

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education  
Winter 2003



**PHYSICS (MODULAR)**  
**Physics in Action (Module 23)**

**346023**

Thursday 27 November 2003 Morning Session

**In addition to this paper you will require:**

- a black ball-point pen;
- an answer sheet.

You may use a calculator.

Time allowed: 30 minutes

**Instructions**

- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title “Physics in Action” printed on it.
- Attempt **one Tier only, either** the Foundation Tier **or** the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only. Rough work may be done on the question paper.

**Instructions for recording answers**

- Use a **black ball-point pen**.

- For each answer **completely fill in the circle** as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

- Do **not** extend beyond the circles.

- If you want to change your answer, **you must** cross out your original answer, as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown:
 

1	2	3	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

**Information**

- The maximum mark for this paper is 36.

**Advice**

- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

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You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.  
The Higher Tier starts on page 16 of this booklet.

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**FOUNDATION TIER**

**SECTION A**

Questions **ONE** to **FIVE**.

In these questions match the words in the list with the numbers.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

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**QUESTION ONE**

Match electrical devices from the list with the numbers **1–4** in the table.

**LED**

**LDR**

**motor**

**relay**

<b>Device</b>	<b>What the electrical device does</b>
<b>1</b>	detects changes in light
<b>2</b>	enables one circuit to control another
<b>3</b>	produces light
<b>4</b>	produces movement

**QUESTION TWO**

Electronic systems contain different types of device.

Match devices from the list with the numbers **1–4** in the table.

**input sensor**

**output device**

**processor**

**relay**

Device	Description
<b>1</b>	could be a motor
<b>2</b>	detects changes in the environment
<b>3</b>	makes decisions on action to take
<b>4</b>	used as a switch

**QUESTION THREE**

Match words from the list with the numbers **1–4** in the sentences.

**heaters**

**NOT gates**

**thermistors**

**variable resistors**

..... **1** ..... are used in processors.

..... **2** ..... can control the current in a circuit.

..... **3** ..... detect changes in temperature.

..... **4** ..... can be used as output devices.

**Turn over ►**

**QUESTION FOUR**


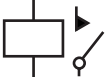


Match words from the list with the numbers **1–4** in the table.

**capacitor**

**LED**

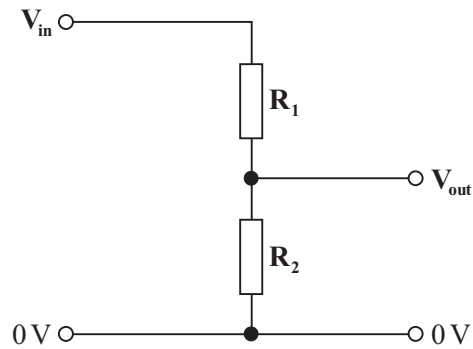
**OR gate**

**relay**

	Symbol
1	
2	
3	
4	

**QUESTION FIVE**

The diagram shows a device used in electronic circuits.



Match words from the list with the spaces **1–4** in the sentences.

**control system**

**potential divider**

**processor**

**variable resistor**

The device shown is a . . . . . **1** . . . . . circuit. It is part of an electronic . . . . . **2** . . . . .

If  $R_1$  is the input sensor,  $R_2$  will be a . . . . . **3** . . . . .

The voltage labelled  $V_{out}$  is fed to a . . . . . **4** . . . . .

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**SECTION B**Questions **SIX** and **SEVEN**.In these questions choose the best **two** answers.Do **not** choose more than two.Mark your choices on the answer sheet.

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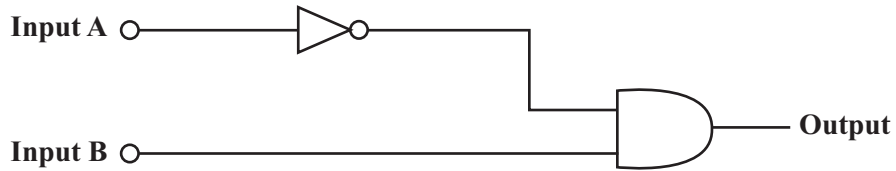
**QUESTION SIX**

Capacitors are components which are used in electronic circuits.

Which **two** of the following statements are **not** correct?**capacitors store charge****the greater the value of the capacitor, the quicker the capacitor charges up****the greater the resistance of a circuit, the longer the capacitor takes to charge****when a capacitor is charging, the voltage across it decreases****when a conductor is connected across a charged capacitor, a current flows**

**QUESTION SEVEN**

The diagram shows an electronic system.



A student completed this truth table for the system.

	Input A	Input B	Output
<b>W</b>	0	0	0
<b>X</b>	0	1	1
<b>Y</b>	1	0	0
<b>Z</b>	1	1	1

Which **two** of the following statements are correct?

**all the lines in the table are correct**

**lines W and Y are correct**

**lines X and Z are correct**

**line X is the only line which is wrong**

**line Z is the only line which is wrong**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**SECTION C**Questions **EIGHT** to **TEN**.

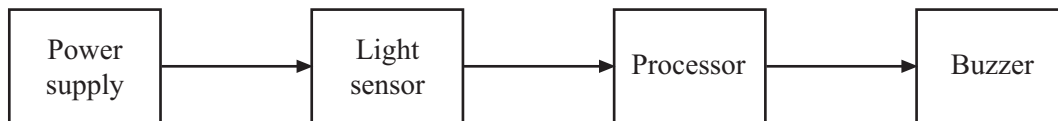
Each of these questions has four parts.

In each part choose only **one** answer.

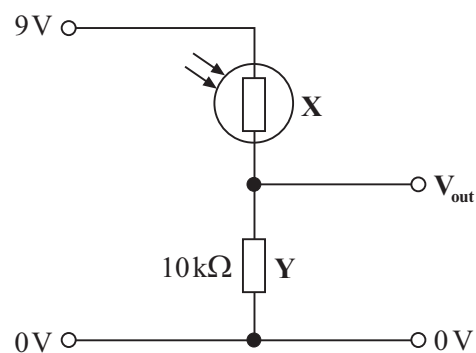
Mark your choices on the answer sheet.

**QUESTION EIGHT**

The diagram shows an electronic system to switch on a buzzer when a beam of light is interrupted.

**8.1** Which part of the system is the output device?

- A Buzzer
- B Light sensor
- C Power supply
- D Processor

**8.2** The system includes the following device.

Which part of the system includes the device shown?

- A Buzzer
- B Light sensor
- C Power supply
- D Processor



You may find the following formula useful when answering the next question.

$$V_{out} = V_{in} \times \frac{R_2}{(R_1 + R_2)}$$

**8.3** When light falls on component **X**, its resistance is 100 ohms.

What is the value of  $V_{out}$  when light falls on **X**?

- A 0.0 V
- B 0.9 V
- C 8.1 V
- D 8.9 V

**8.4** During testing, it is found that the system works the wrong way round.  
When the light shines on **X**, the buzzer is on and when the light beam is broken, the buzzer is off.

The system will work properly if you . . . . .

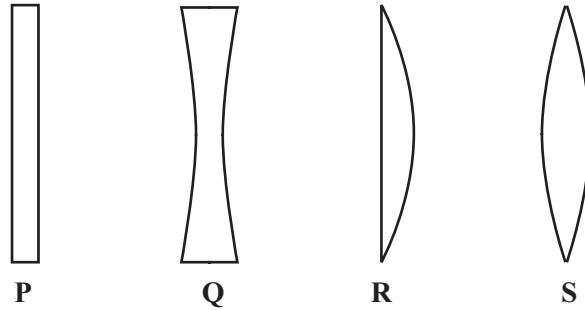
- A decrease the value of resistor **Y**.
- B increase the value of resistor **Y**.
- C insert a NOT gate between the light sensor and the processor.
- D insert a NOT gate between the power supply and the light sensor.

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION NINE**

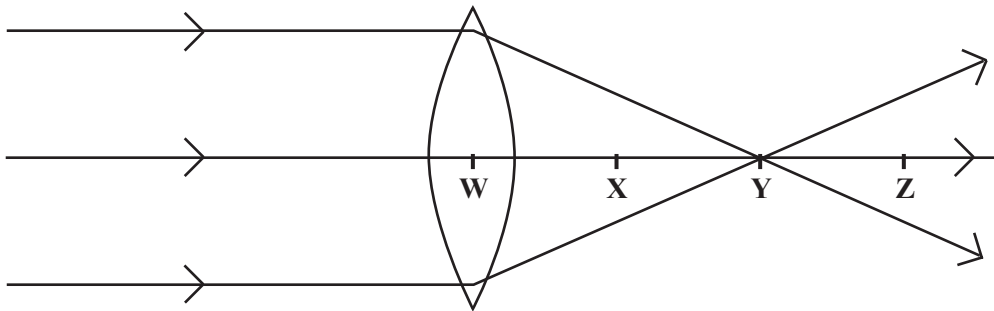
The diagram shows some pieces of glass.



**9.1** Which piece of glass is a diverging lens?

- A P
- B Q
- C R
- D S

**9.2** The diagram shows a parallel beam of light passing through a lens.



Which point is the focus of the lens?

- A W
- B X
- C Y
- D Z

**9.3** Images can be either real or virtual.

Which of the following statements about images is correct?

- A Rays of light only appear to pass through a virtual image, and it can form on a screen
- B Rays of light only appear to pass through a virtual image, and it cannot form on a screen
- C Rays of light pass through a real image, and it cannot form on a screen
- D Rays of light pass through a virtual image, and it cannot form on a screen

**9.4** A converging lens is used in a camera to produce an image of a distant object.

Which of the following statements is correct?

- A The image is real and larger than the object
- B The image is real and smaller than the object
- C The image is virtual and larger than the object
- D The image is virtual and smaller than the object

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

### QUESTION TEN

Some cars have an electronic system that causes a buzzer to sound when the driver switches on the ignition, without having the seatbelt fastened.

Figure 1 represents this system.

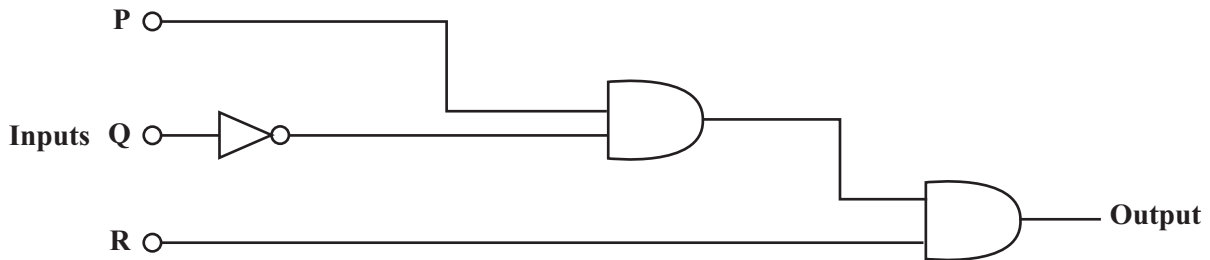


Figure 1

Inputs and outputs are represented by either **0** or **1**.

The inputs are all switches:

<b>P</b> is a switch under the seat.	<b>0</b> = seat not occupied	<b>1</b> = seat occupied
<b>Q</b> is a switch connected to the seatbelt.	<b>0</b> = seatbelt unfastened	<b>1</b> = seatbelt fastened
<b>R</b> is a switch connected to the ignition.	<b>0</b> = ignition off	<b>1</b> = ignition on

**10.1** The system runs off a 12 V battery.

Which of the following statements is **not** correct?

- A **0** represents a low voltage, and **1** a high voltage
- B **0** indicates OFF and **1** indicates ON
- C When checking with a voltmeter, **0** gives a 0 V reading and **1** a 12 V reading
- D When checking with a voltmeter, **0** gives a 12 V reading and **1** a 0 V reading

**10.2** A small current flows from the electronic system.

What must be placed between the electronic system and the buzzer?

- A An LDR
- B An LED
- C Nothing
- D A relay

**10.3** The incomplete truth table for the system is given below.

Input P	Input Q	Input R	Output
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Which are the correct figures for the output column?

<b>A</b>	0	<b>B</b>	0	<b>C</b>	0	<b>D</b>	0
	0		0		0		1
	0		0		0		0
	0		0		1		0
	0		0		0		0
	0		1		0		0
	0		0		0		0
	1		0		0		0

**QUESTION 10 CONTINUES ON THE NEXT PAGE**

**Turn over ►**

10.4 Figure 2 represents another system.

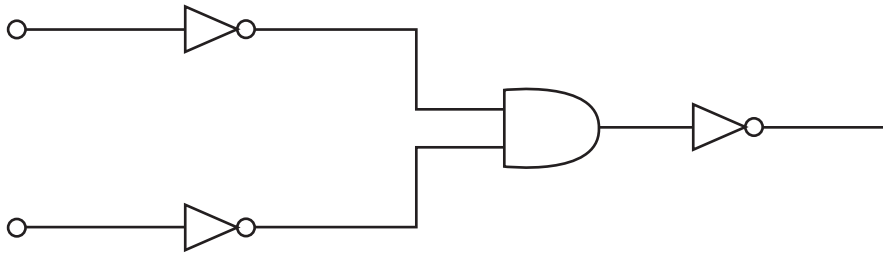


Figure 2

This would be the same as . . . . .

- A an AND gate.
- B a NOT gate.
- C an OR gate.
- D none of these.

END OF TEST

**NO QUESTIONS APPEAR ON THIS PAGE**

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.  
The Foundation Tier is earlier in this booklet.

### HIGHER TIER

#### SECTION A

Questions **ONE** and **TWO**.

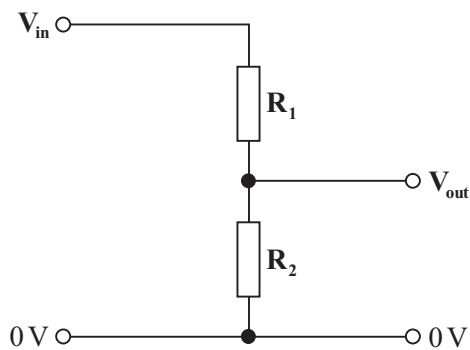
In these questions match the words in the list with the numbers.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

#### QUESTION ONE

The diagram shows a device used in electronic circuits.



Use words from the list to match the spaces **1–4** in the sentences.

**control system**

**potential divider**

**processor**

**variable resistor**

The device shown is a . . . . . **1** . . . . . circuit. It is part of an electronic . . . . . **2** . . . . .

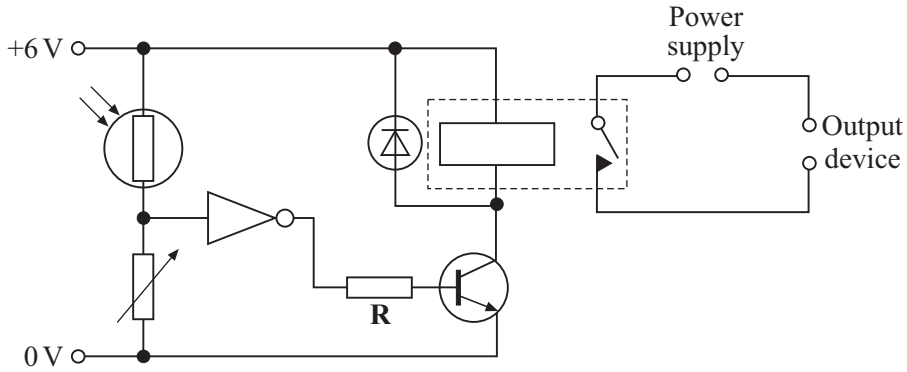
If  $R_1$  is the input sensor,  $R_2$  will be a . . . . . **3** . . . . .

The voltage labelled  $V_{out}$  is fed to a . . . . . **4** . . . . .



## QUESTION TWO

The circuit shown can be used as a switch.



Choose words from the list to match the numbers 1–4 in the sentences.

**current**

**input voltage**

**light intensity**

**resistance**

The . . . . . **1** . . . . . of the LDR changes with . . . . . **2** . . . . . .

This causes the share of the . . . . . **3** . . . . . to change as the light gets less.

As it gets darker, the input to the NOT gate changes from HIGH to LOW, causing the output from the NOT gate to change from LOW to HIGH.

A small . . . . . **4** . . . . . , limited by resistor **R**, then flows to the transistor, which switches ON.

**TURN OVER FOR THE NEXT QUESTION**

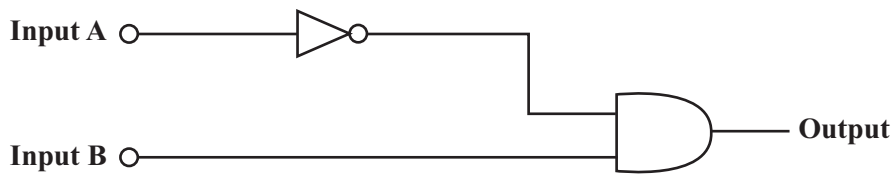
**Turn over ►**

**SECTION B**Questions **THREE** and **FOUR**.In these questions choose the best **two** answers.Do **not** choose more than two.

Mark your choices on the answer sheet.

**QUESTION THREE**

The diagram shows an electronic system.



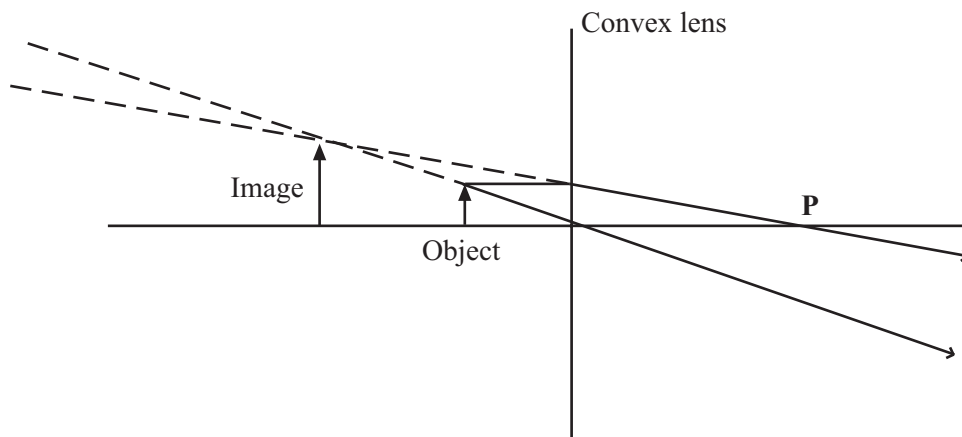
A student completed this truth table for the system.

	Input A	Input B	Output
<b>W</b>	0	0	0
<b>X</b>	0	1	1
<b>Y</b>	1	0	0
<b>Z</b>	1	1	1

Which **two** of the following statements are correct?**all the lines in the table are correct****lines W and Y are correct****lines X and Z are correct****line X is the only line which is wrong****line Z is the only line which is wrong**

**QUESTION FOUR**

The ray diagram shows what happens when an object is placed close to a convex lens.



Which **two** of the following statements are correct?

- the image can be formed on a screen**
- the image formed is smaller than the object**
- the point labelled P is the focus of the lens**
- the ray diagram shows a magnifying glass**
- the ray diagram shows the formation of a real image**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**SECTION C**Questions **FIVE** to **TEN**.

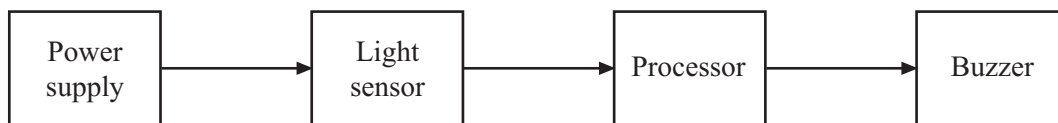
Each of these questions has four parts.

In each part choose only **one** answer.

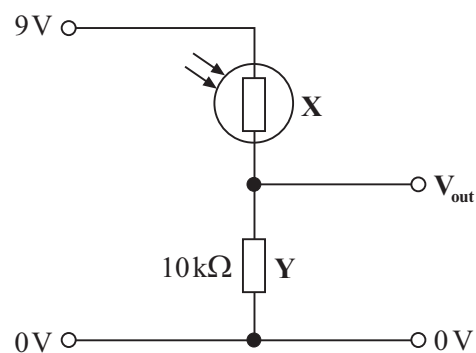
Mark your choices on the answer sheet.

**QUESTION FIVE**

The diagram shows an electronic system to switch on a buzzer when a beam of light is interrupted.

**5.1** Which part of the system is the output device?

- A Buzzer
- B Light sensor
- C Power supply
- D Processor

**5.2** The system includes the following device.

Which part of the system includes the device shown?

- A Buzzer
- B Light sensor
- C Power supply
- D Processor

You may find the following formula useful when answering the next question.

$$V_{out} = V_{in} \times \frac{R_2}{(R_1 + R_2)}$$

**5.3** When light falls on component **X**, its resistance is 100 ohms.

What is the value of  $V_{out}$  when light falls on **X**?

- A 0.0 V
- B 0.9 V
- C 8.1 V
- D 8.9 V

**5.4** During testing, it is found that the system works the wrong way round.  
When the light shines on **X**, the buzzer is on and when the light beam is broken, the buzzer is off.

The system will work properly if you . . . . .

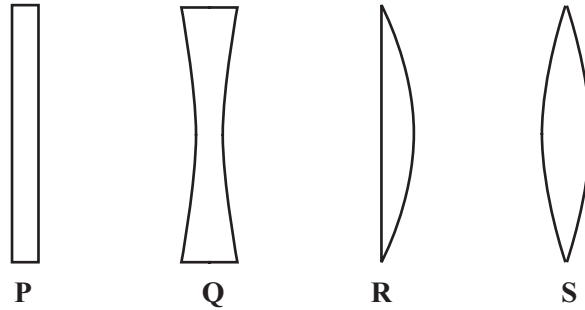
- A decrease the value of resistor **Y**.
- B increase the value of resistor **Y**.
- C insert a NOT gate between the light sensor and the processor.
- D insert a NOT gate between the power supply and the light sensor.

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION SIX**

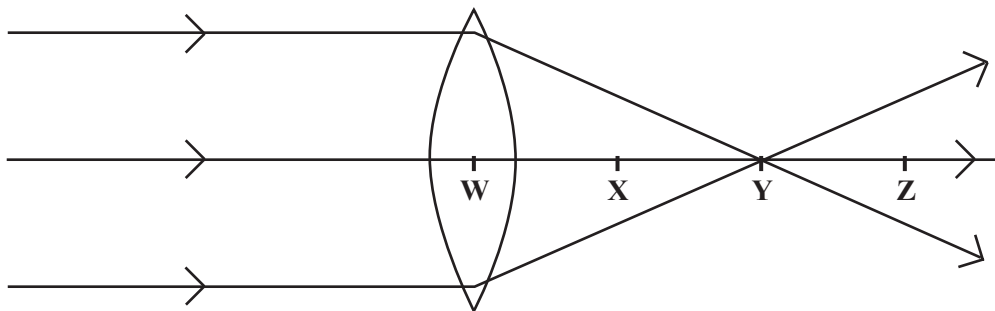
The diagram shows some pieces of glass.



**6.1** Which piece of glass is a diverging lens?

- A P
- B Q
- C R
- D S

**6.2** The diagram shows a parallel beam of light passing through a lens.



Which point is the focus of the lens?

- A W
- B X
- C Y
- D Z

**6.3** Images can be either real or virtual.

Which of the following statements about images is correct?

- A Rays of light only appear to pass through a virtual image, and it can form on a screen
- B Rays of light only appear to pass through a virtual image, and it cannot form on a screen
- C Rays of light pass through a real image, and it cannot form on a screen
- D Rays of light pass through a virtual image, and it cannot form on a screen

**6.4** A converging lens is used in a camera to produce an image of a distant object.

Which of the following statements is correct?

- A The image is real and larger than the object
- B The image is real and smaller than the object
- C The image is virtual and larger than the object
- D The image is virtual and smaller than the object

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

## QUESTION SEVEN

Some cars have an electronic system that causes a buzzer to sound when the driver switches on the ignition, without having the seatbelt fastened.

Figure 1 represents this system.

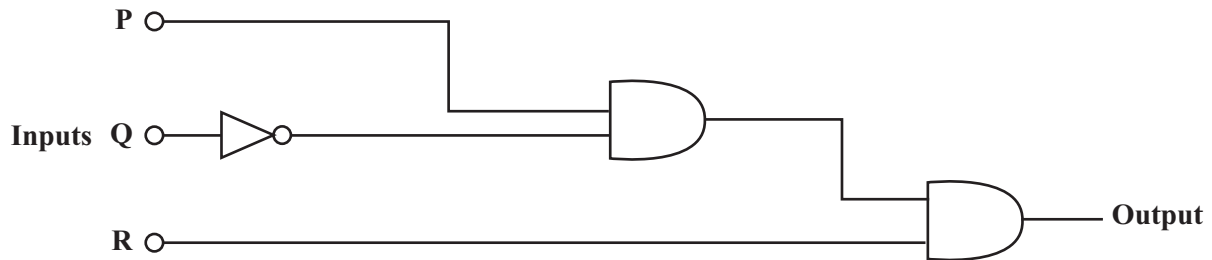


Figure 1

Inputs and outputs are represented by either **0** or **1**.

The inputs are all switches:

<b>P</b> is a switch under the seat.	<b>0</b> = seat not occupied	<b>1</b> = seat occupied
<b>Q</b> is a switch connected to the seatbelt.	<b>0</b> = seatbelt unfastened	<b>1</b> = seatbelt fastened
<b>R</b> is a switch connected to the ignition.	<b>0</b> = ignition off	<b>1</b> = ignition on

7.1 The system runs off a 12 V battery.

Which of the following statements is **not** correct?

- A **0** represents a low voltage, and **1** a high voltage
- B **0** indicates OFF and **1** indicates ON
- C When checking with a voltmeter, **0** gives a 0 V reading and **1** a 12 V reading
- D When checking with a voltmeter, **0** gives a 12 V reading and **1** a 0 V reading

7.2 A small current flows from the electronic system.

What must be placed between the electronic system and the buzzer?

- A An LDR
- B An LED
- C Nothing
- D A relay



7.3 The incomplete truth table for the system is given below.

Input P	Input Q	Input R	Output
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Which are the correct figures for the output column?

**A**

0
0
0
0
0
0
0
1

**B**

0
0
0
0
0
0
1
0
0

**C**

0
0
0
1
0
0
0
0

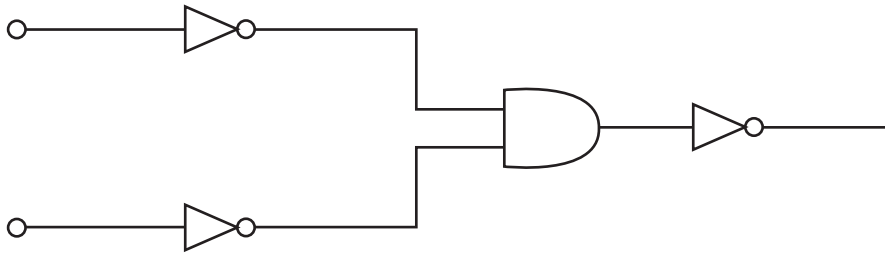
**D**

0
1
0
0
0
0
0
0

QUESTION 7 CONTINUES ON THE NEXT PAGE

Turn over ►

7.4 **Figure 2** represents another system.



**Figure 2**

This would be the same as . . . . .

- A an AND gate.
- B a NOT gate.
- C an OR gate.
- D none of these.

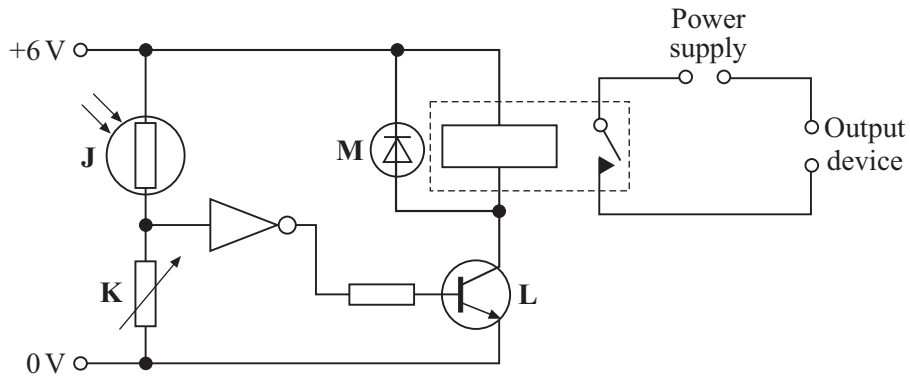
**NO QUESTIONS APPEAR ON THIS PAGE**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

## QUESTION EIGHT

The circuit shown can be used as a switch for street lights.



This circuit can be changed to act as a switch, to switch on a heater when the temperature falls.

**8.1** Which of the labelled components must be replaced?

- A J
- B K
- C L
- D M

**8.2** The component should be replaced by a . . . . .

- A heater.
- B LED.
- C resistor.
- D thermistor.

**8.3** Which of the labelled components acts as a switch?

- A J
- B K
- C L
- D M

**8.4** Which of the labelled components acts as protection when the relay is switched off?

**A J**

**B K**

**C L**

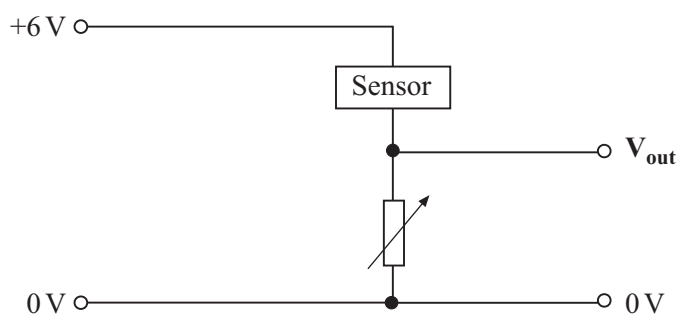
**D M**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION NINE**

The circuit shown has a variable resistor set to  $2000\ \Omega$ .  
The sensor resistance varies with changes in the environment.  
Initially the sensor resistance is  $1000\ \Omega$ .



You may find the following formula useful when answering this question.

$$V_{out} = V_{in} \times \frac{R_2}{(R_1 + R_2)}$$

**9.1** What is the value of  $V_{out}$ , the voltage (potential difference) across the output?

- A 2V
- B 4V
- C 6V
- D 9V

**9.2** What is the value of the voltage across the sensor?

- A 2V
- B 4V
- C 6V
- D 9V

**9.3** The conditions change, and the output voltage becomes 3 V. What is the new value of the sensor resistance?

**A** 1000  $\Omega$

**B** 1333  $\Omega$

**C** 2000  $\Omega$

**D** 4000  $\Omega$

**9.4** The sensor resistance is now 1000  $\Omega$ .

What value must the variable resistor be changed to for an output voltage of 1.5 V?

**A** 250  $\Omega$

**B** 333  $\Omega$

**C** 1250  $\Omega$

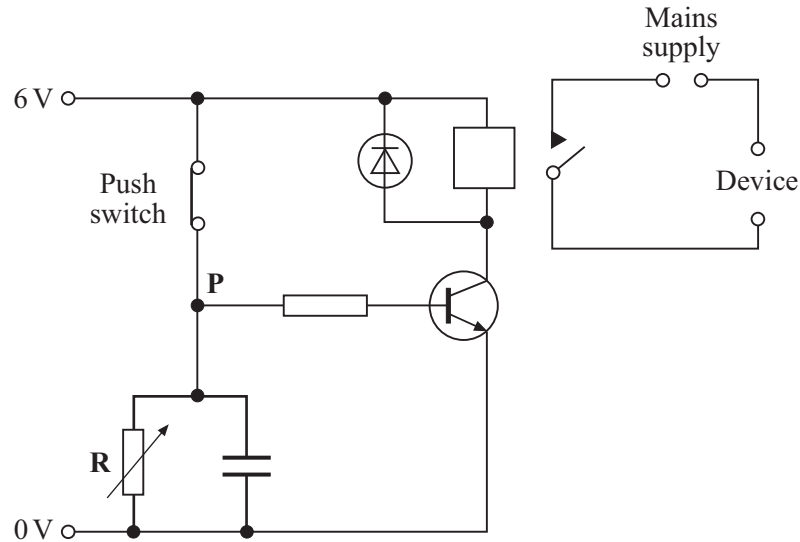
**D** 4000  $\Omega$

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

### QUESTION TEN

A device can be set to be on for different time intervals.  
The control circuit is shown below.



- 10.1** The transistor acts as a switch by . . . . .
- A closing when the relay switch opens.
  - B closing when the voltage input at **P** goes to low.
  - C opening when the voltage input at **P** goes to high.
  - D opening when the voltage input at **P** goes to low.
- 10.2** The relay switch closes and the device operates when . . . . .
- A the diode allows a current to flow to the transistor.
  - B the transistor does not allow a current to flow.
  - C the transistor switch turns off.
  - D the transistor switch turns on.
- 10.3** When the push switch is pressed, the voltage input at **P** goes to high and so the capacitor . . . . .
- A charges up.
  - B conducts a current.
  - C discharges.
  - D releases its stored charge.



**10.4** When the push switch is released, charge flows from the capacitor through the variable resistor **R**. When the input voltage at **P** reaches a certain value, the device switches off.

Which of the following changes is certain to increase the time for which the device is on?

- A** Decreasing the value of the capacitor **and** the resistor
- B** Decreasing the value of either the capacitor **or** the resistor
- C** Increasing the value of either the capacitor **or** the resistor
- D** Increasing the value of the capacitor **and** decreasing the value of the resistor

**END OF TEST**

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