



# Cambridge IGCSE™

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## DESIGN & TECHNOLOGY

0445/42

## Paper 4 Systems & Control

May/June 2026

**1 hour**

You must answer on the question paper.

No additional materials are needed.

## INSTRUCTIONS

- Section A: answer **all** questions.
- Section B: answer **one** question.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Answer in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.

## INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].
- All dimensions are in millimetres unless otherwise stated.

This document has **20** pages. Any blank pages are indicated.

## Section A

Answer **all** questions in this section.

- 1 Identify **two** types of renewable energy from the list.

**nuclear      natural gas      tidal      coal      geothermal**

1 .....

2 ..... [2]

- 2 Protective equipment is commonly used in a workshop.

(a) Figure 2.1 shows push sticks being used on a bandsaw.

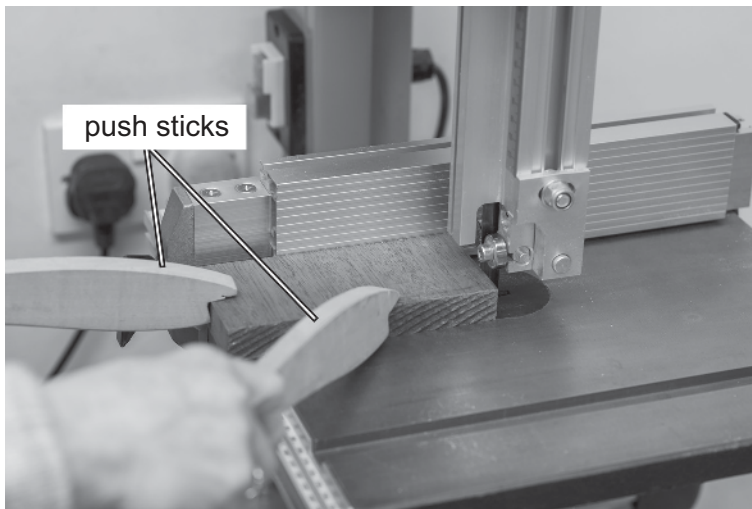


**Figure 2.1**

Describe the purpose of the push sticks shown in Figure 2.1.

.....  
 .....  
 ..... [2]

- (b) Name **two** items of Personal Protective Equipment (PPE) used in a workshop.

1 .....

2 ..... [2]



- 3 Sketch and name **one** example of each of the following types of man-made structure.

triangulated frame

shell

name .....

name .....

[2]

- 4 (a) Figure 4.1 shows a concrete beam.  
Draw arrows on Figure 4.1 to show how shear force would act on the concrete beam.



Figure 4.1

[2]

- (b) Use sketches and notes to show what is meant by torsion acting on the steel rod shown in Figure 4.2.

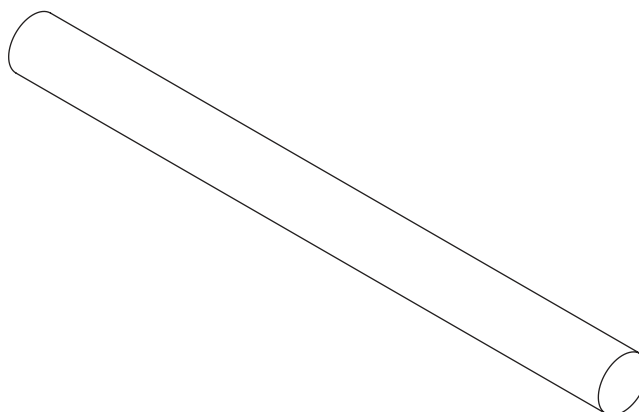


Figure 4.2

[2]



- 5 (a) Spur gears can be used to transmit motion in a mechanism.  
Give **two** benefits of using spur gears to transmit motion.

1 .....

2 .....

[2]

- (b) Figure 5.1 shows two arrangements of spur gears.

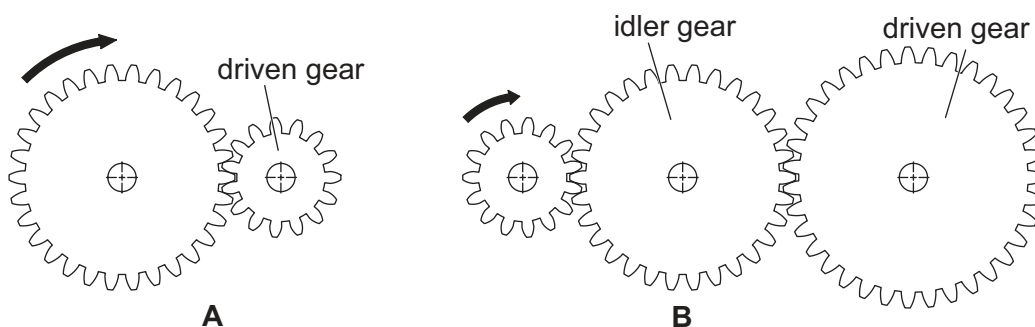


Figure 5.1

- (i) State the effect on the speed of rotation of each of the driven gears.

arrangement **A** .....

arrangement **B** .....

[2]

- (ii) Describe the purpose of the idler gear in arrangement **B**.

.....

.....

..... [2]

- 6 Name the electrical symbols shown in **Figure 6.1**.



Figure 6.1

.....

.....

[2]



- 7 Figure 7.1 shows an ammeter connected in a circuit.

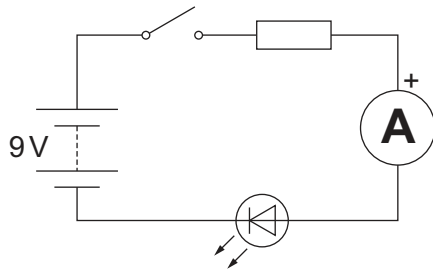


Figure 7.1

- (a) State the method of connection used for the ammeter.

..... [1]

- (b) State the unit being measured by the ammeter.

..... [1]

- 8 (a) Complete Table 8.1 by linking the sub-multiple capacitance units to the correct value as part of 1 farad.  
One has been done for you.

Table 8.1

| sub-multiple | unit              | part of 1 farad   |
|--------------|-------------------|-------------------|
| microfarad   | ( $\mu\text{F}$ ) | 0.000,000,000,000 |
| nanofarad    | (nF)              | 0.000             |
| millifarad   | (mF)              | 0.000,000,000     |
| picofarad    | (pF)              | 0.000,000         |

[2]

- (b) Give **one** practical advantage of using sub-multiple capacitance units.

.....  
 ..... [1]

## Section B

Answer **one** question from this section.

- 9 (a) Figure 9.1 shows a building based on a dome structure where individual triangular frames are joined to form a thin self-supporting shell structure.

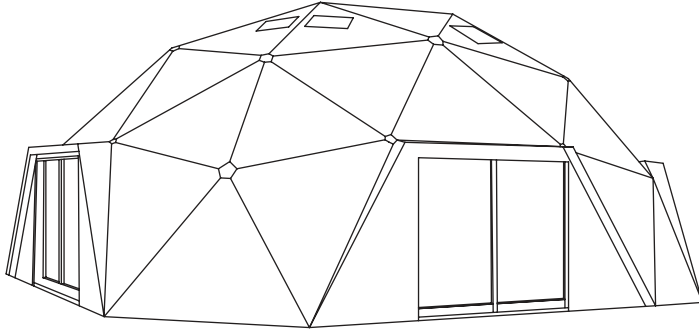


Figure 9.1

- (i) Explain why triangles are important to the success of the structure.

.....

.....

..... [2]

- (ii) Figure 9.2 shows three pieces of wood that will be joined to make one of the triangular frames.

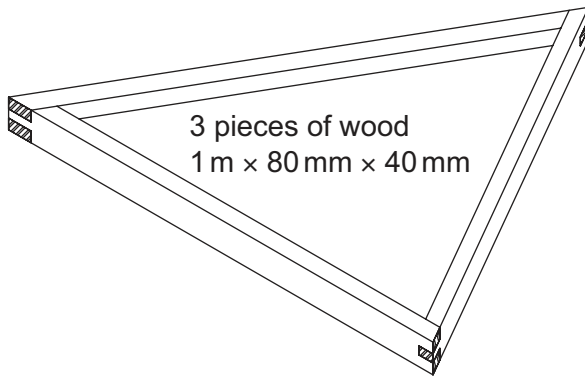


Figure 9.2

Give **two** reasons why Computer Aided Manufacture (CAM) is used to produce the joints in each frame.

1 .....

.....

2 .....

.....

[2]





- (iii) The wood chosen for the frames comes from a sustainable source. Explain what is meant by a 'sustainable source'.

.....

.....

..... [2]

- (iv) When the individual triangular frames are joined together to form the shell structure no internal supports are required. Domes up to 300 m in diameter can be constructed using this method.

Give **three** benefits of having no internal supports within a dome structure.

1 .....

.....

2 .....

.....

3 .....

..... [3]



(b) Figure 9.3 shows nutcrackers with a nut in position ready to be cracked.

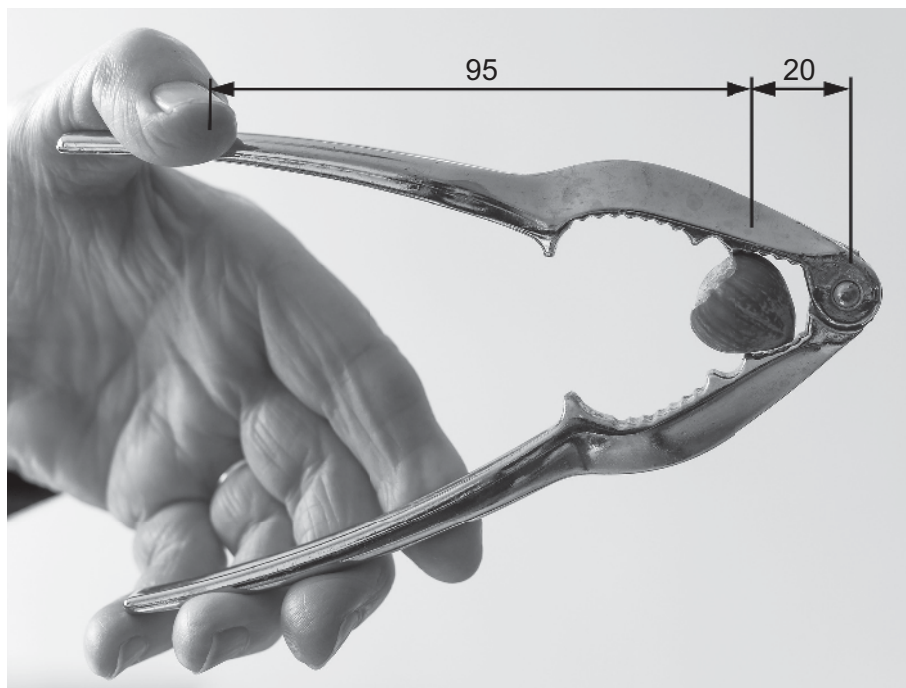


**Figure 9.3**

(i) State the order of lever used in the nutcrackers.

..... [1]

(ii) Explain how the length and shape of the nutcracker handles will affect their performance.

.....  
 .....  
 .....  
 ..... [3]

(iii) A force of 100 N is applied to the effort position.  
 Calculate the load that will be applied to the nut.

.....  
 .....  
 .....  
 ..... [3]



(iv) Figure 9.4 shows the three positions that a nut can be placed in.

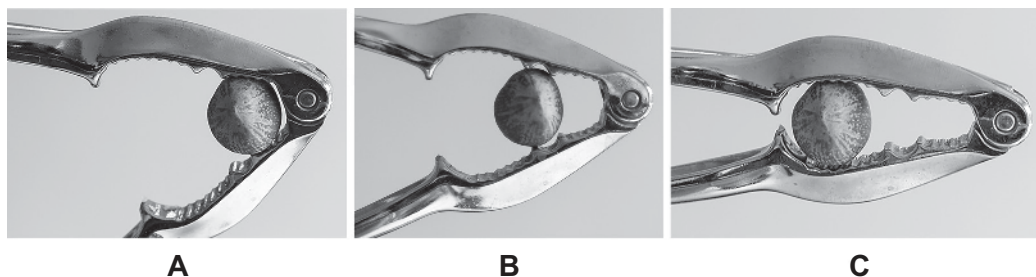


Figure 9.4

Describe why position **B** is the most efficient of the three positions for cracking the nut shown.

.....

.....

..... [2]

(c) Figure 9.5 shows two aluminium tubes 40 mm diameter with a wall thickness of 3 mm. Each tube is 2 metres long.

Use sketches and notes to show a method of joining the tubes without increasing the diameter at the joint.

The method used should allow the joint to be taken apart and resist tension.

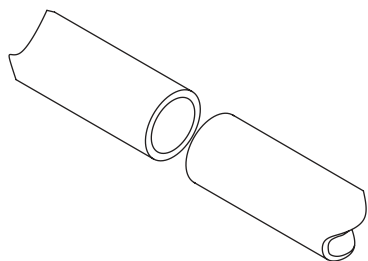


Figure 9.5

[3]





(d) Figure 9.6 shows a lorry parked on a bridge.

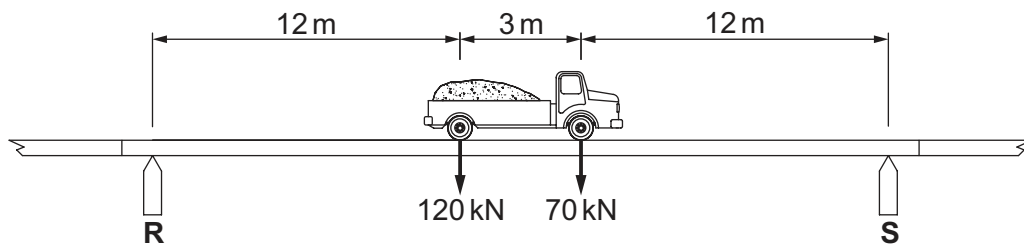


Figure 9.6

Calculate the reactions at **R** and **S**.

.....

.....

.....

.....

.....

reaction at **R** ..... reaction at **S** ..... [4]



10 Figure 10.1 shows three cam profiles.

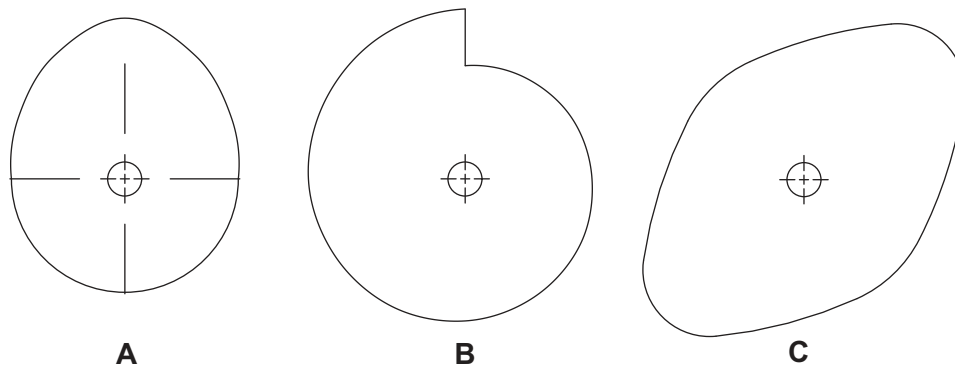


Figure 10.1

(a) (i) Describe the movement of the followers when each cam rotates.

cam A .....

.....

.....

cam B .....

.....

.....

cam C .....

.....

.....

[6]

(ii) Draw an arrow on the snail cam in Figure 10.1 to indicate the direction of rotation. [2]

(iii) Use sketches and notes to show a lever follower.

[2]

(iv) State the output motion that is provided by a cam with a lever follower.

..... [1]



(b) Figure 10.2 shows a geared pepper mill used to grind peppercorns.

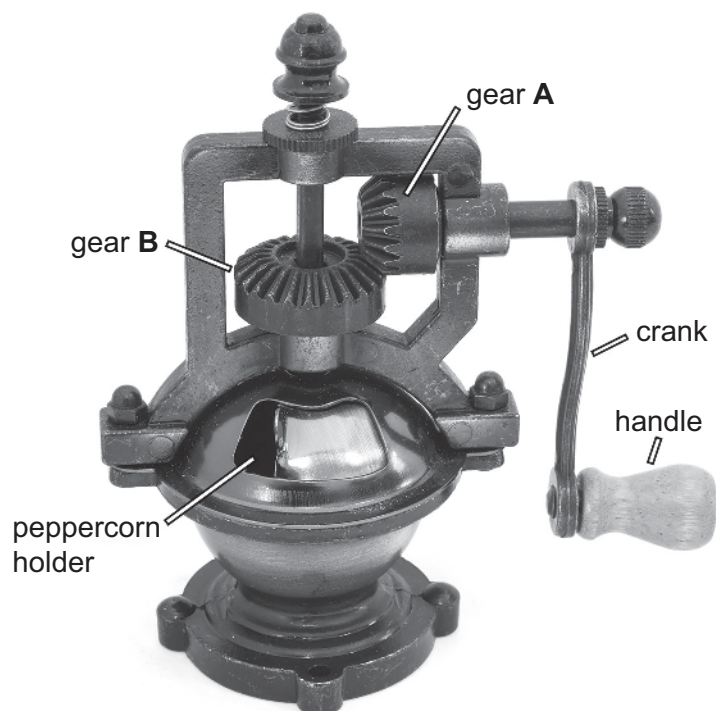


**Figure 10.2**

(i) Name the type of gears used.

..... [1]

(ii) Explain how the length of the crank can affect the amount of torque applied to gear **A**.

.....  
 .....  
 .....  
 ..... [2]

(iii) A function of the gears is to provide a mechanical advantage.  
 Give **one** other function of the gears.

.....  
 ..... [1]

(iv) Gear **A** has 17 teeth and gear **B** has 21 teeth.  
 Calculate the mechanical advantage provided by the gears.

.....  
 .....  
 ..... [2]



(v) Calculate the speed of rotation of gear **B** when the handle is turned at 60 rpm.

.....

.....

.....

..... [3]

(vi) State **one** factor that will cause loss of efficiency in the gear system.

..... [1]

(c) Figure 10.3 shows four types of bearing.

| bearing type                                                                        | operating condition                                  |
|-------------------------------------------------------------------------------------|------------------------------------------------------|
|   | <div>will resist a large axial and radial load</div> |
|  | <div>compensates for bends in a shaft</div>          |
|  | <div>will resist a large radial load</div>           |
|  | <div>low maintenance</div>                           |

Figure 10.3

(i) Draw lines on Figure 10.3 to match each bearing type to the most suitable operating condition.

[3]



(ii) Figure 10.4 shows a one piece forged crankshaft and a split plain bearing.

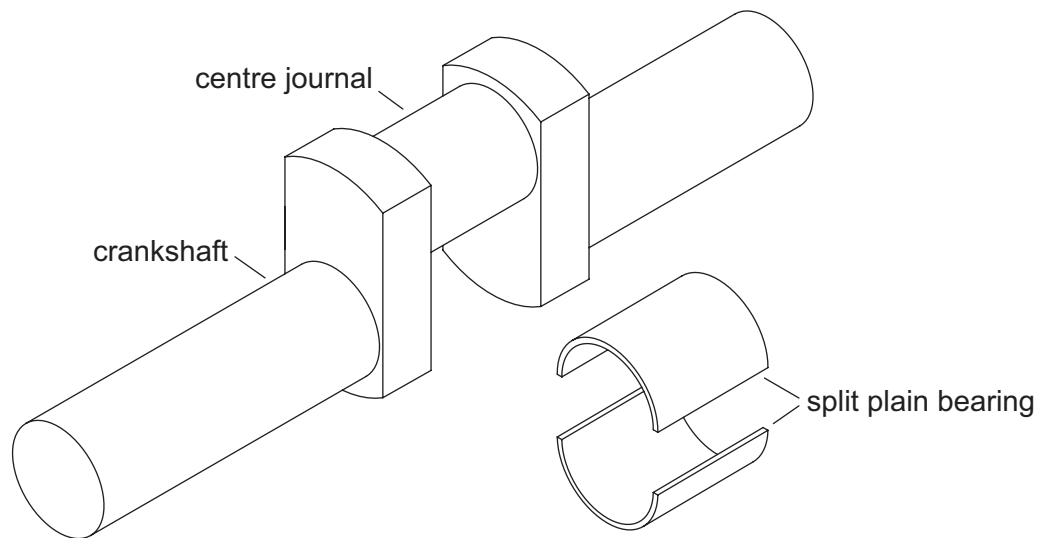


**Figure 10.4**

Give **one** reason why a split plain bearing must be used on the crankshaft centre journal.

.....  
.....  
..... [1]



11 Figure 11.1 shows two possible methods of testing an electronic circuit.

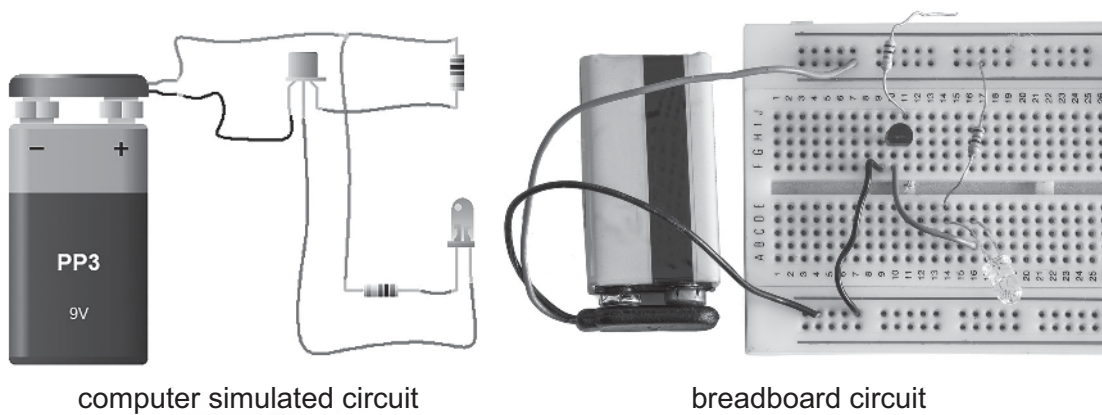


Figure 11.1

(a) (i) Give **two** benefits for each method of testing the circuit.

Computer simulated circuit:

1 .....

.....

2 .....

.....

Breadboard circuit:

1 .....

.....

2 .....

.....

[4]

(ii) After testing the circuit a Printed Circuit Board (PCB) can be made.  
State **two** health and safety measures taken when making a PCB.

.....

.....

.....

..... [2]



- (iii) Test points can be built into the PCB to allow a multimeter to be connected quickly. Explain how this can improve quality control on completed circuits.

.....  
.....  
..... [2]

- (iv) PCBs can be blocked together as shown in Figure 11.2.

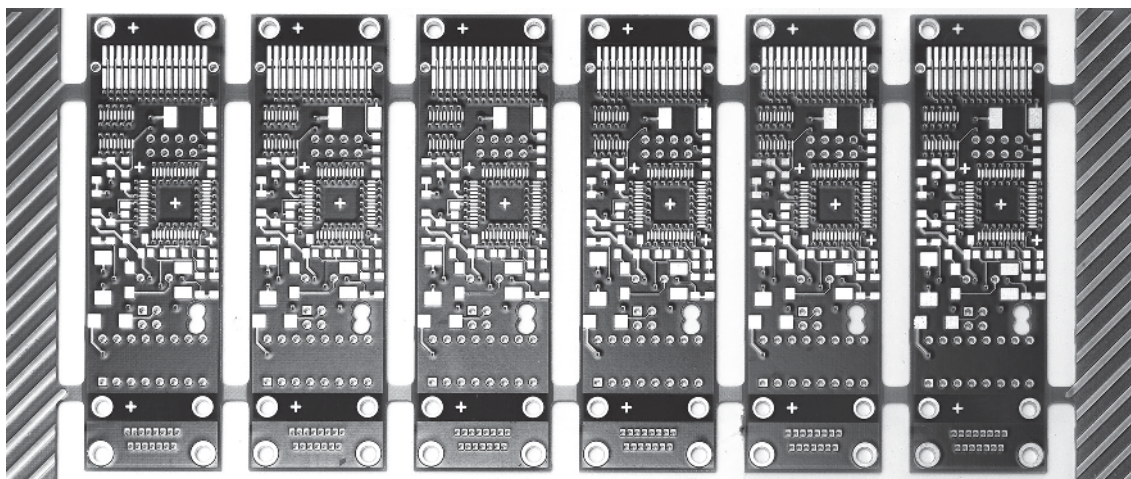


Figure 11.2

Give **one** drawback of doing this before a prototype PCB has been fully tested.

..... [1]



(b) Figure 11.3 shows two pairs of connected resistors in a potential divider circuit.

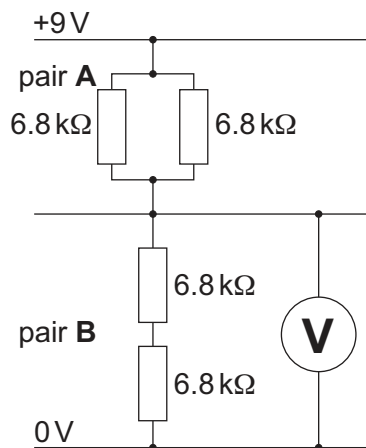


**Figure 11.3**

(i) Calculate the resistance across each pair of resistors.

pair A .....

.....

pair B .....

.....

[2]

(ii) Calculate the reading that should appear on the voltmeter.

Use the formula  $V_{\text{out}} = \frac{V_{\text{in}} \times R_2}{(R_1 + R_2)}$

.....

.....

.....

.....

[3]



(c) Figure 11.4 shows a circuit used to power a single segment in a 7-segment display.

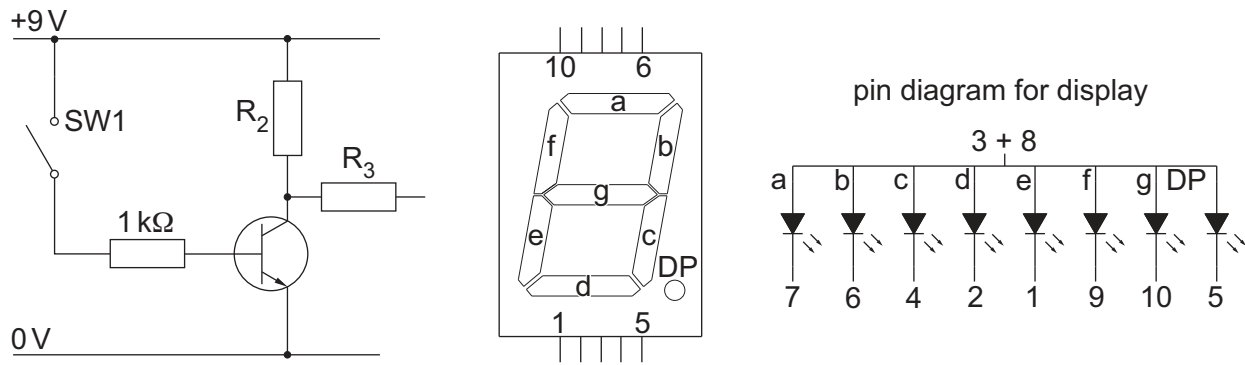


Figure 11.4

- (i) 7-segment displays can be common cathode or common anode. Describe the difference in the driving circuit needed for each type of display.

..... [2]

- (ii) Draw the connections on Figure 11.4 that will light segment **c** on the display when **SW1** is closed. [2]

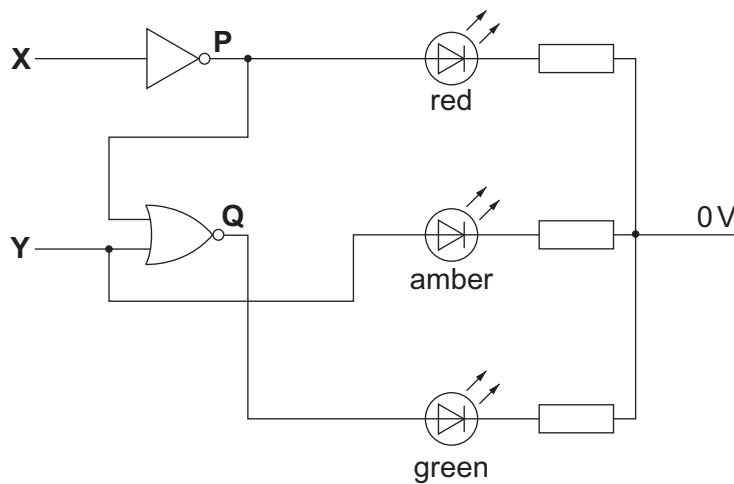
- (iii) State the purpose of resistors **R<sub>2</sub>** and **R<sub>3</sub>** in the circuit.

purpose of **R<sub>2</sub>** .....

purpose of **R<sub>3</sub>** ..... [2]



- (d) Figure 11.5 shows the circuit and truth table for a logic-based model traffic light system. Logic 1 at **X** or **Y** is +6V.



| X | Y | P | Q | red | amber | green |
|---|---|---|---|-----|-------|-------|
| 0 | 0 | 1 | 0 |     |       |       |
| 0 | 1 | 1 | 0 |     |       |       |
| 1 | 0 | 0 | 1 |     |       |       |
| 1 | 1 | 0 | 0 |     |       |       |

**Figure 11.5**

- (i) Complete the truth table using '1' for **on** and '0' for **off** to show which LEDs will be on for each combination of inputs. [4]
- (ii) The system uses one NOT gate (inverter) and one NOR gate. Use sketches and notes to show how the inverter could be made from a NOR gate.

[1]





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