FOR OFFICIAL USE

N5

National Qualifications 2018

Mark

X860/75/01 Practical Electronics

WEDNESDAY, 30 MAY
9:00 AM – 10:00 AM

X8607501

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth
Day Month Year

Scottish candidate number

Total marks — 60

Attempt ALL questions.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SQA ©

X860750101

MARKS DO NOT WRITE IN THIS MARGIN

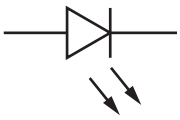
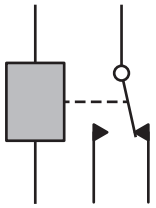
Total marks — 60

Attempt ALL questions

1. (a) The table gives information about some circuit components.

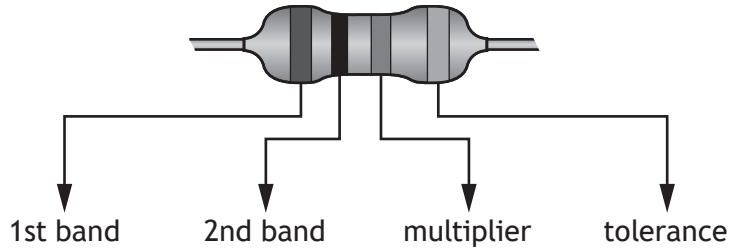
Some of the boxes have been left blank.

Complete the table for the missing entries. **3**

Name	*Symbol*	*Function*
electrolytic capacitor		stores charge
		emits light
relay		
741 operational amplifier (op-amp)		comparator

1. **(continued)**

(b) The following diagram shows the colour coding for a resistor.



A student is comparing two resistors R_1 and R_2. The colour code for each resistor is given in the table below.

Resistor	*1st band*	*2nd band*	*Multiplier*	*Tolerance*
R_1	brown	red	orange	silver
R_2	brown	red	orange	brown

Using information from the data sheet:

(i) determine the resistance of resistor R_1; **1**

(ii) state the percentage tolerance value of resistor R_2; **1**

(iii) determine the colour codes for a resistor of value 6K8 $\pm$ 5%. **2**

1st band	*2nd band*	*Multiplier*	*Tolerance*
			gold

[Turn over

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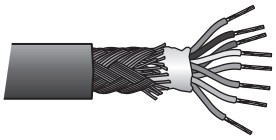
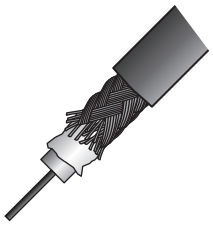
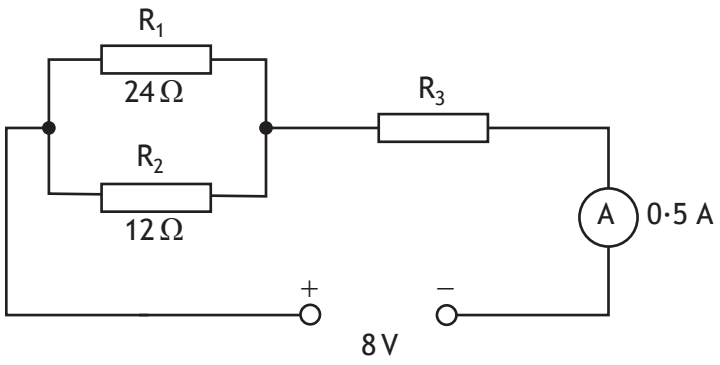
MARKS | DO NOT WRITE IN THIS MARGIN

2. Complete the table by stating a typical use for each cable type shown. **2**

	Cable type	*Typical use*
	multi-strand	
	coaxial	

[Turn over

3. A student sets up the circuit shown.



(a) Calculate the total resistance of the circuit. **3**

Space for working and answer

(b) Calculate the effective resistance of R_1 and R_2 in parallel. **3**

Space for working and answer

(c) Determine the resistance of resistor R_3. **1**

Space for working and answer

MARKS | DO NOT WRITE IN THIS MARGIN

3. (continued)

(d) Determine the voltage across R_3. **1**

Space for working and answer

(e) Calculate the power dissipated in resistor R_3. **3**

Space for working and answer

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

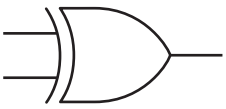
4. Logic gates are widely used in electronic circuits.

(a) Complete the truth table for an OR gate. **1**

A	B	Output
0	0	
0	1	
1	0	
1	1	

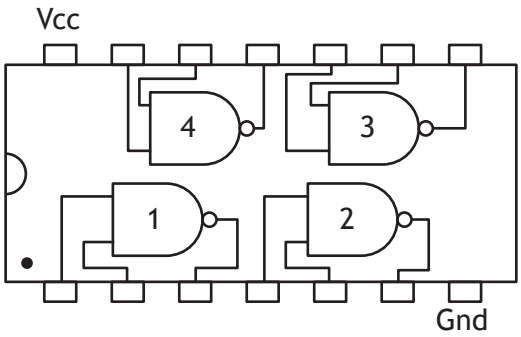
(An additional truth table, if required, can be found on *page 24*.)

(b) Name the logic gate shown below. **1**

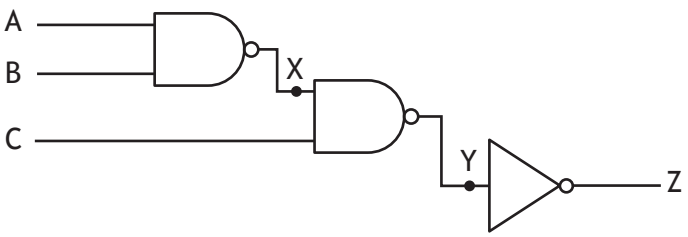


4. (continued)

(c) Using information from the data sheet, identify the **integrated circuit** (IC) shown. **1**



(d) Complete the truth table for the logic circuit shown. **3**



A	B	C	X	Y	Z
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

(An additional truth table, if required, can be found on *page 24*.)

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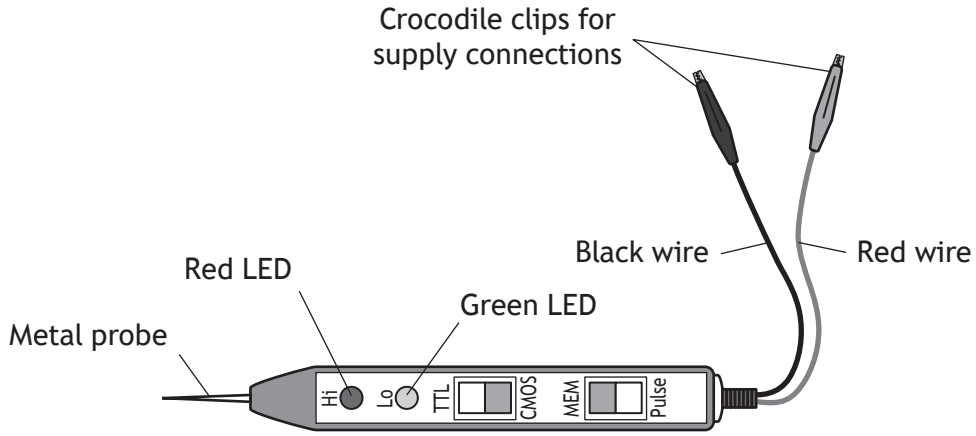
5. A logic probe is used to test the inputs and outputs of a 74 series logic chip.

The logic probe is set to TTL and pulse.



Describe how to connect and use the logic probe to test the inputs and outputs of the chip.

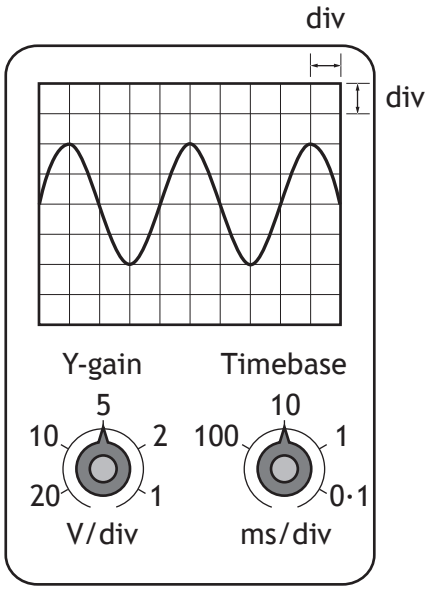
In your answer include how a logic 1 is detected. **3**

[Turn over

6. (a) The output from a signal generator is connected to the input terminals of an oscilloscope.

The trace is shown on the screen.

The Y-gain and timebase settings are also shown.



Determine the frequency of the signal. **3**

Space for working and answer

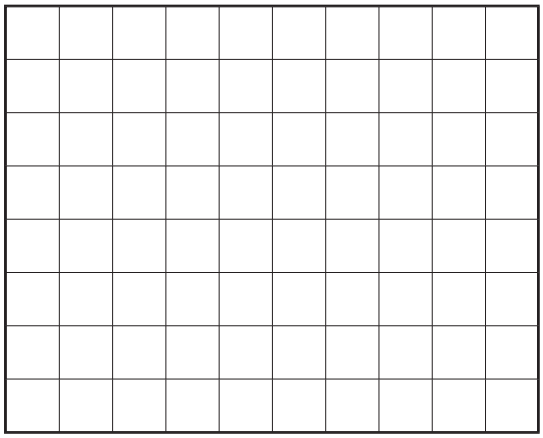
6. (continued)

(b) The peak voltage of the output signal from the signal generator is now **doubled**.

The frequency of the signal is unchanged.

The settings on the oscilloscope are unchanged.

Draw the new trace that would be shown on the screen. **1**

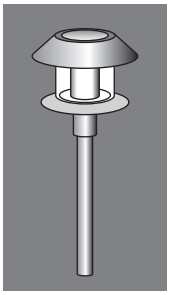


(An additional diagram, if required, can be found on *page 24*.)

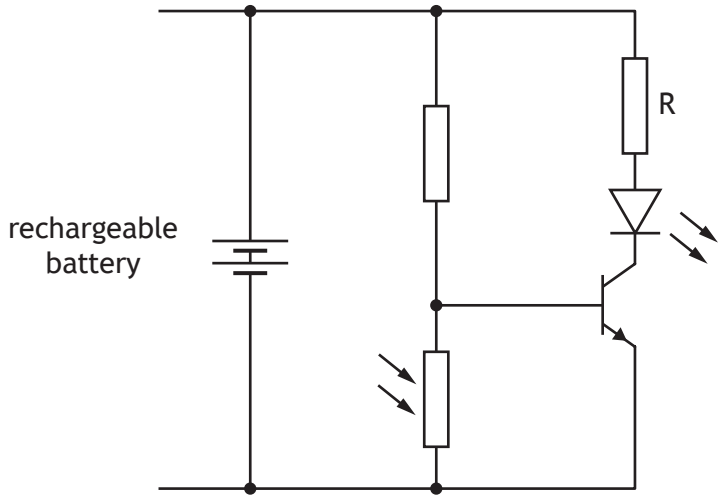
[Turn over

DO NOT WRITE IN THIS MARGIN

7. A high intensity LED is used as a garden light. The light turns on automatically when it becomes dark.

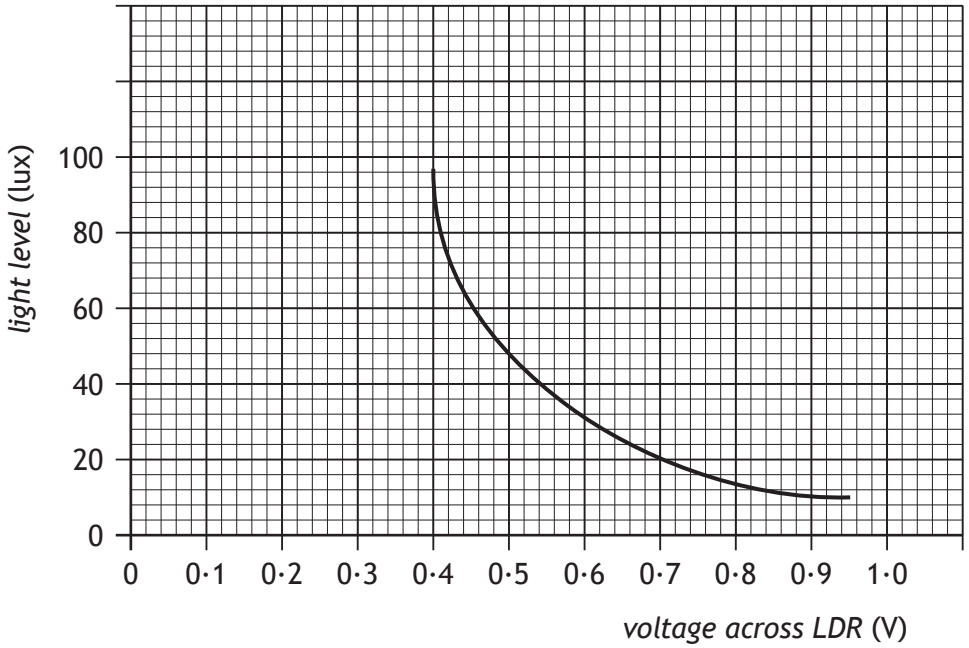


(a) The LED is switched on using the following circuit.



7. (a) (continued)

The graph shows the voltage across the LDR in this circuit for different light levels.



(i) For the LED to switch on, the voltage across the LDR must be at least 0·7 V.

Determine the light level at which the LED switches on. **1**

(ii) Explain the purpose of resistor R. **1**

(iii) The manufacturer has used a bipolar transistor, as a MOSFET cannot be used in this circuit.

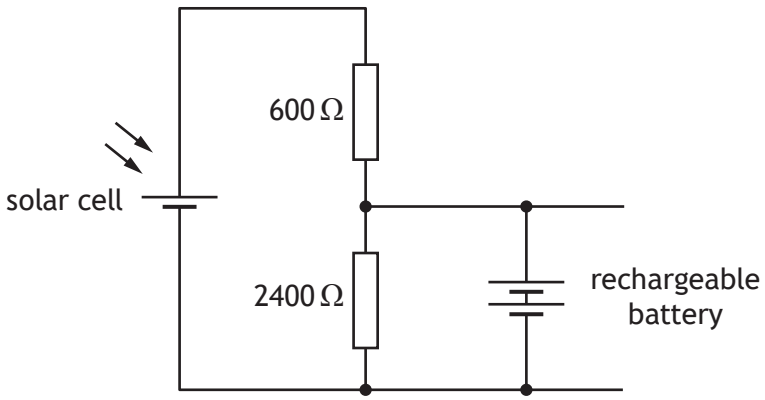
Explain why a MOSFET cannot be used in this circuit. **1**

[Turn over

7. (continued)

(b) The light also contains a solar cell which charges the rechargeable battery during daylight hours.

Part of the circuit is shown.



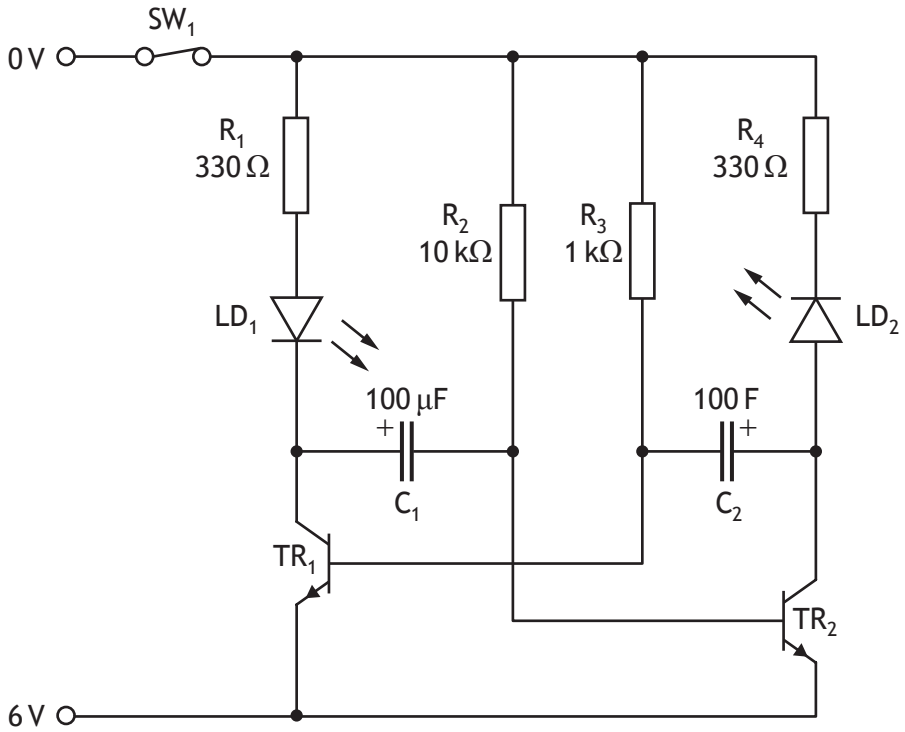
At a particular light level, the voltage generated by the solar cell is 1·5 V.

Calculate the voltage across the rechargeable battery at this light level. **3**

Space for working and answer

8. When switched on, the circuit shown should have the LEDs alternately **flashing at the same rate**. However the student has made four errors.

Identify the **four** errors. **4**



Error 1:

Error 2:

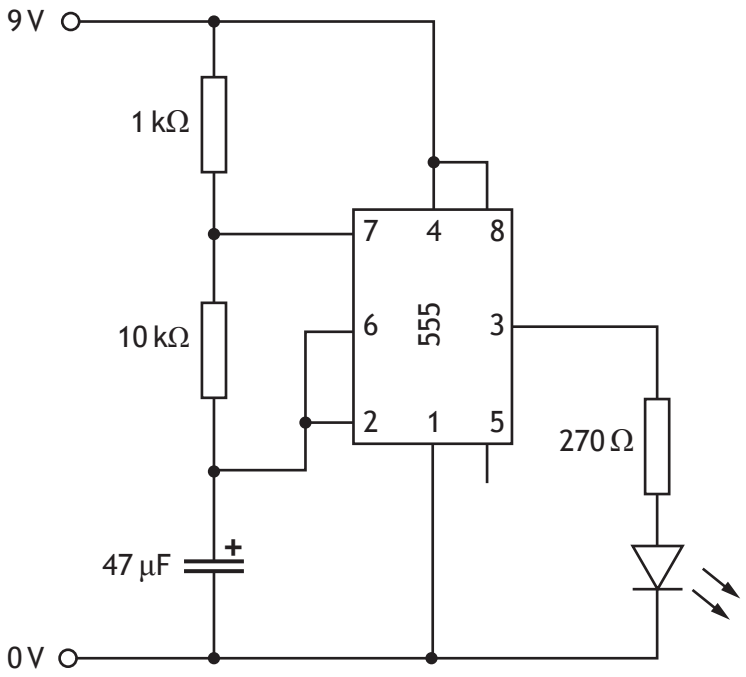
Error 3:

Error 4:

[Turn over

MARKS DO NOT WRITE IN THIS MARGIN

9. A student builds the circuit shown.



Using the information from two suppliers' catalogues shown on the opposite page, complete the costings sheet to produce the **lowest** cost for the circuit. **5**

Supplier	*Component*	*Product code*	*Cost (p)*
JIMSON	NE555	TC124	20
SWIFT	8 way DIL socket	SK-0080	10
	LED 5 mm std		
	47 µF electrolytic capacitor		
	270R		
	1K		
	10K		

DO NOT WRITE IN THIS MARGIN

9. (continued)

Supplier	SWIFT			
	Component	**Description**	**Product code**	**Cost**
Integrated circuits	LM555CM	timers	IC-0283	45p
	NE555	timers	IC-0254	32p
	NE556	timers	IC-0216	25p
	8 way dil	ic socket	SK-0080	10p
Semi-conductors	LED	5 mm std red	SC-0155	4p
	LED	10 mm std red	SC-0177	10p
Electrolytic capacitors	10 μF	16 V	CP-0555	10p
	47 μF	16 V	CP-0566	18p
	47 μF	6 V	CP-0588	10p
	47 μF	5 V	CP-0599	8p
Resistors	220R	0·25 W carbon film 5%	EC-0159	0·5p
	270R	0·25 W carbon film 5%	EC-0161	0·5p
	1K	0·25 W carbon film 5%	EC-0175	0·5p
	10K	0·25 W carbon film 5%	EC-0182	1·5p
	100K	0·25 W carbon film 5%	EC-0198	3p

Supplier	JIMSON			
	Component	**Description**	**Product code**	**Cost**
Integrated circuits	LM555CM	timers	TC 123	90p
	NE555	timers	TC 124	20p
	NE556	timers	TC 125	80p
	8 way dil	ic socket	SK 099	50p
Semi-conductors	LED	5 mm std red	LD345	12p
	LED	10 mm std red	LD346	20p
Electrolytic capacitors	10 μF	16 V	EC 798	10p
	47 μF	16 V	EC 799	14p
	47 μF	6 V	EC 800	10p
	47 μF	5 V	EC 801	8p
Resistors	220R	0·25 W carbon film 5%	FR 921	0·25p
	270R	0·25 W carbon film 5%	FR 922	0·25p
	1K	0·25 W carbon film 5%	FR 923	0·25p
	10K	0·25 W carbon film 5%	FR 924	2p
	100K	0·25 W carbon film 5%	FR 925	5p

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10. An engineer designs a system to control the temperature within a greenhouse.

The system includes a sensor which measures the temperature within the greenhouse.

If the temperature exceeds 24 °C this turns on a motor to open a window.

An LED indicator lights when the window is open.

There is also a manual switch to turn the whole system on and off.

Selecting from the elements given, draw a block diagram of an electronic solution for this system.

On your diagram, clearly indicate the input, process and output sections of your solution. **6**

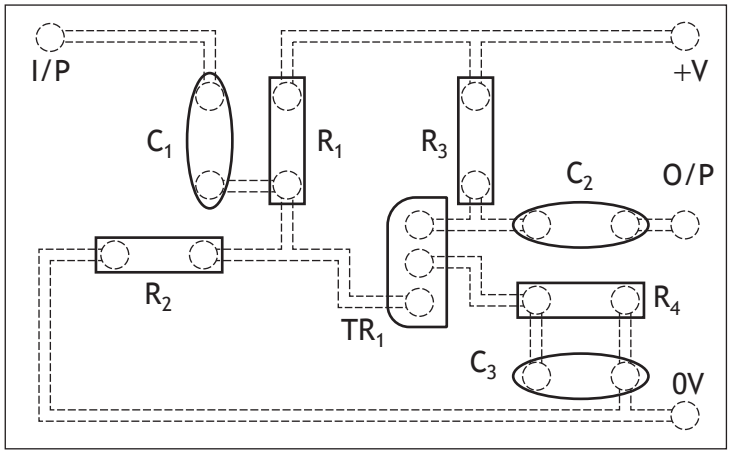
AND gate	NOR gate	NOT gate	Window motor (requires a logic 0 to turn the motor on)	Manual switch circuit (logic 1 when closed)
OR gate	XOR gate	LED circuit (requires a logic 1 to turn the LED on)	Temperature sensor (logic 1 when temperature is greater than 24 °C)	
Light sensor (logic 1 when light)				

MARKS | DO NOT WRITE IN THIS MARGIN

10. (continued)

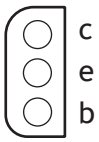
[Turn over for next question

11. The following PCB layout shows a circuit with the following component data.



Component data

R_1 — carbon film 82K 0·25 W
R_2 — carbon film 10K 0·25 W
R_3 — carbon film 8K2 0·25 W
R_4 — carbon film 1K 0·25 W
C_1 — 0·1 µF
C_2 — 0·1 µF
C_3 — 10 µF
TR_1 — BC182 npn bipolar



TR_1 pin connections

Draw a circuit diagram for this circuit. **6**

Each component must be labelled.

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11. (continued)

[END OF QUESTION PAPER]

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

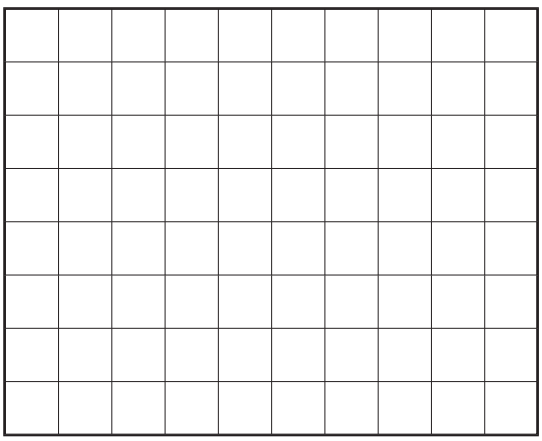
Additional truth table for question 4 (a)

A	B	Output
0	0	
0	1	
1	0	
1	1	

Additional truth table for question 4 (d)

A	B	C	X	Y	Z
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Additional diagram for question 6 (b)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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National Qualifications 2018

X860/75/11

Practical Electronics Data Sheet

WEDNESDAY, 30 MAY

9:00 AM – 10:00 AM

X8607511

A/PB

Relationships required for National 5 Practical Electronics

$$V = IR$$

$$R_T = R_1 + R_2 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

$$P = IV$$

$$P = I^2 R$$

$$P = \frac{V^2}{R}$$

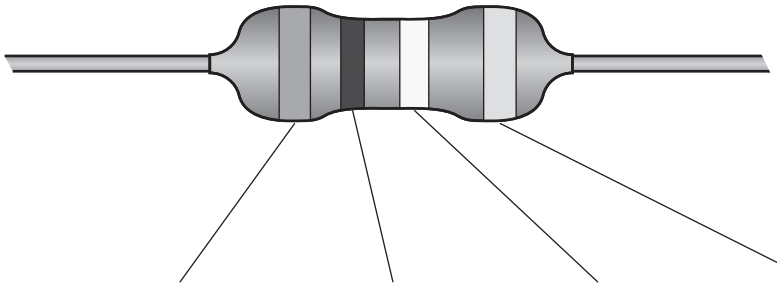
$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$$V_2 = \frac{R_2}{R_1 + R_2} \times V_S$$

$$f = \frac{1}{T}$$

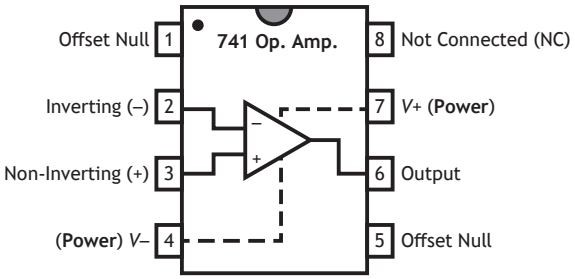
Resistor Colour Codes

4-band Resistor

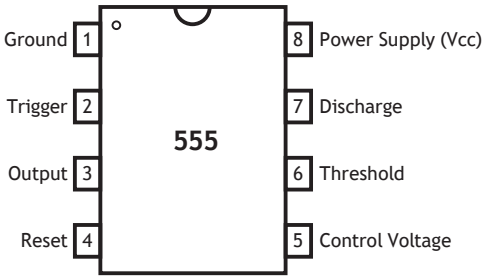


Colour	*1st band value*	*2nd band value*	*Multiplier*	*Tolerances*
Black	0	0	× 1	
Brown	1	1	× 10	±1%
Red	2	2	× 100	±2%
Orange	3	3	× 1000	±3%
Yellow	4	4	× 10000	±4%
Green	5	5	× 100000	±0·5%
Blue	6	6	× 1000000	±0·25%
Violet	7	7	× 10000000	±0·10%
Grey	8	8	× 100000000	±0·05%
White	9	9	× 1000000000	
Gold			× 0·1	±5%
Silver			× 0·01	±10%
No band				±20%

IC Pinout diagrams

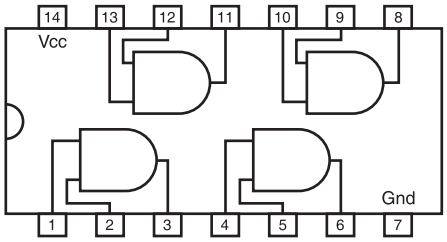


741 Op-amp

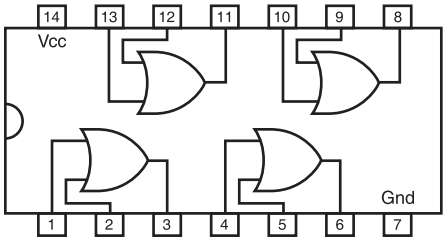


555 timer

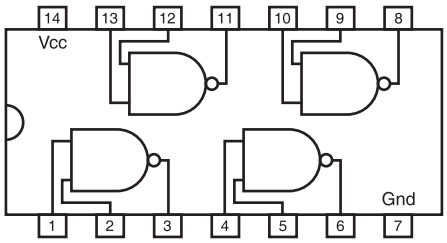
[Turn over



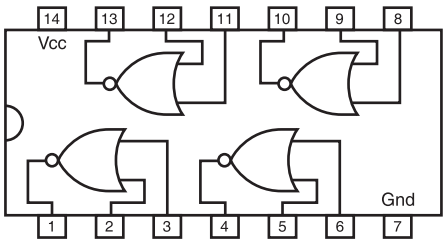
7408 Quad 2 input
AND Gates



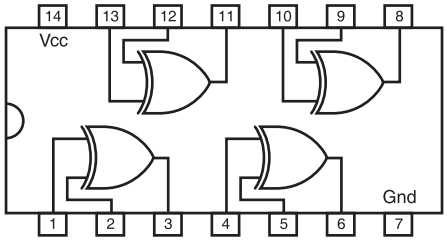
7432 Quad 2 input
OR Gates



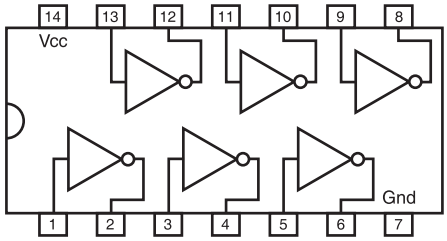
7400 Quad 2 input
NAND Gates



7402 Quad 2 input
NOR Gates



7486 Quad 2 input
XOR Gates



7404 Hex NOT Gates
(Inverters)

[END OF DATA SHEET]