

SECTION A

Attempt all the questions in this Section. (Total 120 marks)

1. The tumble dryer shown in Figure Q1 vents warm air back into the house through a filter, and collects moisture from the clothes in a water tank. An air flow sensor detects when the filter needs to be cleaned.



Figure Q1

A logic system controls a warning buzzer. If the water tank is full ($W=1$) or the air flow is too low ($A=0$) when the start button is pressed ($S=1$), then the buzzer sounds ($B=1$).

- (a) Draw a truth table for the output, B , in terms of the inputs S , W and A . 3
- (b) Write a Boolean expression for B in terms of S , W and A . 4
- (c) Draw a logic diagram for the control system, constructed from AND, OR and NOT gates. 3
- (d) Draw a logic diagram for the control system, using only NAND gates. 4

Simplify where appropriate.

(14)

2. The control panel for the climate-control system in a car is shown in Figure Q2(a). A combinational-logic system controls the operation of a compressor (C).
 An air-conditioning select switch (A), a windscreen-demist switch (D), and a temperature sensor (T) provide input signals to the combinational-logic system.

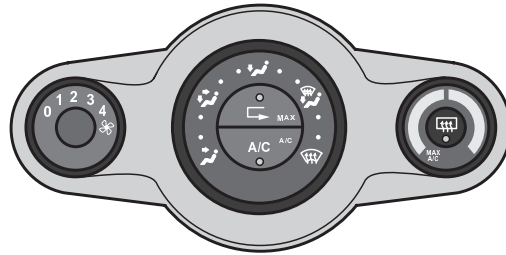


Figure Q2(a)

A truth table for the system is shown in Figure Q2(b).

Air-conditioning Select (A)	Windscreen Demist (D)	Temperature Sensor (T)	Compressor (C)
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Figure Q2(b)

- (a) Write a Boolean equation for the compressor (C), in terms of A, D and T. 4

The compressor will operate only if the temperature sensed is above 5 °C.

- (b) State the logic value of the temperature sensor at 6 °C. 1

- (c) Draw a combinational-logic system to control the compressor using AND, OR and NOT gates. 6

- (d) Draw an equivalent logic system using only NAND gates. Simplify where possible. 6

(17)