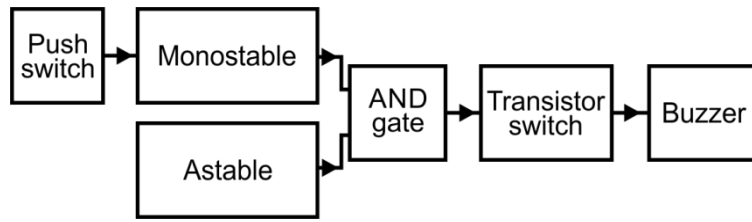


A LEVEL ELECTRONICS Sample Assessment Materials

2. The following alarm system sets off a buzzer when the monostable is triggered.



- The monostable output remains at logic 1 for 10 seconds after it is triggered.
- The astable has an equal mark-space ratio and a period of 2 seconds.

(a) The monostable is triggered. Describe the behaviour of the buzzer over the next 15 seconds. [2]

AO 2

.....

.....

.....

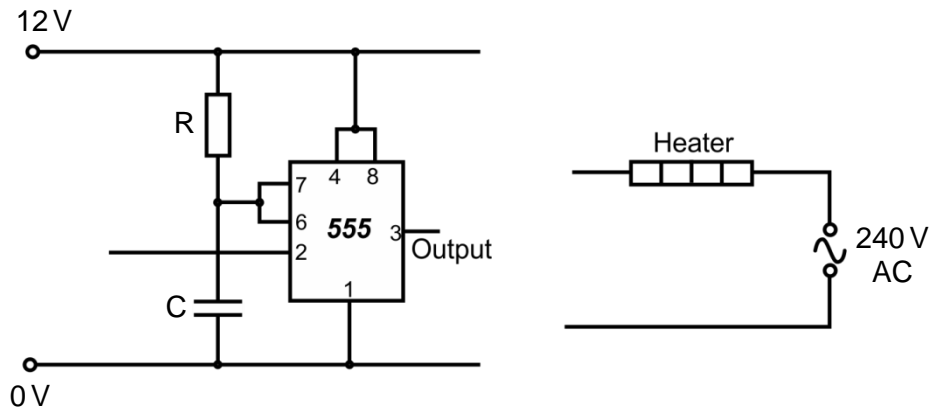
(b) A greenhouse is kept warm by a 240 V AC mains heater. The heater comes on for a predetermined time when a switch is pressed.

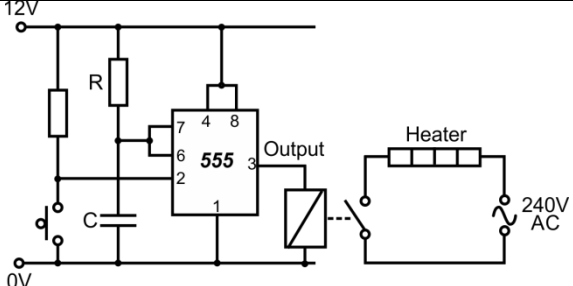
The following diagram shows an incomplete circuit for a 555 monostable timer used to control the heater. The 555 is falling-edge triggered. The monostable output is interfaced to the heater by a relay.

Complete the circuit diagram.

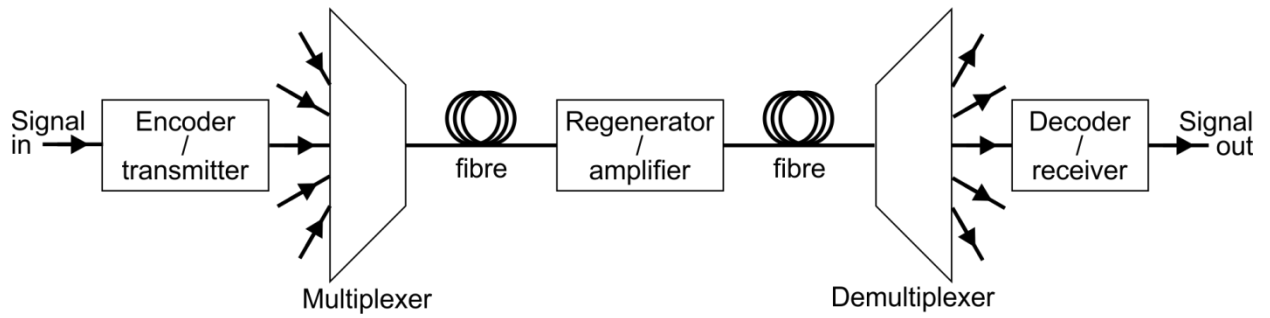
[4]

AO 1



Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
2	a	For 10 seconds, buzzer pulses and then stops. (1) While sounding, buzzer is on for 1 s then off for 1 s. (1)		2		2	
	b	 <p>Voltage divider with switch and resistor (1) Correct orientation (1) Relay coil connected correctly (1) Switch added to AC circuit (1)</p>					
		Question 2 total	4	2	0	6	0

6. The block diagram shows a typical optical communication system.



(a) Two commonly used light sources for the optical signal are LEDs and laser diodes. Give two advantages of a laser diode compared to a LED. [2]

AO 1

.....

.....

.....

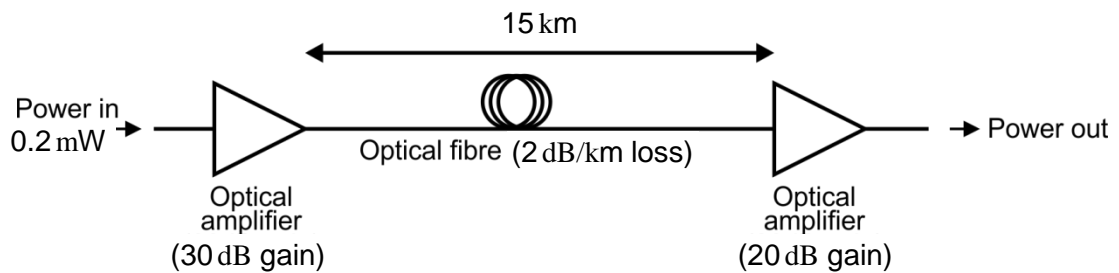
.....

.....

.....

.....

(b) The diagram shows part of an optical communication system. It shows a 15 km length of optical fibre, which has a cable loss of 2 dB/km and two regenerators.



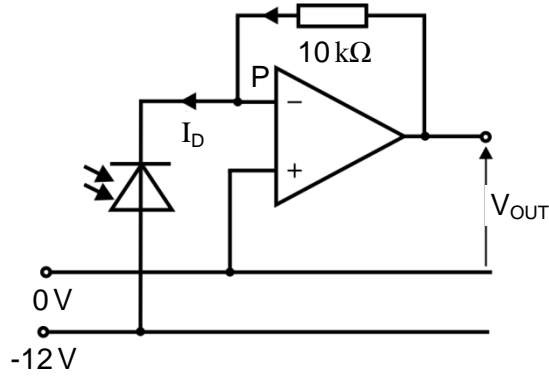
Calculate the power leaving this section of the communication system. [4]

AO 1

AO 2

power = mW

- (c) The circuit diagram for a simple optical fibre receiver is given below. It consists of a photodiode and an op-amp configured as a current-to-voltage converter.



- (i) Explain why the voltage at point P at the inverting input of the op-amp, is zero providing the op-amp output is not saturated. [2]

AO 1

AO 2

.....

.....

.....

- (ii) Explain why the current through the feedback resistor is virtually equal to that through the photodiode. [2]

AO 1

AO 2

.....

.....

.....

- (iii) Calculate the output voltage V_{OUT} when the current through the photodiode is 0.25 mA. [1]

AO 2

$V_{OUT} = \dots\dots\dots V$

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	
6	a	Any 2 × (1) from: <ul style="list-style-type: none"> • Greater power output • Higher efficiency • Higher data transmission rate 	2			2		
	b	Overall gain = (30 + 20) - (15 × 2) = + 20 dB (1) Manipulation of $G_{dB} = 10 \log_{10} \frac{P_{OUT}}{P_{IN}}$ (1) Substitute into $P_{OUT} = 10^{\left(\frac{G}{10}\right)} \times P_{IN} = 10^{\left(\frac{20}{10}\right)} \times 0.2$ (1) Correct answer = 20 [mW] (1)	1	1		4	4	
	c	i	Providing output is not saturated, difference between input voltages ~ V_S / open-loop gain ~ 0 V (1) Non-inverting input is at 0 V so P is at ~0 V.(1)	1	1		2	
		ii	Input impedance of op-amp ~ infinite. (1) No current flows into input so current through photodiode = feedback current (1)	1	1		2	
		iii	Current through feedback resistor = 0.25 mA Voltage across feedback resistor = 0.25 × 10 = 2.5 V so $V_{OUT} = +2.5[V]$ (1)		1		1	1

Question		Marking details	Marks available				
			AO1	AO2	AO3	Total	Maths
	d	<p>Indicative content:</p> <p>AO3 allocation (installation and transmitter) – The installation involves short cable runs of ~ hundred metres. The data will consist of emails, images and documents rather than streaming video and so the bandwidth need not be huge. Transmitter - Monomode uses laser diodes whereas multimode uses LEDs - much cheaper but slower and wider bandwidth which can cause issues with chromic dispersion.</p> <p>AO1 allocation – Fibre - Monomode uses purer glass to reduce attenuation but is more expensive as a result. It does not suffer from modal dispersion, which limits bit rate in multimode fibre. Regenerators - The short cable runs make these unnecessary. Environmental - Monomode fibres are much finer and as a result are susceptible to problems with dust in connectors, which can block the aperture completely.</p> <p>AO3 allocation (verdict) – Providing data transmission rates can be kept relatively low, multimode fibres offer a lower cost solution.</p> <p>5-6 marks A detailed analysis is given of the factors involved in the installation, including cable length and likely bandwidth requirements. The properties of both fibres and their peripherals are compared in detail. There is a reasoned verdict.</p> <p><i>There is a sustained line of reasoning which is coherent, substantiated and logically structured. The information included in the response is relevant to the argument.</i></p>	2		2		

Question	Marking details	Marks available				Maths
		AO1	AO2	AO3	Total	
	<p>3-4 marks A general account is given of the factors involved and the relative merits of the two types of fibre. Some attempt is made to justify a decision between the two.</p> <p><i>There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.</i></p> <p>1-2 marks Little consideration is given to requirements of the installation. The focus is on a comparison of factors involved in the two types of installation. The verdict is unsupported.</p> <p><i>There is a basic line of reasoning which is not coherent, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.</i></p> <p>0 marks No attempt made or no response worthy of credit.</p>				6	
	Question 6 total	7	6	4	17	5