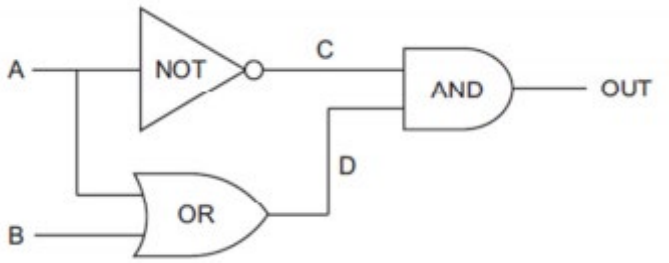
1.3.3 Logic Gates and Logic Circuits

May/June 2011. P11/ P12

6. Complete the table for this circuit of logic gates.



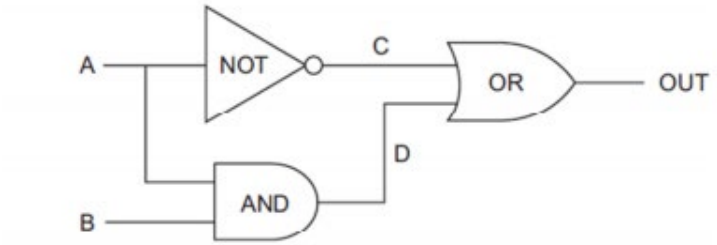
A	B	C	D	Out
0	0			
0	1			
1	0			
1	1			

[6]

1.3.3 Logic Gates and Logic Circuits

May/June 2011. P13

6. Complete the table for this circuit of logic gates.



A	B	C	D	Out
0	0			
0	1			
1	0			
1	1			

[6]

Oct/NOV 2011. P11

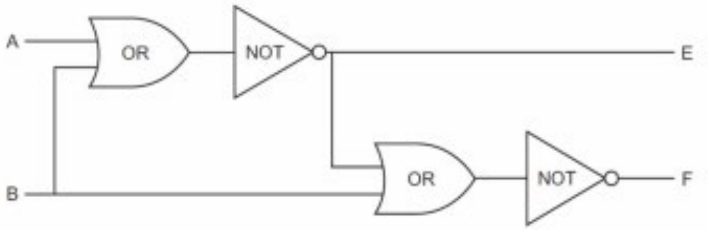
9 (a) Complete the table to show the outputs for the possible inputs to this circuit.

A	B	C	D
0	0		
0	1		
1	0		
1	1		

[2]

(b) Complete the table to show the outputs for the possible inputs to this circuit.

1.3.3 Logic Gates and Logic Circuits

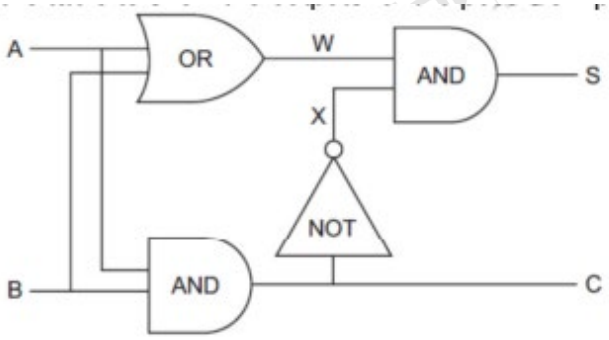


A	B	E	F
0	0		
0	1		
1	0		
1	1		

[4]

Oct/NOV 2011. P12

9 (a) Complete the table to show the outputs for the possible inputs to this circuit.



A	B	W	X	C	S
0	0				
0	1				
1	0				
1	1				

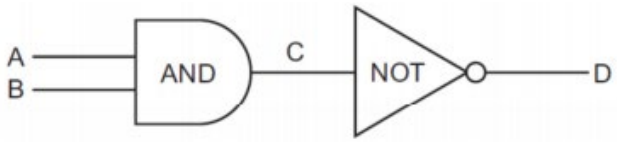
1.3.3 Logic Gates and Logic Circuits

[5]

(b) State a possible use for this circuit in a processor. **[1]**

Oct/NOV 2011. P13

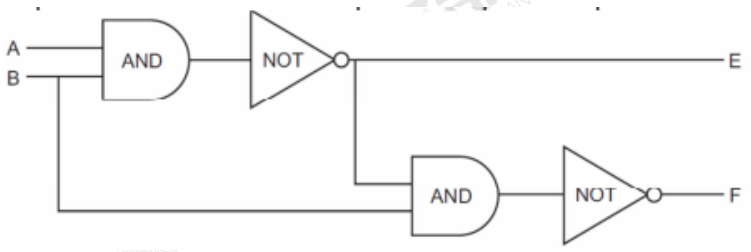
9 (a) Complete the table to show the outputs for the possible inputs to this circuit.



A	B	C	D
0	0		
0	1		
1	0		
1	1		

[2]

(b) Complete the table to show the outputs for the possible inputs to this circuit.



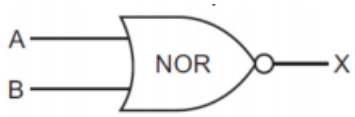
A	B	E	F
0	0		
0	1		
1	0		
1	1		

[4]

1.3.3 Logic Gates and Logic Circuits

May/June 2012. P11/12

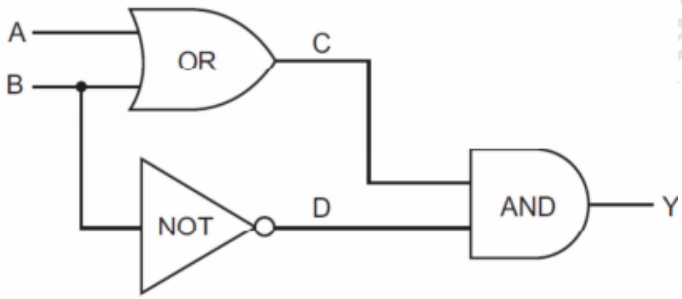
9 (a) Complete the truth table to show the output from the logic gate shown.



A	B	X
0	0	
0	1	
1	0	
1	1	

[2]

(b) Complete the truth table to show the outputs from the logic circuit shown.



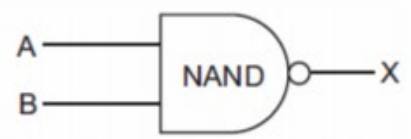
A	B	C	D	Y
0	0			
0	1			
1	0			
1	1			

[4]

1.3.3 Logic Gates and Logic Circuits

May/June 2012. P13

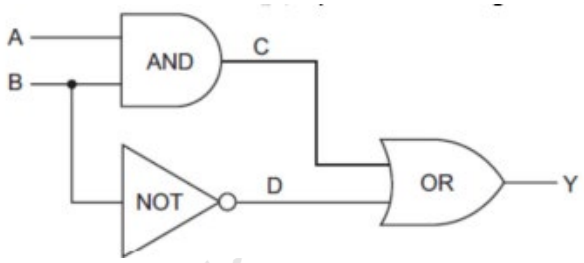
9 (a) Complete the truth table to show the output from the logic gate shown. **[2]**



A	B	X
0	0	
0	1	
1	0	
1	1	

[2]

(b) Complete the truth table to show the outputs from the logic circuit shown.



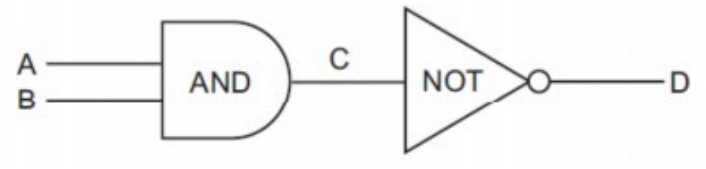
A	B	C	D	Y
0	0			
0	1			
1	0			
1	1			

[4]

1.3.3 Logic Gates and Logic Circuits

Oct/NOV 2012. P11

10 (a) (i) Complete the truth table for this logic circuit.

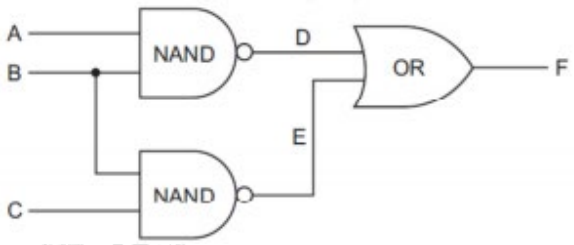


A	B	C	D
0	0		
0	1		
1	0		
1	1		

[1]

(ii) State a single logic gate which would have the same final outcome as this pair of logic gates. [1]

(b) Complete the truth table for this logic circuit.



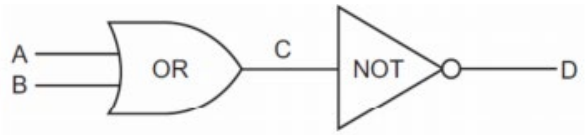
1.3.3 Logic Gates and Logic Circuits

A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			

[4]

Oct/NOV 2012. P12

10 (a) (i) Complete the truth table for this logic circuit. **[1]**

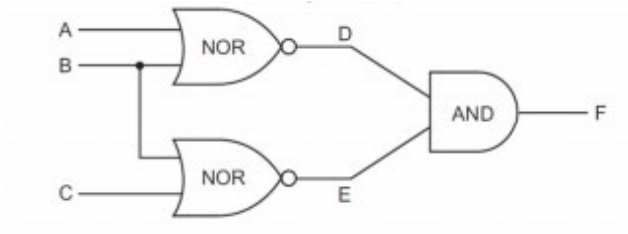


A	B	C	D
0	0		
0	1		
1	0		
1	1		

(ii) State a single logic gate which would have the same final outcome as this pair of logic gates. **[1]**

(b) Complete the truth table for this logic circuit.

1.3.3 Logic Gates and Logic Circuits

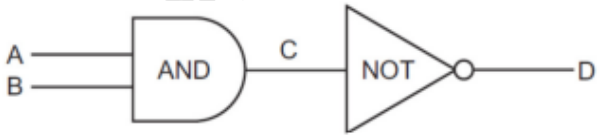


A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			

[4]

Oct/NOV 2012. P13

10 (a) (i) Complete the truth table for this logic circuit.



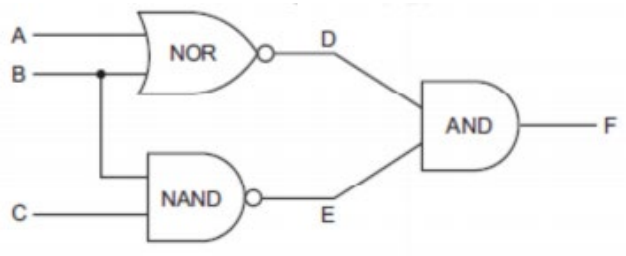
A	B	C	D
0	0		
0	1		
1	0		
1	1		

1.3.3 Logic Gates and Logic Circuits

[1]

(ii) State a single logic gate which would have the same final outcome as this pair of logic gates. **[1]**

(b) Complete the truth table for this logic circuit.



A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			

[4]

May/June 2013. P11/P12

9 (a) Draw the logic circuit corresponding to the following logic statement:

X = 1 IF (A is 1 AND B is 1) OR (B is 1 OR C is NOT 1)

1.3.3 Logic Gates and Logic Circuits

[4]

(b) Complete the truth table for the above logic statement:

A	B	C	Working Space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

1.3.3 Logic Gates and Logic Circuits

May/June 2013. P13

6 (a) Draw the logic circuit corresponding to the following logic statement:

X = 1 IF ((A is NOT 1 AND B is 1) OR (B is 1 AND C is 1)) OR (C is 1)

[5]

1.3.3 Logic Gates and Logic Circuits

(b) Complete the truth table for the above logic statement:

A	B	C	Working Space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

1.3.3 Logic Gates and Logic Circuits

Oct/NOV 2013. P11

4 (a) Draw the logic circuit that directly corresponds to the following logic statement:

X = 1 IF (A is NOT 1 OR B is 1) AND (B is 1 OR C is 1)

[4]

(b) Complete the truth table for the above logic statement

A	B	C	Working Space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

Oct/NOV 2013. P12

6 A combination of three lights is to be shown in a set sequence at a rock music concert. The three lights are red (R), green (G) and yellow (Y). The sequence is as follows:

- red only for 3 seconds
- red and green for 1 second
- yellow only for 3 seconds
- green only for 1 second

A counter is used which consists of three bits (A, B and C). The counter is incremented every second and recycles continually.

A logic circuit is to be built to generate the sequence of lights. A Boolean value of 1 represents the light switched on. The lighting sequence starts with red only.

(a) Complete the truth table for the sequence of lights:

1.3.3 Logic Gates and Logic Circuits

counter values			coloured lights (output)		
A	B	C	R	G	Y
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

[4]

1.3.3 Logic Gates and Logic Circuits

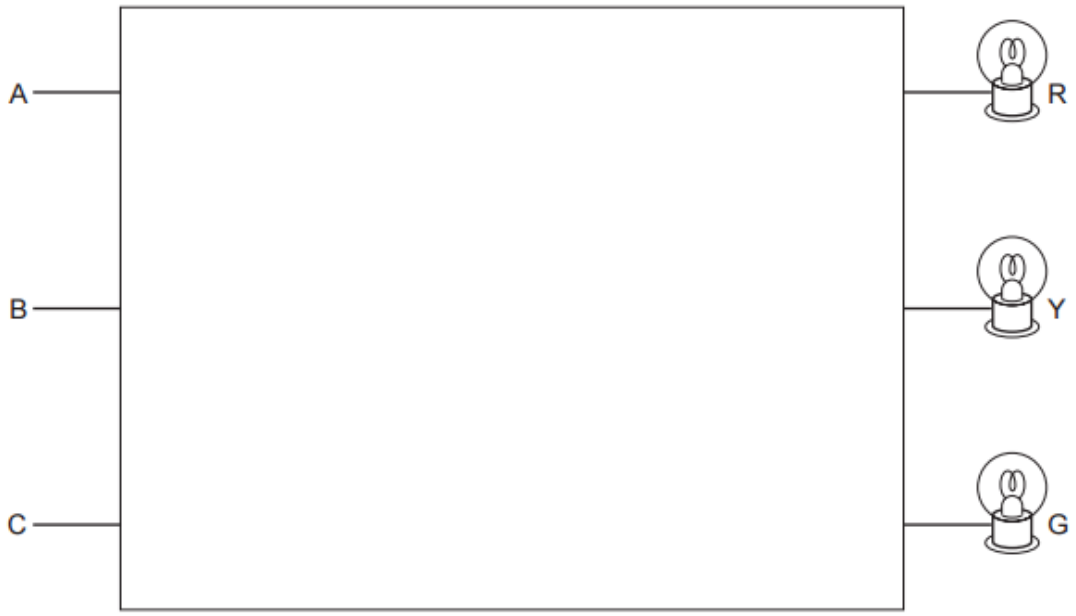
(b) The following three logic statements define the light sequence:

• R = 1 IF (A is NOT 1)

• G = 1 IF (B is 1 AND C is 1)

• Y = 1 IF (A is 1 AND NOT (B is 1 AND C is 1))

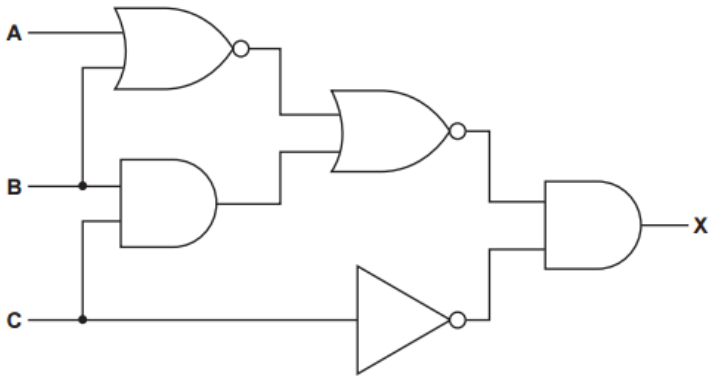
Draw the logic circuit that directly combines ALL three of these logic statements and produces **three** outputs R, G and Y.



[5]

Oct/NOV 2013. P13

8 (a) Complete the truth table for the following logic circuit.



1.3.3 Logic Gates and Logic Circuits

A	B	C	Working Space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

(b) Draw the logic circuit which corresponds to the following logic statement.

X = 1 IF (A is NOT 1 OR B is NOT 1) OR (B is 1 AND C is 1)

[5]

1.3.3 Logic Gates and Logic Circuits

May/June 2014. P11/ P12

8 A car has an engine management system (EMS). The EMS outputs the following signals

signal	value	description
A	0	temperature within limits
	1	temperature too high (fault condition)
B	0	pressure within limits
	1	pressure too high (fault condition)
C	0	carbon emissions within limits
	1	carbon emissions too high (fault condition)

(a) (i) Draw a logic circuit for the following fault condition:

All three signals (A = 1, B = 1 and C = 1) indicate a fault. The driver is warned to stop the engine – output X = 1.

[2]

(ii) Draw a logic circuit for the fault condition:

1.3.3 Logic Gates and Logic Circuits

Either (A = 1 and B = 1) or (B = 1 and C = 1) indicate a fault. The driver is warned that the engine needs a service – output Y = 1.

[2]

1.3.3 Logic Gates and Logic Circuits

(iii) Draw a logic circuit for the fault condition:

Either A = 1 or B = 1 or C = 1 indicate a fault. A red warning light shows up on the dashboard – output Z = 1.

[2]

(b) Complete the truth table for the three fault conditions:

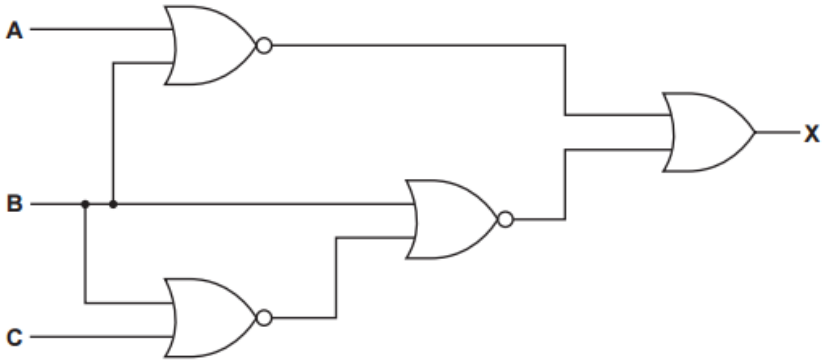
A	B	C	Working Space	X	Y	Z
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

[6]

1.3.3 Logic Gates and Logic Circuits

May/June 2014. P13

8 (a) Complete the truth table for the following logic circuit:



A	B	C	Working Space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

1.3.3 Logic Gates and Logic Circuits

(b) Draw a logic circuit corresponding to the following logic statement:

X = 1 if (A = **NOT** 1 **OR** B = 1) **AND** (B = **NOT** 1 **AND** C = **NOT** 1)

[6]

Oct/Nov 2014. P11/ P13

6 A wind turbine must shut down when certain conditions are met.

The three variables and the conditions which dictate their values are shown in the table:

variable		binary value	condition
name	**description**		
W	wind speed	1	wind speed ⩾ 100 kilometres per hour (kph)
		0	wind speed < 100 kilometres per hour (kph)
P	oil pressure	1	oil pressure **low**
		0	oil pressure **normal**
T	motor temperature	1	motor temperature ⩾ 50 °C
		0	motor temperature < 50 °C

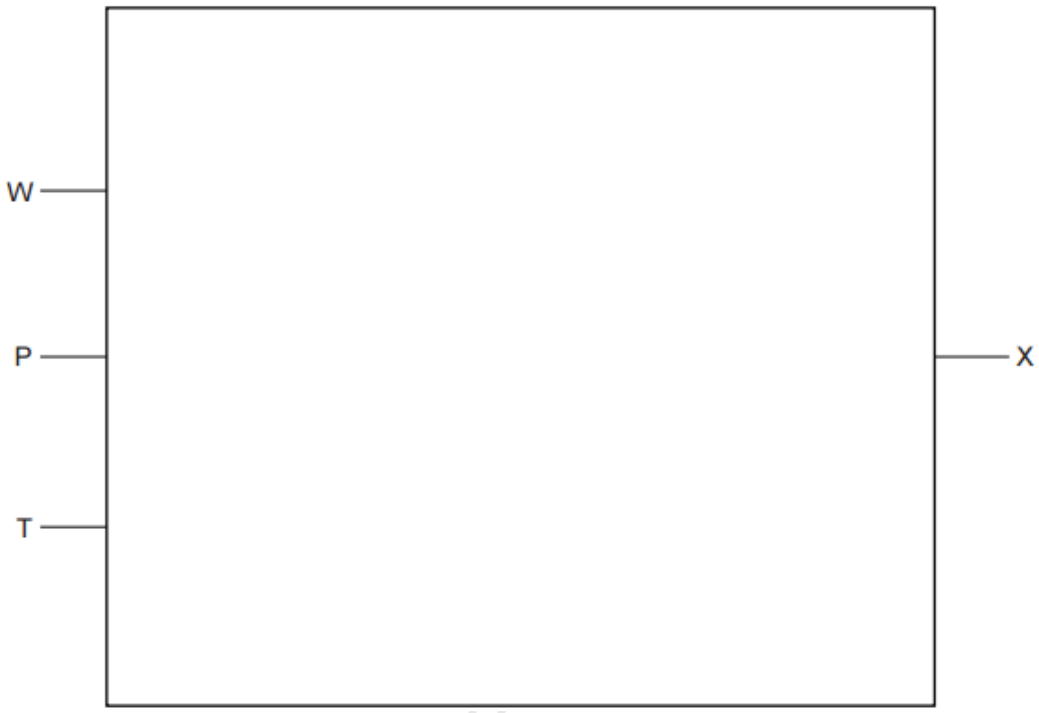
A logic circuit is to be designed where the output, **X**, is 1 if:

1.3.3 Logic Gates and Logic Circuits

either wind speed 100 kph and oil pressure normal

or motor temperature 50°C and oil pressure low

or wind speed 100 kph and motor temperature 50°C (a) Draw a logic circuit.



[7]

1.3.3 Logic Gates and Logic Circuits

(b) Complete the truth table for this system:

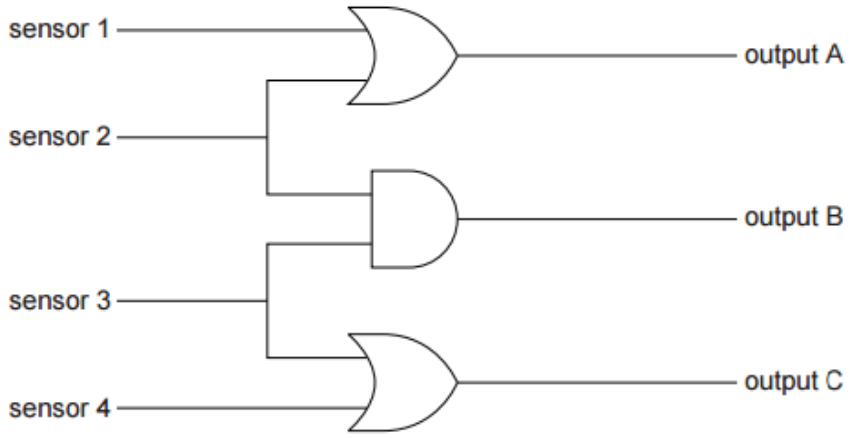
W	P	T	Work	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

Oct/Nov 2014. P12

7 Four sensors (numbered 1 to 4) produce binary output which controls the lights at a rock concert.

The diagram shows how the sensors are connected:



1.3.3 Logic Gates and Logic Circuits

(a) Complete the truth table for this logic circuit

inputs				outputs		
sensor 1	sensor 2	sensor 3	sensor 4	A	B	C
0	0	0	0			
0	0	0	1			
0	0	1	0			
0	0	1	1			
0	1	0	0			
0	1	0	1			
0	1	1	0			
0	1	1	1			
1	0	0	0			
1	0	0	1			
1	0	1	0			
1	0	1	1			
1	1	0	0			
1	1	0	1			
1	1	1	0			
1	1	1	1			

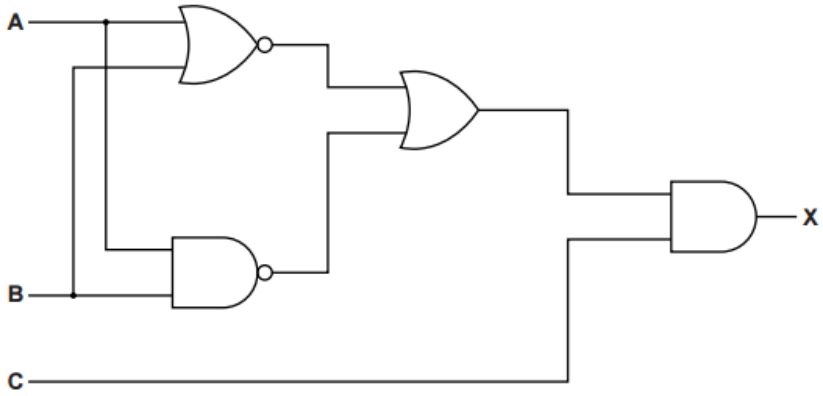
[4]

1.3.3 Logic Gates and Logic Circuits

May/June 2015.P11

6 The following logic circuit is used to monitor part of a chemical process. A, B and C are binary values input to the logic circuit from the chemical process.

X is the binary value output from the logic circuit.



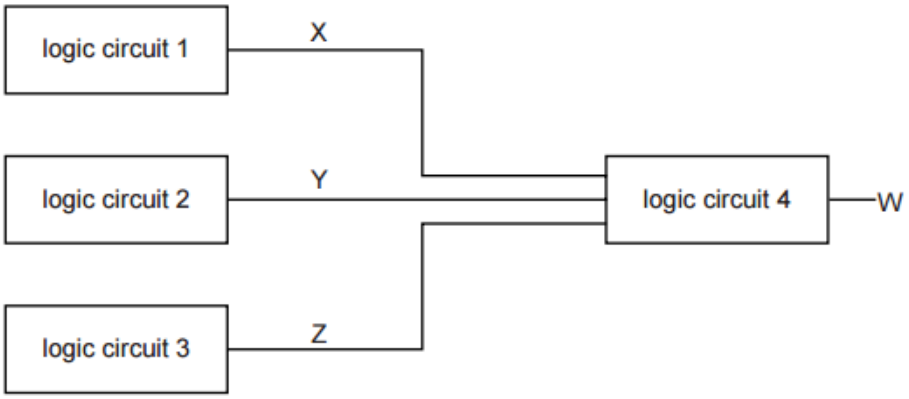
(a) Complete the truth table for this logic circuit.

A	B	C	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

1.3.3 Logic Gates and Logic Circuits

(e) There are three parts of the chemical process being monitored. Each part is monitored by its own logic circuit.



A fourth logic circuit has X, Y and Z as inputs. The output, W, determines whether or not the chemical process should be stopped.

W has a value of 1 if:

(X = 1 OR Y = 1) OR (Y = 1 AND Z = 0)

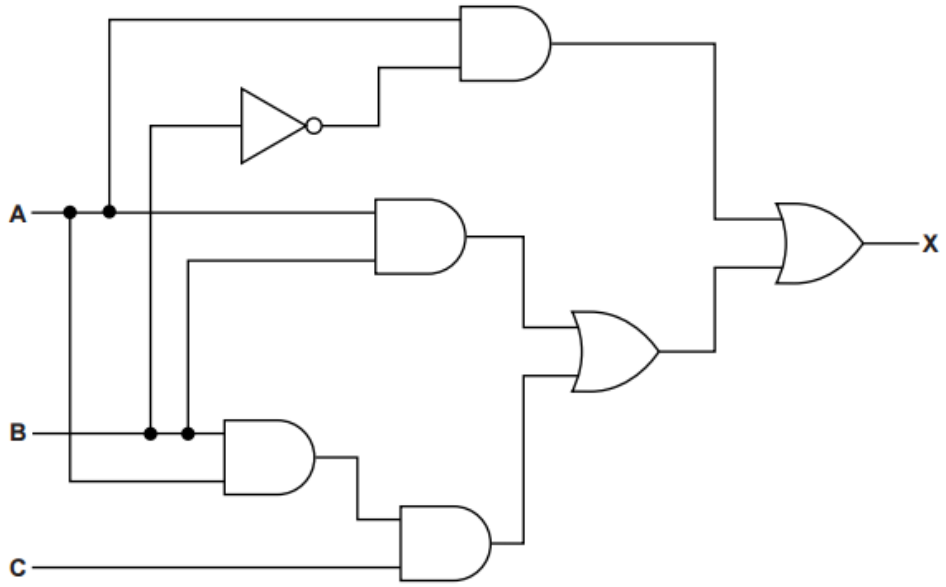
Draw a logic circuit to represent the above process.

[4]

1.3.3 Logic Gates and Logic Circuits

May/June 2015.P12

8 (a) A student, in an electronics lesson, built the following circuit.



(i) Complete the truth table for this logic circuit

Inputs			Working space	Output
A	B	C		X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

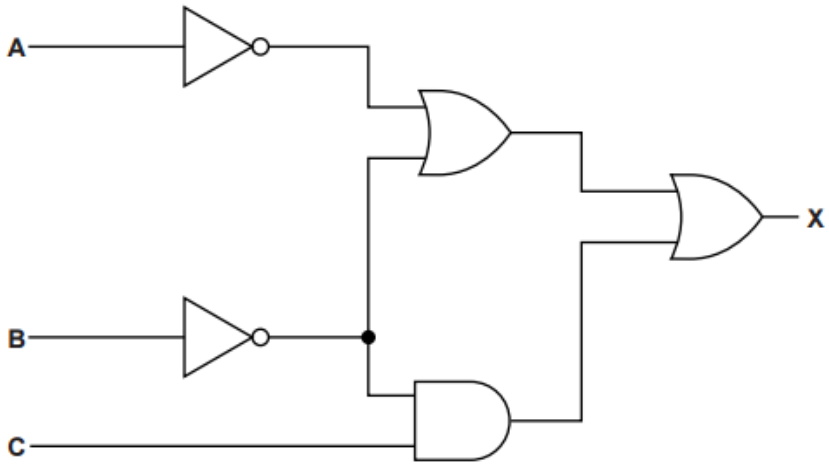
[4]

1.3.3 Logic Gates and Logic Circuits

(ii) Study the output in your answer to part (a)(i).

State what could replace this whole logic circuit. **[1]**

(b) Write a logic expression to represent the following logic circuit.



[3]

May/June 2015.P13

4 A safety monitoring system uses three inputs S, T and G. These inputs are used in a logic circuit which produces an output value, X.

The description of each input is shown in the table.

Parameter	Description	Binary value	Conditions
S	sound level	1	sound level >= 90 dB
		0	sound level < 90 dB
T	temperature	1	temperature >= 35°C
		0	temperature < 35°C
G	oxygen level	1	oxygen level >= 75%
		0	oxygen level < 75%

1.3.3 Logic Gates and Logic Circuits

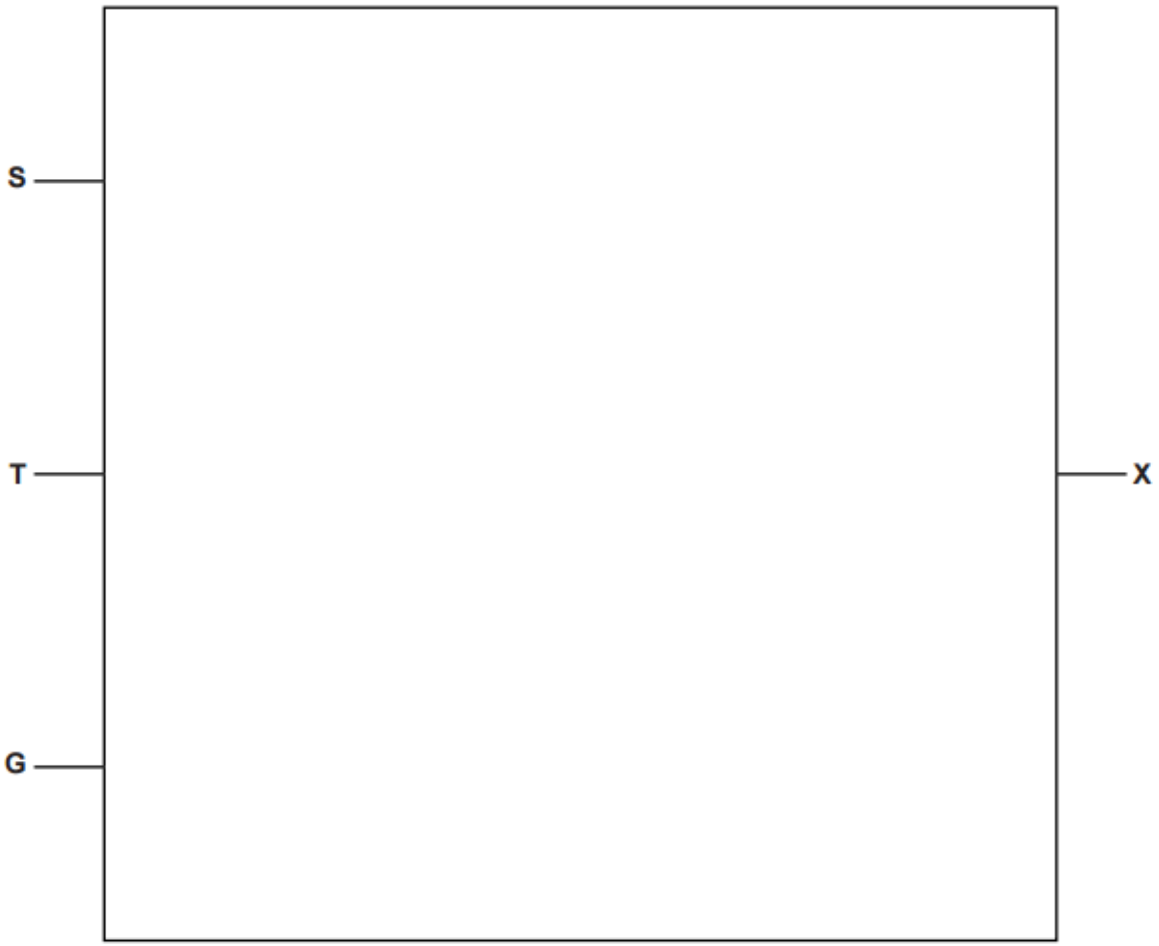
X has the value 1, if:

either sound level >= 90 dB **and** temperature >= 35°C

or temperature >= 35°C **and** oxygen level < 75%

or sound level < 90 dB **and** oxygen level >= 75%

(a) Draw a logic circuit to represent the above safety system.



[7]

1.3.3 Logic Gates and Logic Circuits

(b) Complete the truth table for this safety system

Inputs			Workspace	Output X
S	T	G		
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

1.3.3 Logic Gates and Logic Circuits

Computer Science (9608)

May/June 2015.P11/ P12

7 A system is monitored using sensors. The sensors output binary values corresponding to physical conditions, as shown in the table:

Parameter	Description of parameter	Binary value	Description of condition
P	oil pressure	1	pressure >= 3 bar
		0	pressure < 3 bar
T	temperature	1	temperature >= 200°C
		0	temperature < 200°C
R	rotation	1	rotation <= 1000 revs per minute (rpm)
		0	rotation > 1000 revs per minute (rpm)

The outputs of the sensors form the inputs to a logic circuit. The output from the circuit, X, is 1 if any of the following three conditions occur:

either oil pressure >= 3 bar **and** temperature >= 200°C

or oil pressure < 3 bar **and** rotation > 1000 rpm

or temperature >= 200°C **and** rotation > 1000 rpm

(a) Draw a logic circuit to represent the above system.

[5]

(b) Complete the truth table for this system.

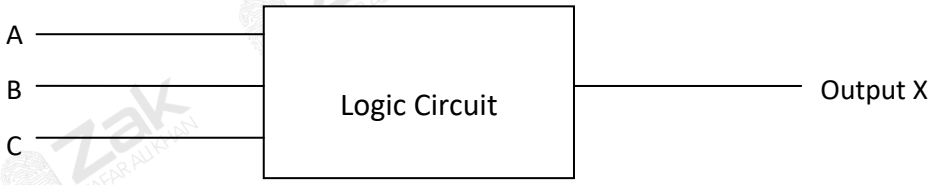
P	T	R	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

May/June 2015.P13

6 (a) Three digital sensors A, B and C are used to monitor a process. The outputs from the sensors are used as the inputs to a logic circuit.

A signal, X, is output from the logic circuit:



Output, X, has a value of 1 if either of the following two conditions occur:

- sensor A outputs the value 1 OR sensor B outputs the value 0
- sensor B outputs the value 1 AND sensor C outputs the value 0

Draw a logic circuit to represent these conditions.

1.3.3 Logic Gates and Logic Circuits

[5]

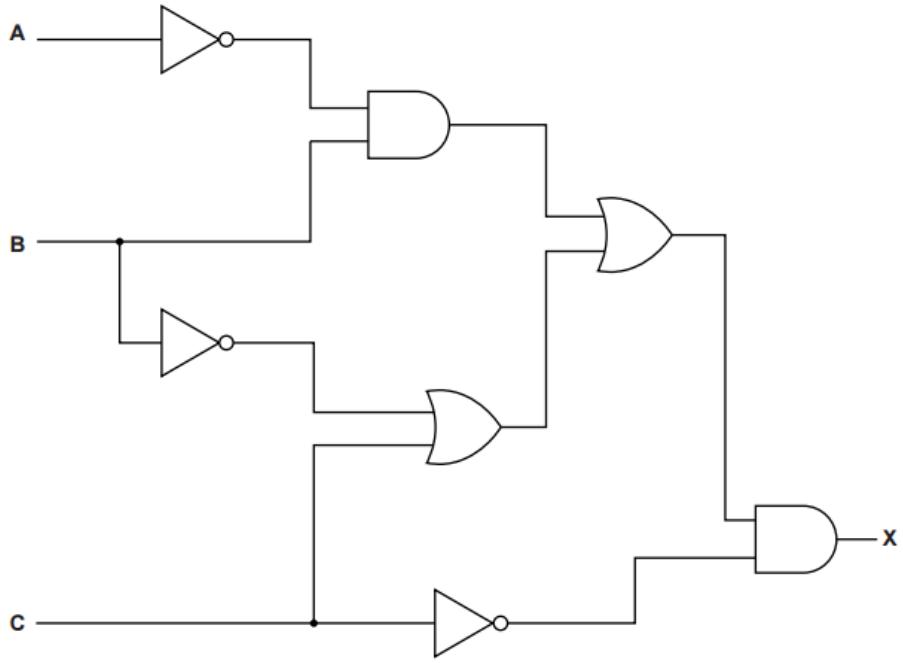
(b) Complete the truth table for the logic circuit described in part (a).

A	B	C	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

(c) Write a logic statement that describes the following logic circuit.

1.3.3 Logic Gates and Logic Circuits

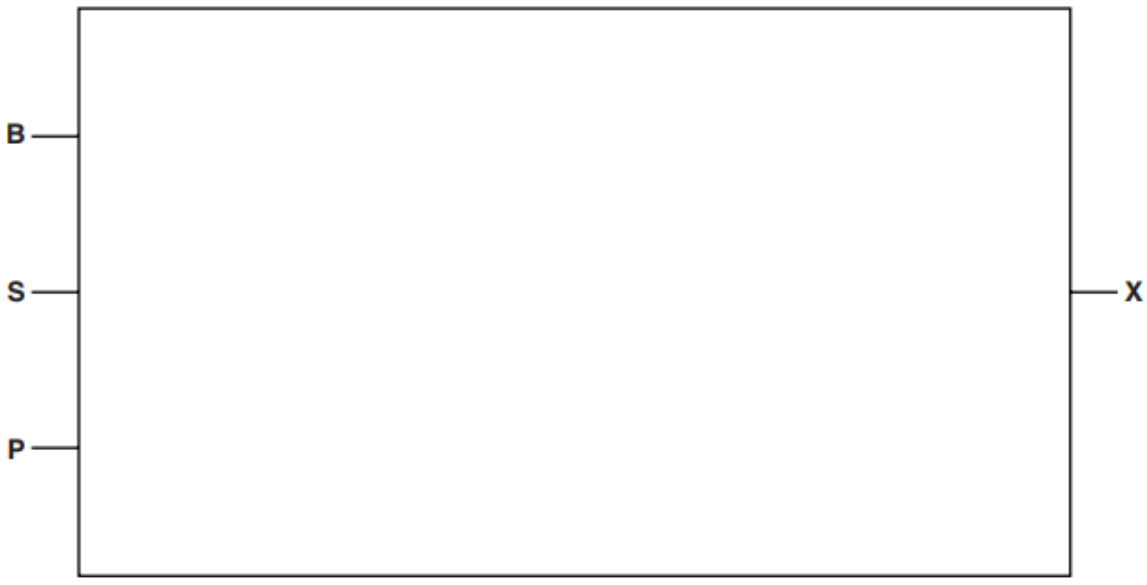


[3]

Oct/Nov 2015. P12

6 (a) A student wrote the following logic statement:

X is 1 if (B is NOT 1 AND S is NOT 1) OR (P is NOT 1 AND S is 1)
Draw a logic circuit to represent the above logic statement.



[6]

(b) Complete the truth table for this system.

B	S	P	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

May/June 2016. P11/ P12

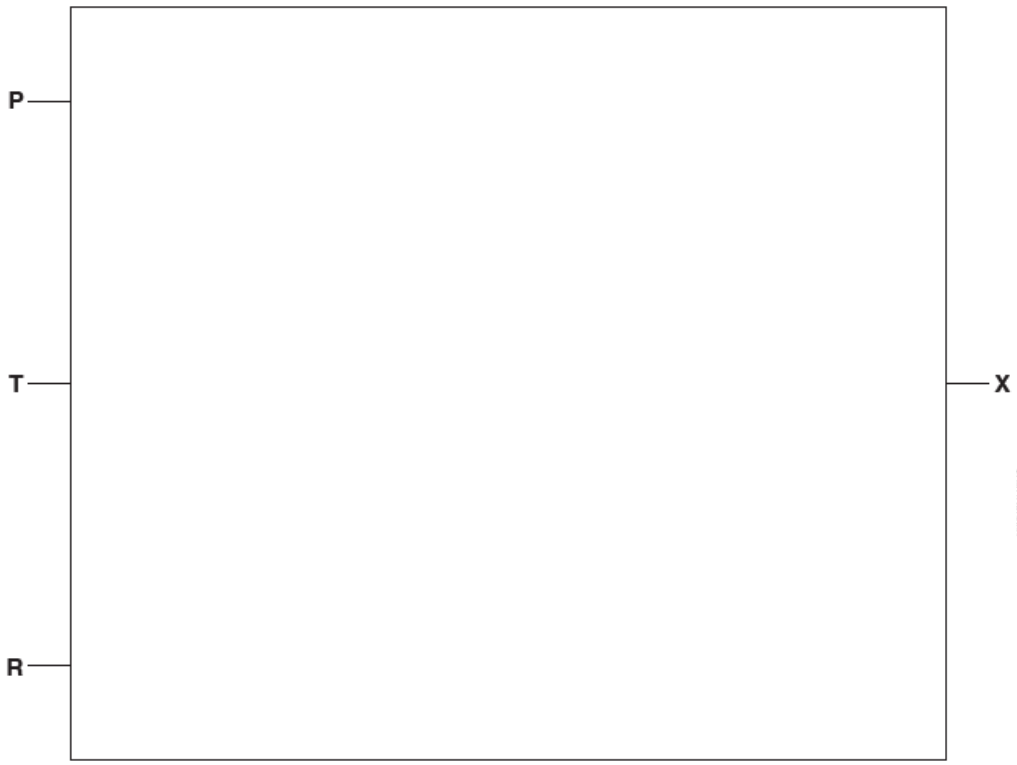
7 A system is monitored using sensors. The sensors output binary values corresponding to physical conditions, as shown in the table:

Parameter	Description of parameter	Binary value	Description of condition
P	oil pressure	1	pressure >= 3 bar
		0	pressure < 3 bar
T	temperature	1	temperature >= 200°C
		0	temperature < 200°C
R	rotation	1	rotation <= 1000 revs per minute (rpm)
		0	rotation > 1000 revs per minute (rpm)

The outputs of the sensors form the inputs to a logic circuit. The output from the circuit, X, is 1 if any of the following three conditions occur:
either oil pressure >= 3 bar **and** temperature >= 200°C
or oil pressure < 3 bar **and** rotation > 1000 rpm
or temperature >= 200°C **and** rotation > 1000 rpm

1.3.3 Logic Gates and Logic Circuits

(a) Draw a logic circuit to represent the above system.



[5]

(b) Complete the truth table for this system.

P	T	R	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

Oct/Nov 2016. P11/P13

5 A motor is controlled by a logic circuit. The circuit has inputs (0 or 1) from three sensors R, T and W. The motor is switched off when the output from the logic circuit is 1.

1.3.3 Logic Gates and Logic Circuits

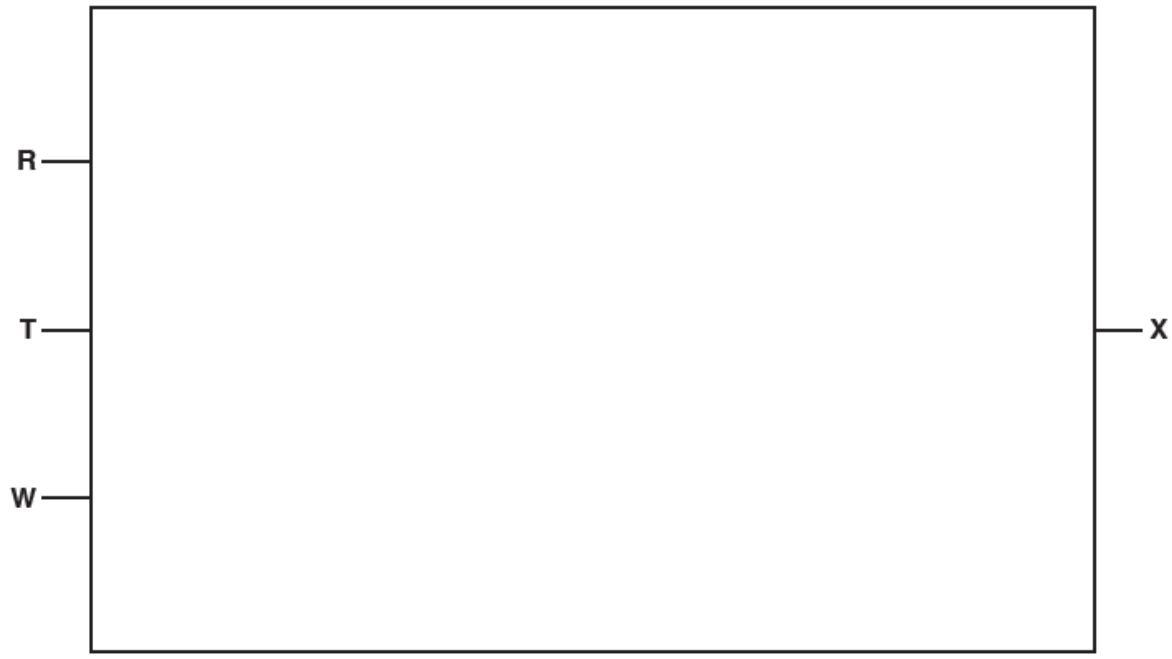
The following table shows the three sensors and the conditions being monitored.

Sensor	Description	Binary value	Condition
R	rotation	0	rotation < 4000 rpm
		1	rotation >= 4000 rpm
T	temperature	0	temperature >= 90 °C
		1	temperature < 90 °C
W	water flow rate	0	water flow rate >= 50 litre/min
		1	water flow rate < 50 litre/min

The output, X, is 1 if:

temperature >= 90 °C and rotation >= 4000 rpm
or
temperature < 90 °C and water flow rate >= 50 litre/min

(i) Draw a corresponding logic circuit.



[5]

(ii) Give a logic statement corresponding to the logic circuit in part **(i)**. **[2]**

(iii) Complete the truth table for this system.

1.3.3 Logic Gates and Logic Circuits

INPUT			Workspace	OUTPUT
R	T	W		X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

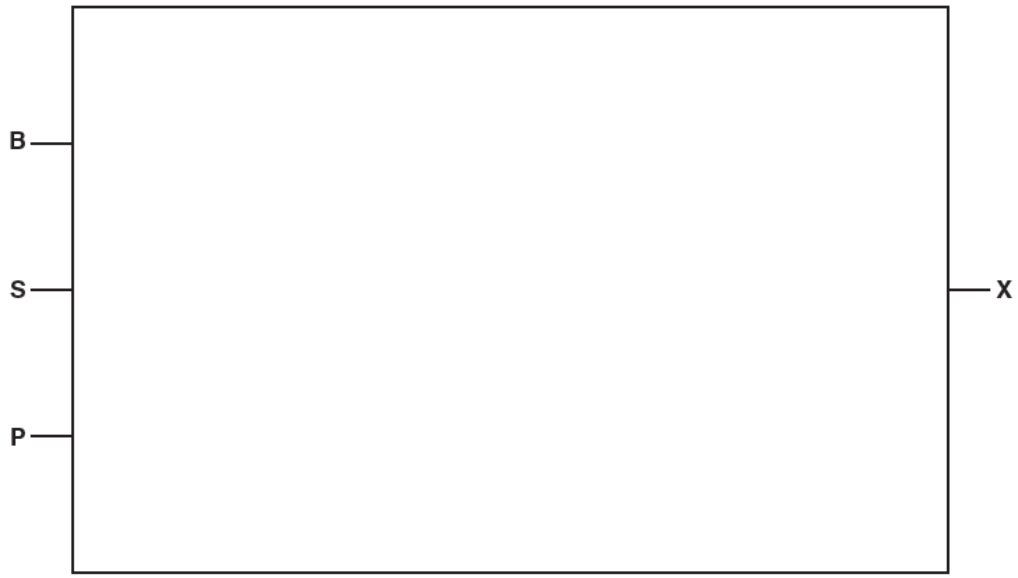
[4]

Oct/Nov 2016. P12

1 (a) A student writes the following logic expression:

X is 1 IF (B is NOT 1 AND S is NOT 1) OR (P is NOT 1 AND S is 1)

Draw a logic circuit to represent this logic expression.
Do not attempt to simplify the logic expression.



[6]

(b) Complete the truth table for the logic expression given in **part (a)**.

1.3.3 Logic Gates and Logic Circuits

B	S	P	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

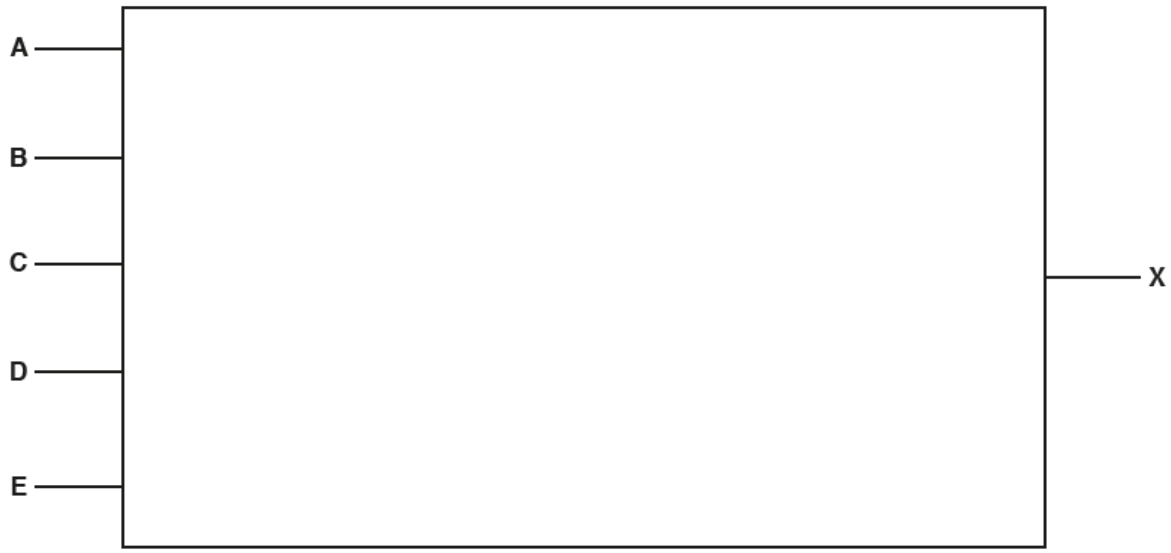
May/June 2018. P11

4 (a) An alarm system (X) is enabled and disabled using either a switch (A) or a remote control (B). There are **two** infra-red sensors (C, D) and **one** door pressure sensor (E).

Parameter	Description of parameter	Binary value	Condition
A	Switch	1	Switch enabled
		0	Switch disabled
B	Remote control	1	Remote enabled
		0	Remote disabled
C	Infra-red sensor	1	Activated
		0	Not activated
D	Infra-red sensor	1	Activated
		0	Not activated
E	Door pressure sensor	1	Activated
		0	Not activated

The alarm sounds (X = 1) if the alarm is enabled **and** any one or more of the sensors is activated.
Draw a logic circuit to represent the alarm system.

1.3.3 Logic Gates and Logic Circuits



[3]

(b) Complete the truth table for the logic expression: **X** = **A** OR (**B** XOR **C**)

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]