances

What is the input impedance at each of the circuit's input terminals (not the op amp's terminals, n.b.), for two cases–

3.2.1 1) a differential input, almost (2 points)

Apply the signals to one input terminal at a time, while the other amp input sits still:

3.2.2 a- Hold non-inverting input (B) fixed:

If B is fixed, then Bj is fixed as well. Because of the golden rules, negative feedback occurs and also fixes Aj. This like when we would be put ground at the non-inverting terminal and negative feedback would create a virtual ground at the inverting terminal. It follows then that Rin for A is just the 10K R.

There's a voltage being experienced at Bj. No current is flowing into op-amp, but the V is being sensed by the op-amp there and being redirected over the 1M toward ground. According to the golden rules, the op-amp

3.2.3 b- Hold inverting input (A) fixed:
There is no loop between the non-inverting input and the op-amp output, so we can't expect any feedback if we put a signal in at B. The signal is just going to run through to that ground. Rs are in series so they sum to 1.01M.

2) a common-mode input:
Here we're putting in the same signal at both inputs, since we are talking about common mode. I believe the current going through the 10K at A will be mirrored by the current through the 10K at B. As I mentioned since signal is the same, that's the same as saying Vins are the same. All told then Rin A and Rin B are both 1.01M.

3.3 A question about input impedances (Grads: 1 point)

It's a virtue that Rins on both of the inputs are the same. If the Routs of the two sources are equal, then they will then be equally loaded by the subsequent equal Rins of the diff amp. Why is this good? Well we're trying to maintain similarity between the otherwise identical signals. Heaven forbid the diff amp itself—being used for common mode!—rocks the boat and generates a difference between the signals due to asymmetric loading. This is definitely a good thing then, that Rins of the two inputs are the same.

Falstad, for my records: **https://tinyurl.com/y4k8qhb2**