Electronics Unit 2 Test 4 (Answers)

Name	
Number	

You have addressed the skills being assessed in this Test.

Recognise the op-amp as a voltage comparator.	
Recognise the op-amp as an inverting amplifier.	
Explain the properties of the inverting amplifier.	
Explain the concept of virtual earth.	
Calculate the gain of an inverting amplifier.	
Recognise the non-inverting amplifier.	
Calculate the gain of a non-inverting amplifier.	
Compare the input resistance of the inverting and non-inverting amplifier.	

There are things that you need to do to improve your work:

Ensure that you use good English…	
…and clear presentation.	
Correct use of technical terms.	
Not to leave questions un-attempted.	
Show your working out fully.	
Include units as part of your final answer	

Comment:

Mark: ____/ 45

Grade: _____

MTG: _____

1.		The circuit below shows a simple thermostat circuit to control temperature in a greenhouse	
	(a)	Complete the sentence:	1
		The op-amp is being used as a <u>voltage</u> <u>comparator</u>	✓
	(b)	In the space below draw a system diagram for the circuit. One box has been completed as an example.	5
	(c)	Complete the circuit diagram by adding a component that will protect the MOSFET.	3
	(d)	Explain why the component you have just added is needed.	2
		Relay is an electromagnetic device	✓
		Gives a high reverse voltage spike when turned off	✓
		This can wreck the MOSFET.	✓

	(e)	At a certain temperature the resistance of the thermistor is 7.0 kilohms. Calculate the voltage at the inverting input.	2
		Vout = 12(4700 ÷ (7000 + 4700))	✓
		Vout = 4.8 V	✓
	(f)	What is the voltage at the non-inverting input? Explain your answer.	2
		4.8 V	
		The difference between the inputs is very small.	
	(g)	When the greenhouse is cold, explain how the heater comes on.	3
		The resistance of the thermistor is high	✓
		The output of the voltage divider circuit is low	✓
		Voltage of the inverting input is lower than the non-inverting input	✓
		Op amp gives out a high (positive) voltage (to turn on the MOSFET).	✓
	(h)	When the greenhouse is warm, explain how the heater remains switched off	2
		The resistance of the thermistor is low	
		The output of the voltage divider circuit is high	
		Voltage of the inverting input is higher than the non-inverting input	
		Op amp gives out a negative voltage	
		The MOSFET remains turned off.	

2.		The diagram shows an operational amplifier used in inverting mode	
	(a)	On the diagram, draw a line to show where the current flows.	2
	(b)	State what assumption you made, giving a reason	2
		No current goes into the op-amp…	✓
		…because the resistance is extremely high.	✓
	(c)	Explain what is meant by a *virtual earth*.	2
		The inverting input is almost at 0 V…	
		…because the voltage difference is very small.	
	(d)	The amplifier has Ra = 2.2 k and Rf = 820 k. If the input voltage = 6 mV, calculate the output voltage.	3
		Vout/Vin = -820 ÷ 2.2 = - 370	✓
		Vout = - 2.24 V	✓ ✓ ✓
	(e)	The amplifier has a unity gain bandwidth constant of 125 000. What is the bandwidth?	2
		Bandwidth = 125 000 ÷ 370	
		Bandwidth = 338 Hz	
	(f)	In the space below, sketch the sinusoidal input waves and the output waves to show the phase difference.	2
			✓ ✓
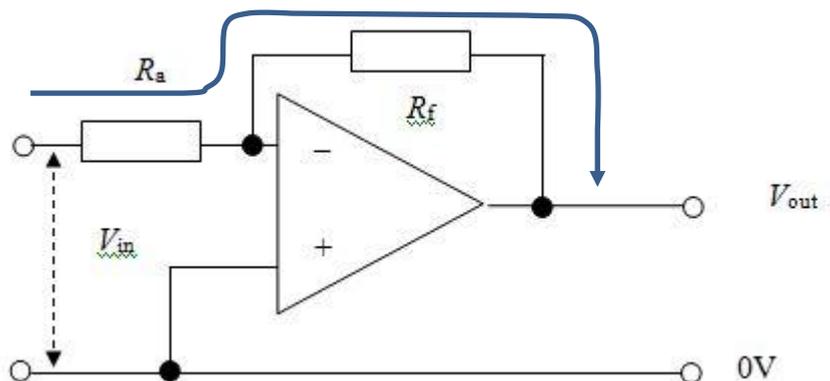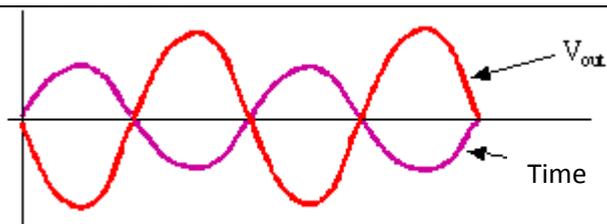
3.		The circuit diagram shows a non-inverting amplifier.	
	(a)	Explain why this circuit uses negative feedback.	2
		Feedback loop is fed into…	✓
		…the inverting input.	✓
	(b)	Calculate the voltage gain if Ra = 33 k and Rf = 270 k.	2
		Gain = 1 + Rf/Ra = 1 + (270 ÷ 33)	✓
		Gain = 9.18	✓
	(c)	A 100 k resistor is placed in series with the **non-inverting** input. Explain what difference, if any, will be made to the gain of the amplifier.	3
		No difference	✓
		Input resistance to non-inverting input…	✓
		…is much higher than 100 k.	✓
	(d)	With reference to the input resistance and phase, explain the advantage of using a non-inverting amplifier to an inverting amplifier.	4
		The non-inverting amplifier has an almost infinite input resistance…	✓
		…while the input resistance of the inverting op-amp is Ra.	✓
		The input and output of the non-inverting op-amp are in phase…	✓
		…while those of the inverting op-amp are 180° out of phase.	✓
			Total = 45 marks
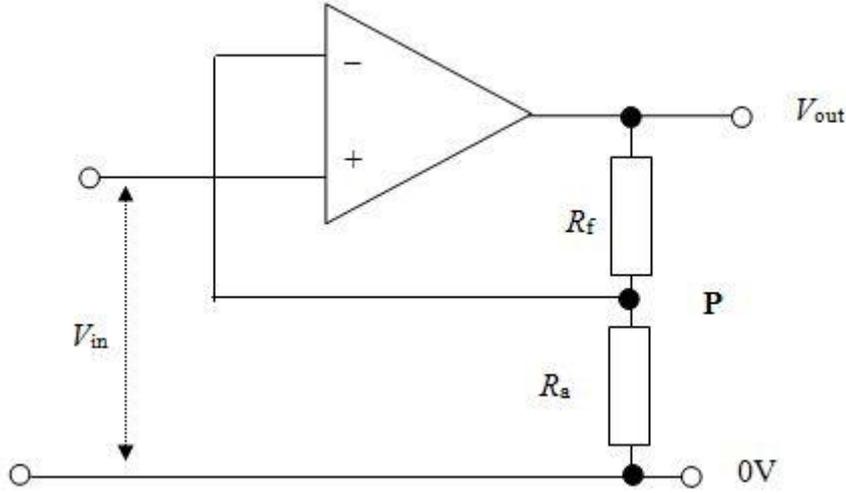
End of Examination.

Now go back and check your work.