Quiz 4

This is a preview of the published version of the quiz

Started: Feb 15 at 7:32am

Quiz Instructions

You may use notes, slides, homeworks, solutions, and other things on canvas.

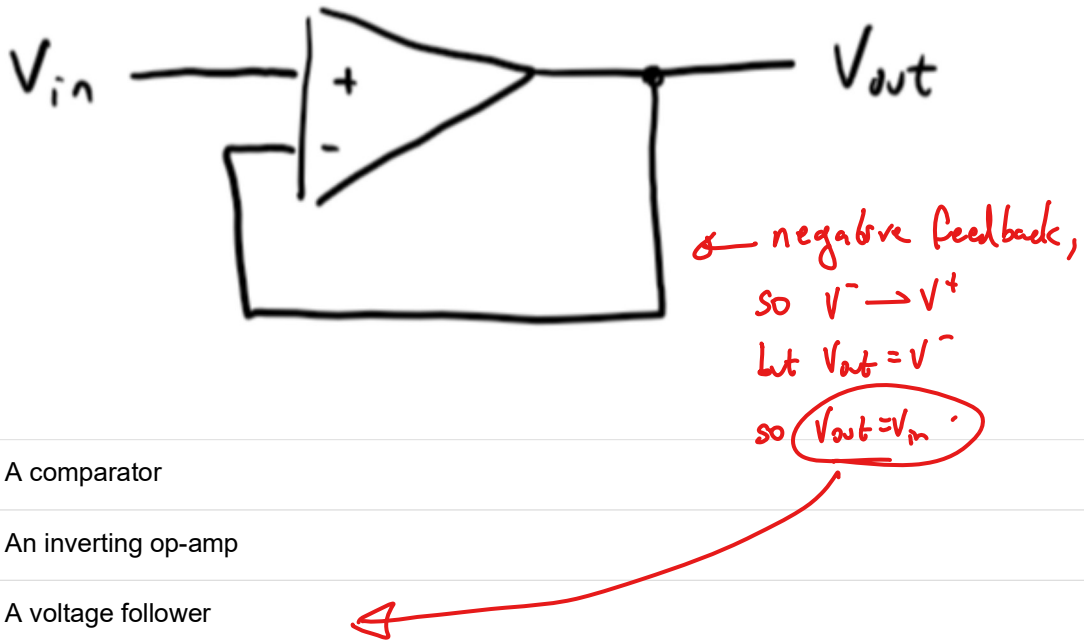
No people, online calculators, etc.

Don't forget units!

I will manually adjust scores on Saturday morning.

Question 1 — 1 pts

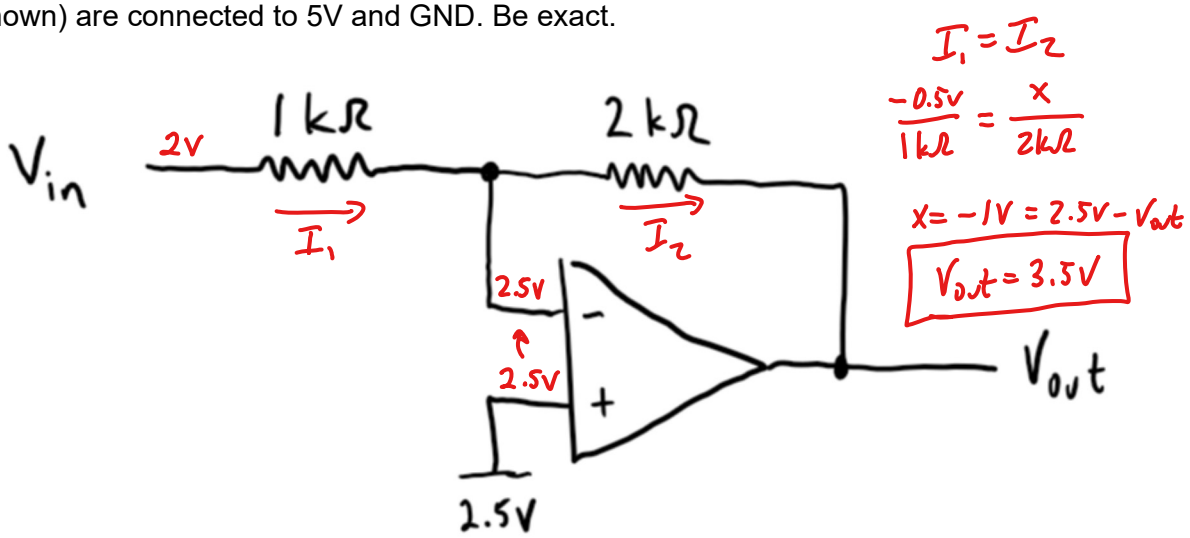
The op-amp in the figure is wired as...?



- ○ A comparator
- ○ An inverting op-amp
- ● A voltage follower

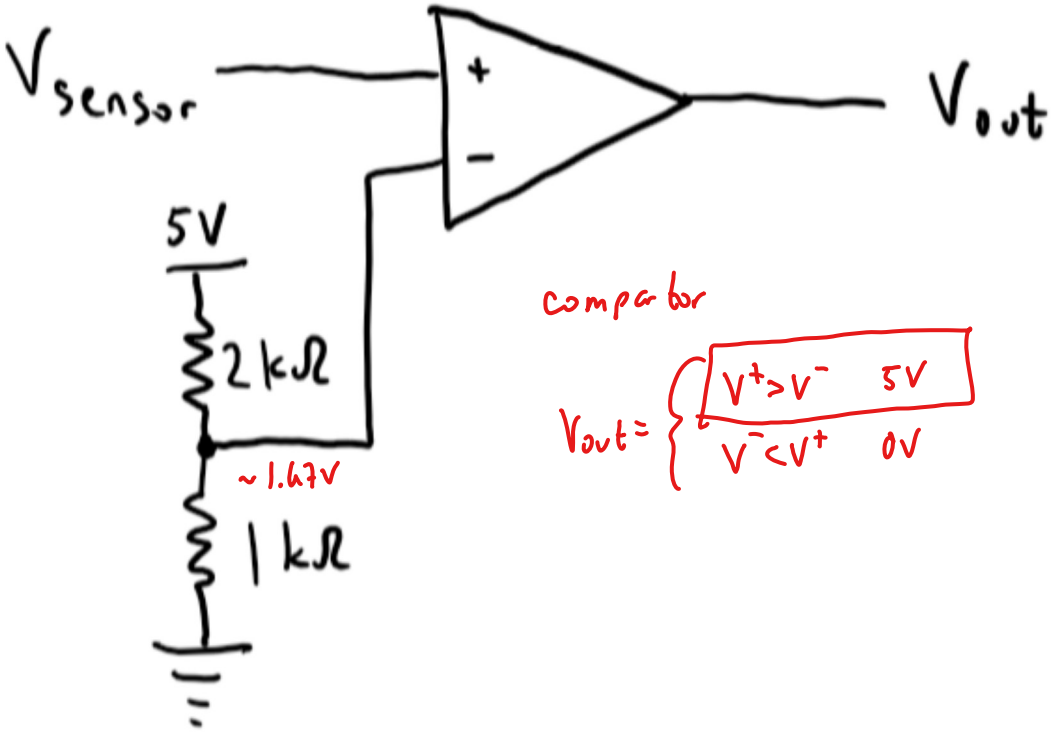
Question 2 — 1 pts

For the op-amp circuit shown, what is the output voltage when V_in is 2V? The rails (not shown) are connected to 5V and GND. Be exact.



Question 3 — 1 pts

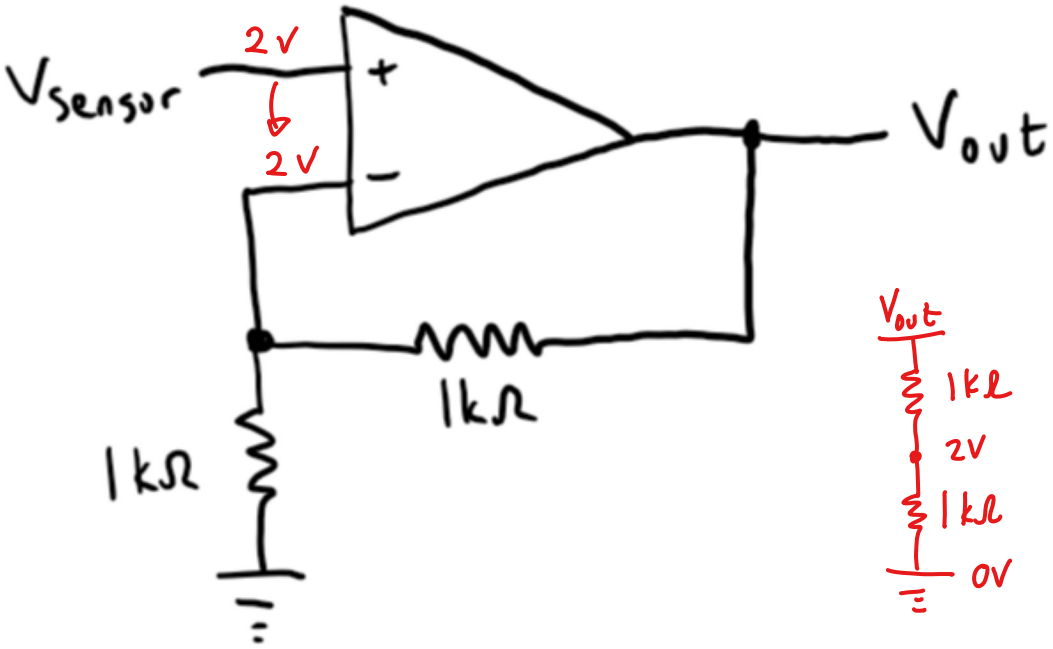
For the op-amp circuit shown, what is the output voltage when the sensor voltage is 3V? The rails (not shown) are connected to 5V and GND. Be exact.



Question 4

1 pts

For the op-amp circuit shown, what is the output voltage when the sensor voltage is 2V? The rails (not shown) are connected to 5V and GND. Be exact.



Question 5

1 pts

A motor will be used to drive an arm, as shown in the figure. At the design condition, the arm will be lifting 400g at 100rpm. Ignore the weight of the arm. The speed ratio, *e*, is 0.36.

If the gear has an efficiency of 0.95, how much power must the motor provide to meet the requirements? Write your answer to 4 significant digits.

we want 4 sig. digits, so keep more here

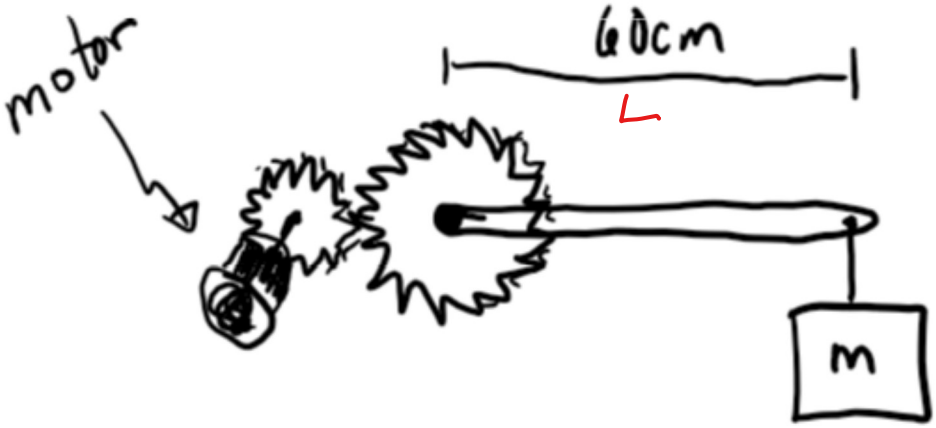
$P_{arm} = \eta P_{motor} \Rightarrow P_{motor} = \frac{1}{\eta} P_{arm}$

$P_{arm} = \tau \cdot \omega = mgL \cdot \omega = 0.4\,kg \cdot 9.8067\frac{m}{s^2} \cdot 0.6m \cdot 100\frac{rot}{min} \times \frac{1\,min}{60\,sec} \times \frac{2\pi}{1\,rot}$

$= 24.647\,W$

$P_{motor} = \frac{P_{arm}}{0.95} = \boxed{25.94\,W}$

I was generous with rounding, since I never specified g (in fact the key had 25.95W

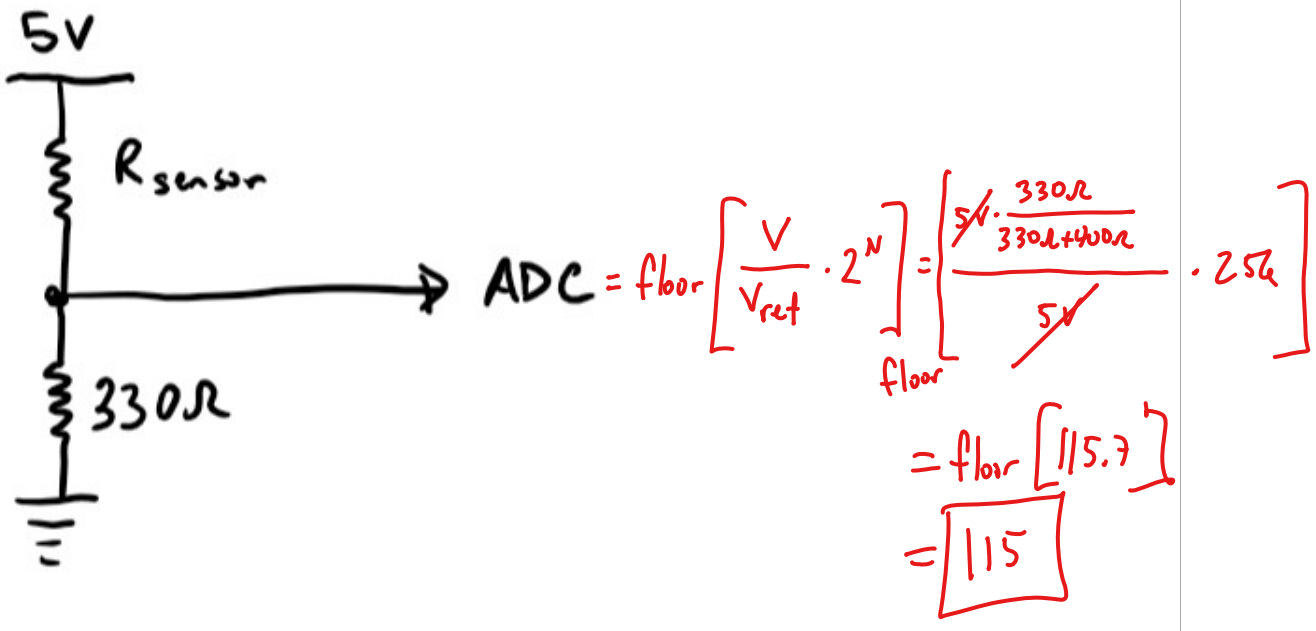


Question 6

1 pts

An 8-bit ADC is used to sample the voltage divider, as shown. If the resistance of the sensor is 400 Ohm, what will the reading on the ADC be? V_ref for the ADC is 5V.

Be exact.



Question 7

1 pts

An **4-bit** ADC, with V_ref of **8V** returns 7. Which of the following voltages could produce that results? Check all that apply.

- ☐ 2.7 V → 5
- ☑ 3.8 V $\frac{3.8V}{8V} \cdot 2^4 = 7.6 \rightarrow 7$
- ☐ 5.3 V → 10
- ☐ 7.6 V → 15

Question 8

1 pts

A motor with performance shown below is used to drive a pulley that must provide 40 W of power at 5 rpm. You will connect the motor to the pulley using gear stages with no more than 3:1 gear ratios. How many gear stages are required if each stage is 95% efficient?

torque (Nm)	speed (rpm)	power (W)
0	100	0.00
1	95	9.95
2	90	18.85
3	85	26.70
4	80	33.51
5	75	39.27
6	70	43.98
7	65	47.65
8	60	50.27
9	55	51.84
10	50	52.36
11	45	51.84
12	40	50.27
13	35	47.65
14	30	43.98
15	25	39.27

40W → 75 rpm @ perfect efficiency, which would need $e = \frac{5}{75} = \frac{1}{15}$ ⇒ 3 stages

Now add η:

$P_{out} = P_{motor} \cdot (0.95)^3$

$P_{motor} = \frac{40W}{(0.95)^3} = 44.7W$

Motor speed is now ≈ 44 rpm

$e = \frac{5}{44} = 0.076$

$\frac{1}{3} = 0.33$

$\frac{1}{3^2} = 0.11$

$\frac{1}{3^3} = 0.037$

so 3 stages still works

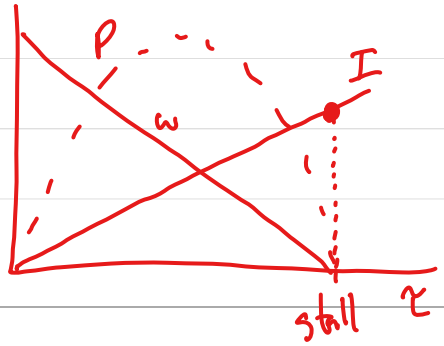
Question 9

1 pts

The maximum electrical current drawn by a motor occurs...

- ◯ At the no-load speed

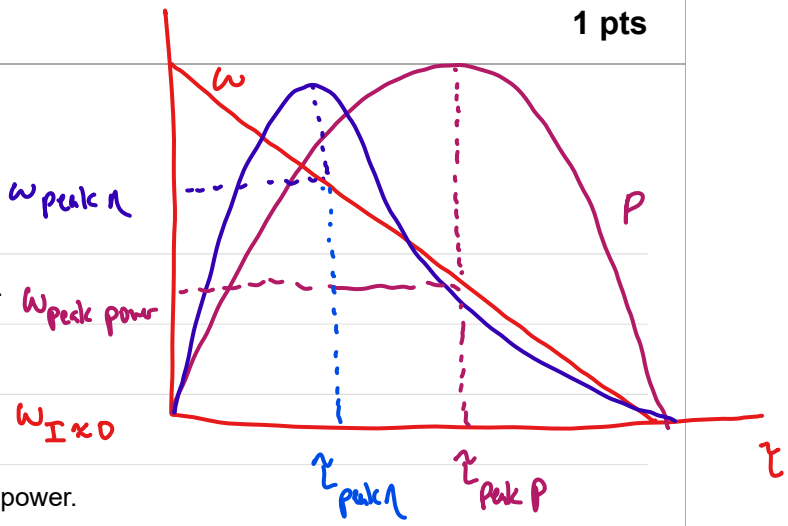
- ○ At peak power
- ● At stall torque
- ○ At peak efficiency



Question 10

1 pts

Peak efficiency for a motor typically...



- ○ Occurs at a higher torque than peak power.
- ● Occurs at a higher speed than peak power.
- ○ Occurs at the lowest current.
- ○ Occurs when the motor is generating peak power.

Not saved Submit Quiz

Happy Valentine's Day!