

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Secondary Education  
Winter 2004



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

**346023**

Thursday 18 November 2004 Morning Session

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

- a 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 14 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.

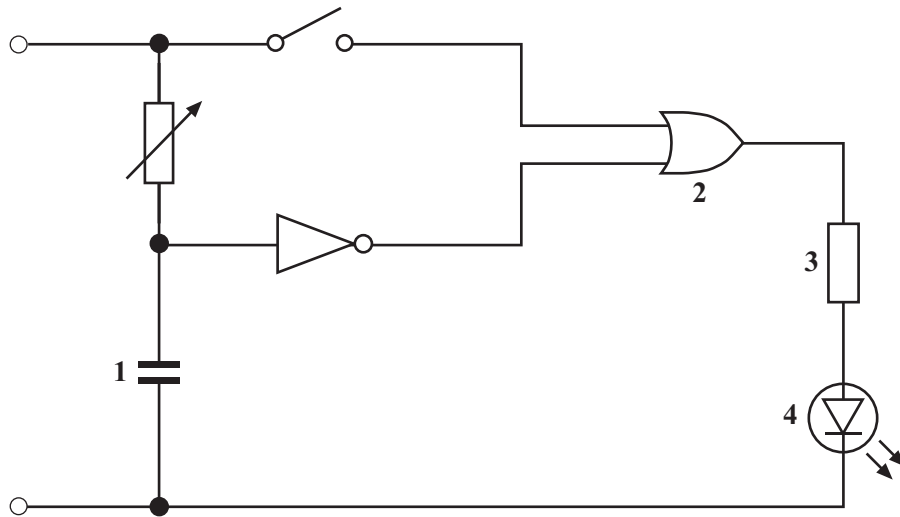
Use **each** answer only **once**.

Mark your choices on the answer sheet.

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#### QUESTION ONE

The diagram shows an electronic circuit.



Match components in the list with the symbols **1–4** in the circuit diagram.

**capacitor**

**LED**

**OR gate**

**resistor**

**QUESTION TWO**

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

**input sensors**

**logic gates**

**output devices**

**variable resistors**

The flow of electricity through circuits can be controlled using . . . . . **1** . . . . .

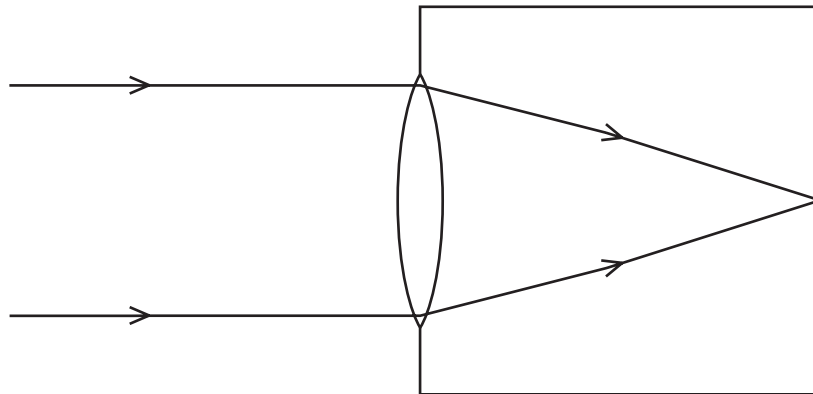
Electronic systems have . . . . . **2** . . . . . to detect changes in the environment.

Processors decide what action to take. Processors contain . . . . . **3** . . . . .

The processors control . . . . . **4** . . . . .

**QUESTION THREE**

The diagram shows two rays of light entering a simple camera.



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

**converging**

**film**

**focus**

**real**

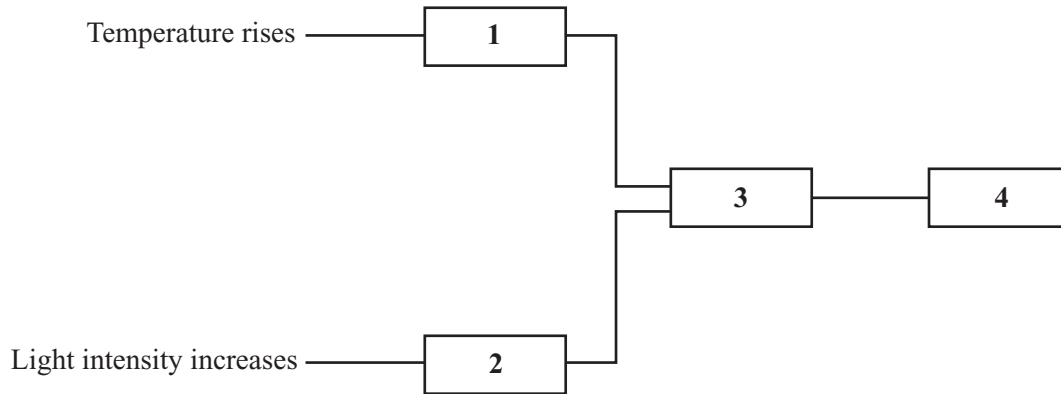
The camera uses a . . . . . **1** . . . . . lens to . . . . . **2** . . . . . the rays of light.

The image is . . . . . **3** . . . . . and is formed on the . . . . . **4** . . . . .

**Turn over** ►

**QUESTION FOUR**

A gardener has a warning system fitted in a greenhouse.  
It sounds a buzzer if the greenhouse becomes too hot.  
The system only works during daylight.



Match devices in the list with the stages **1–4** in the diagram.

**AND gate**

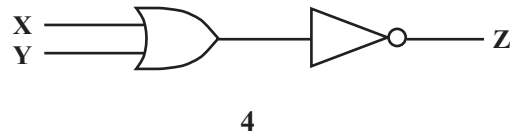
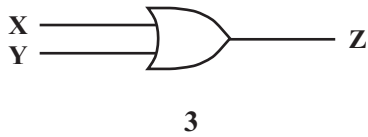
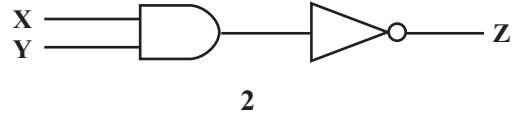
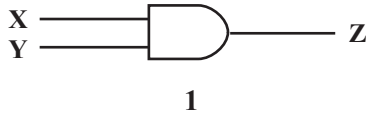
**buzzer**

**LDR**

**thermistor**

**QUESTION FIVE**

The diagrams show four different arrangements of logic gates.



Input X is always zero.

Match the truth tables P, Q, R and S with the arrangements 1–4.

	Input Y	Output Z
P	0	0
	1	0

	Input Y	Output Z
Q	0	0
	1	1

	Input Y	Output Z
R	0	1
	1	0

	Input Y	Output Z
S	0	1
	1	1

Turn over ►

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**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**

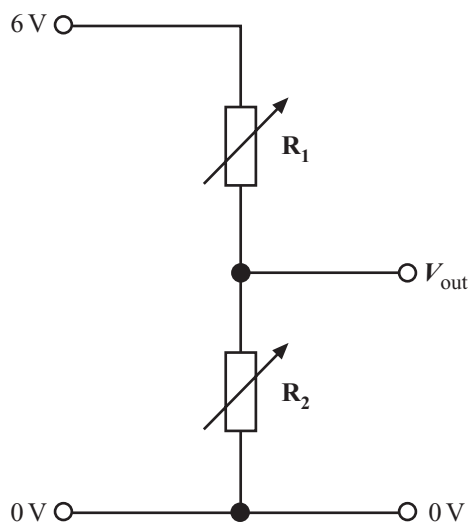
This question is about capacitors.

Which **two** statements **J**, **K**, **L**, **M** and **N** are correct?

- J** capacitors store electric charge
- K** current flows across the gap between the plates of a capacitor when it is discharging
- L** the potential difference (voltage) across a capacitor increases when it is discharging
- M** timers in electronic circuits use capacitors
- N** when a conductor is connected across a charged capacitor, current flows into the capacitor

### QUESTION SEVEN

The diagram shows a potential divider.



The table shows five ways in which the resistance of  $R_1$  and  $R_2$  can be changed.

Which **two** of the lines **P**, **Q**, **R**, **S** and **T** would cause  $V_{out}$  to increase?

	Resistance of $R_1$	Resistance of $R_2$
<b>P</b>	reduced	no change
<b>Q</b>	no change	reduced
<b>R</b>	no change	increased
<b>S</b>	increased	no change
<b>T</b>	doubled	doubled

**TURN OVER FOR THE NEXT QUESTION**

Turn over ►

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**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.

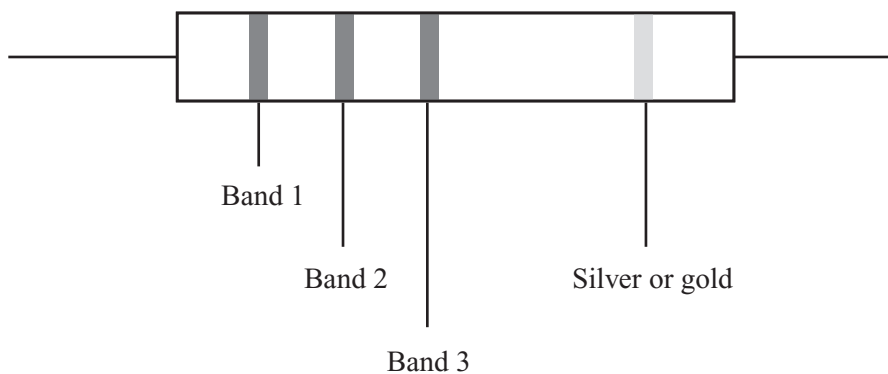
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**QUESTION EIGHT**

The table shows the colour code for resistors.

<b>0</b>	Black
<b>1</b>	Brown
<b>2</b>	Red
<b>3</b>	Orange
<b>4</b>	Yellow
<b>5</b>	Green
<b>6</b>	Blue
<b>7</b>	Violet
<b>8</b>	Grey
<b>9</b>	White

The diagram shows how the colour code is used on a resistor.





8.1 Which band shows the tolerance of the resistor?

- A Band 1
- B Band 2
- C Band 3
- D The gold or silver band

8.2 What value of resistance is shown by the following code?

Band 1	Band 2	Band 3
red	red	brown

- A  $22 \Omega$
- B  $220 \Omega$
- C  $221 \Omega$
- D  $2\,200 \Omega$

8.3 What colour bands would be on a  $680 \Omega$  resistor?

	Band 1	Band 2	Band 3
A	black	grey	brown
B	blue	green	black
C	blue	grey	black
D	blue	grey	brown

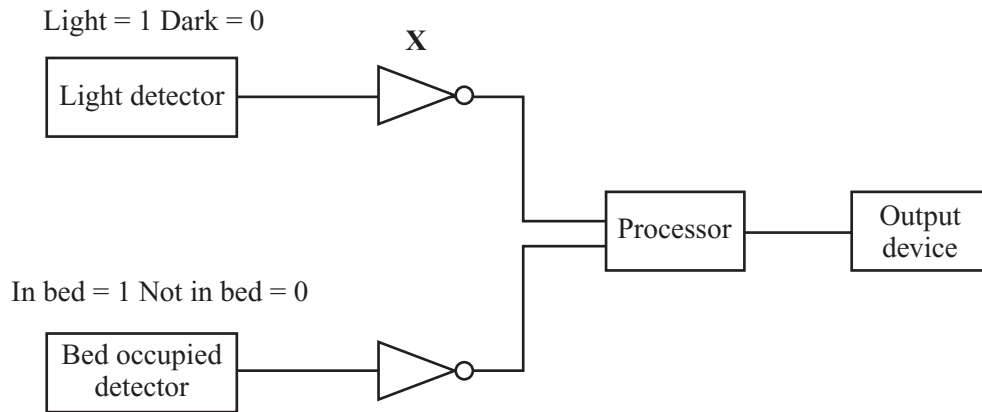
8.4 What colour bands would be on a  $1000 \text{ k}\Omega$  resistor?

	Band 1	Band 2	Band 3
A	brown	black	red
B	brown	black	yellow
C	brown	black	green
D	brown	blue	black

Turn over ►

**QUESTION NINE**

A hospital uses an electronic system to alert a nurse if a patient gets out of bed at night.



**9.1** Which of the following could be used as the 'bed occupied' detector?

- A LDR
- B LED
- C Pressure switch
- D Thermistor

**9.2** Name the component **X** in the diagram.

- A AND gate
- B LED
- C NOT gate
- D OR gate

**9.3** The processor contains . . . . .

- A an AND gate.
- B an OR gate.
- C both an AND gate and an OR gate.
- D neither an AND gate nor an OR gate.

**9.4** The output device must warn the nurse that a patient is out of bed, but it must not wake the other patients.

Which output device would be best to use?

- A** Buzzer
- B** Electric motor
- C** Heater
- D** LED

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

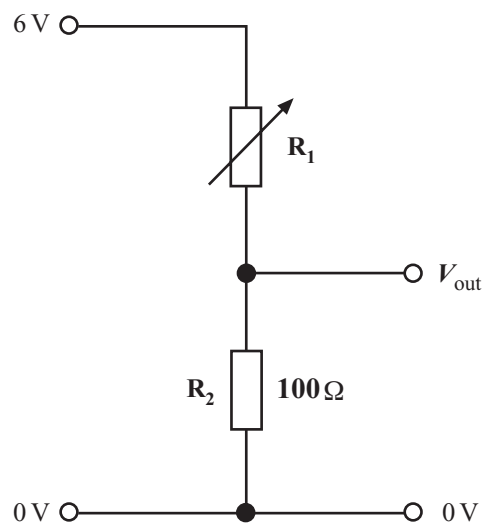
## QUESTION TEN

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

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

Potential dividers are used in electronic circuits.

$R_1$  is a variable resistor. Its resistance can change from 0 to  $200\ \Omega$ .



**10.1** The output  $V_{\text{out}}$  is fed to . . . . .

- A a processor.
- B a relay.
- C an input sensor.
- D an output device.

**10.2** When the value of  $R_1$  is 0,  $V_{\text{out}}$  is . . . . .

- A 0 V
- B 3 V
- C 6 V
- D 100 V

**10.3** When the value of  $R_1$  is  $200\ \Omega$ , the value of  $V_{\text{out}}$  is . . . . .

- A 0.33 V
- B 2 V
- C 3 V
- D 4 V

**10.4** The value of  $R_1$  is kept at  $200\ \Omega$  and  $R_2$  is replaced by a capacitor.

The value of  $V_{\text{out}}$  will now . . . . .

- A be 0 V.
- B be 6 V.
- C decrease as the capacitor is charged.
- D increase as the capacitor is charged.

**END OF TEST**

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

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**HIGHER TIER****SECTION A**Questions **ONE** and **TWO**.

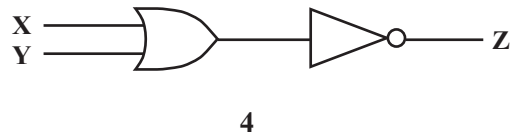
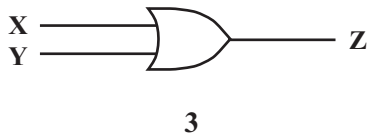
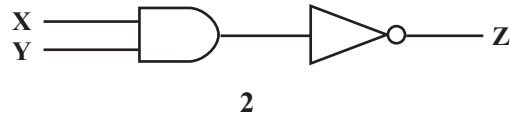
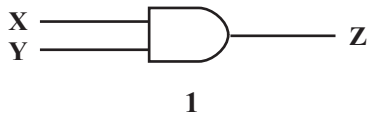
In these questions match the words in the list with the numbers.

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

Mark your choices on the answer sheet.

**QUESTION ONE**

The diagrams show four different arrangements of logic gates.

Input **X** is always zero.**QUESTION ONE IS ON THE FACING PAGE**

Match the truth tables **P**, **Q**, **R** and **S** with the arrangements **1–4**.

	<b>Input Y</b>	<b>Output Z</b>
<b>P</b>	0	0
	1	0

	<b>Input Y</b>	<b>Output Z</b>
<b>Q</b>	0	0
	1	1

	<b>Input Y</b>	<b>Output Z</b>
<b>R</b>	0	1
	1	0

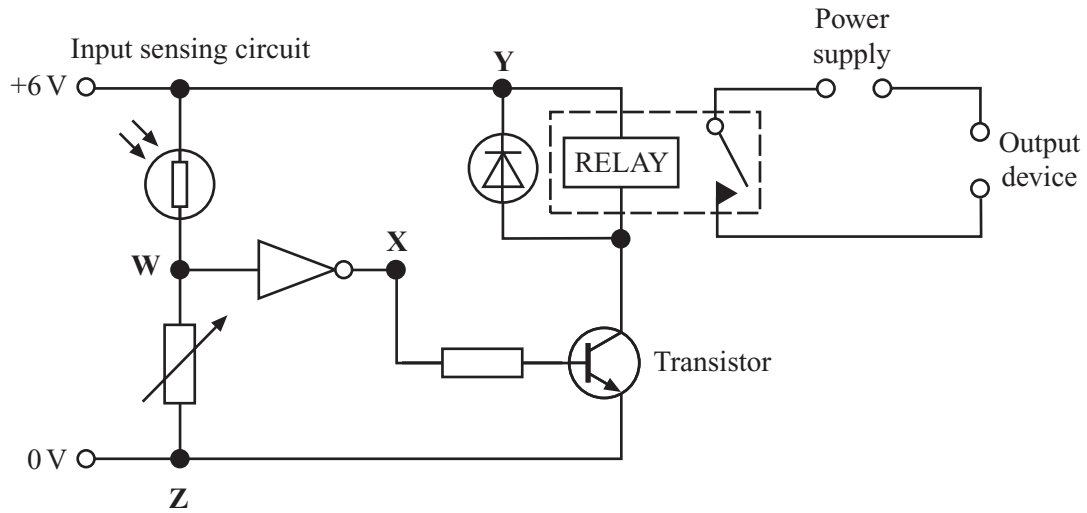
	<b>Input Y</b>	<b>Output Z</b>
<b>S</b>	0	1
	1	1

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

## QUESTION TWO

The diagram shows a sensing circuit of an electronic control system.



Match points **W**, **X**, **Y** and **Z** in the circuit with the descriptions 1–4.

	Description of voltage at point indicated
1	always remains at 0V
2	always remains at +6V
3	may fall if the resistance of the variable resistor is increased
4	rises when the light intensity increases



**NO QUESTIONS APPEAR ON THIS PAGE**

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

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**SECTION B**

 Questions **THREE** and **FOUR**.

 In these questions choose the best **two** answers.

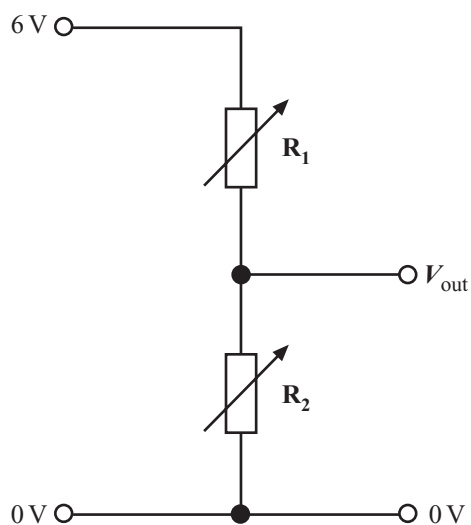
 Do **not** choose more than two.

 Mark your choices on the answer sheet.
 

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**QUESTION THREE**

The diagram shows a potential divider.

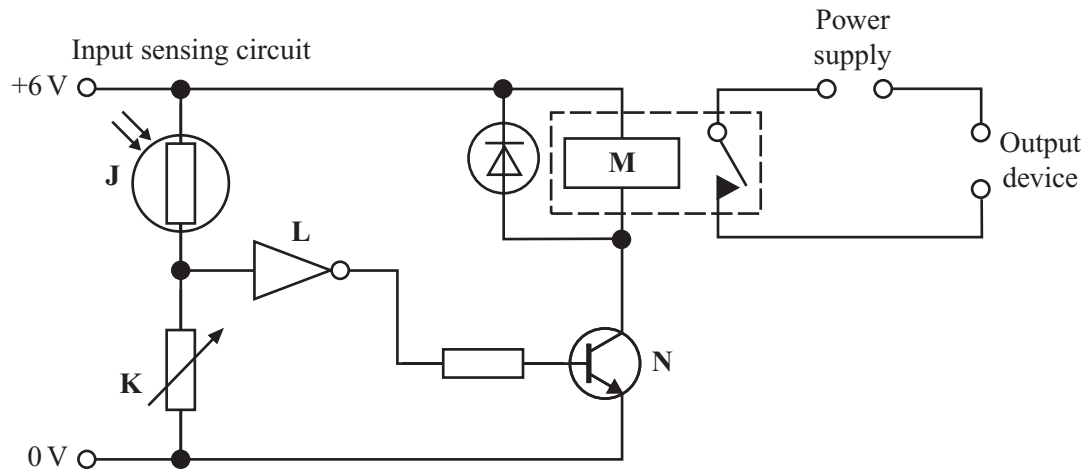

 The table shows five ways in which the resistance of  $R_1$  and  $R_2$  can be changed.

 Which **two** of the lines **P**, **Q**, **R**, **S** and **T** would cause  $V_{out}$  to increase?

	Resistance of $R_1$	Resistance of $R_2$
<b>P</b>	reduced	no change
<b>Q</b>	no change	reduced
<b>R</b>	no change	increased
<b>S</b>	increased	no change
<b>T</b>	doubled	doubled

**QUESTION FOUR**

The diagram shows an electronic control system.



Which **two** components **J**, **K**, **L**, **M** and **N** act as switches in this system?

**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.

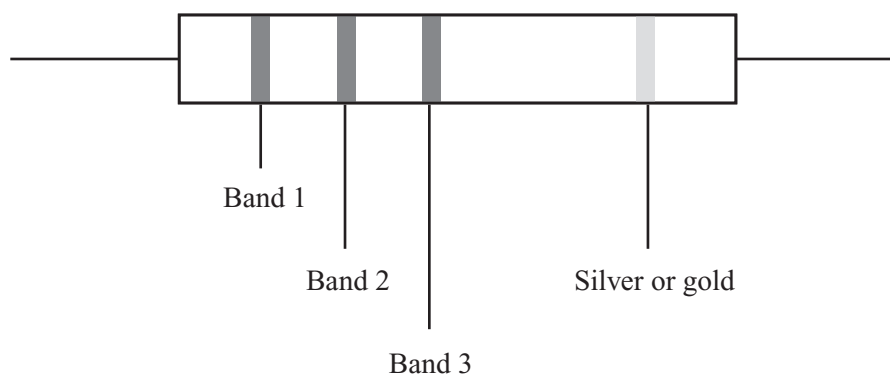
Mark your choices on the answer sheet.

**QUESTION FIVE**

The table shows the colour code for resistors.

<b>0</b>	Black
<b>1</b>	Brown
<b>2</b>	Red
<b>3</b>	Orange
<b>4</b>	Yellow
<b>5</b>	Green
<b>6</b>	Blue
<b>7</b>	Violet
<b>8</b>	Grey
<b>9</b>	White

The diagram shows how the colour code is used on a resistor.



5.1 Which band shows the tolerance of the resistor?

- A Band 1
- B Band 2
- C Band 3
- D The gold or silver band

5.2 What value of resistance is shown by the following code?

Band 1	Band 2	Band 3
red	red	brown

- A  $22 \Omega$
- B  $220 \Omega$
- C  $221 \Omega$
- D  $2\,200 \Omega$

5.3 What colour bands would be on a  $680 \Omega$  resistor?

	Band 1	Band 2	Band 3
A	black	grey	brown
B	blue	green	black
C	blue	grey	black
D	blue	grey	brown

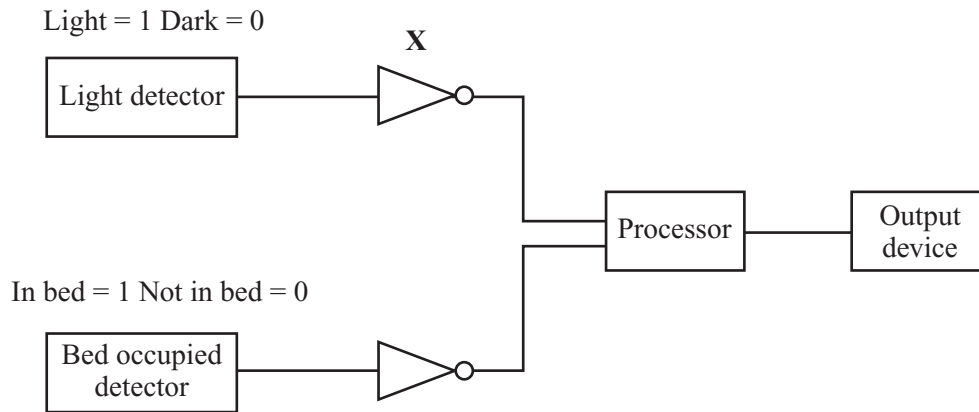
5.4 What colour bands would be on a  $1000 \text{ k}\Omega$  resistor?

	Band 1	Band 2	Band 3
A	brown	black	red
B	brown	black	yellow
C	brown	black	green
D	brown	blue	black

Turn over ►

### QUESTION SIX

A hospital uses an electronic system to alert a nurse if a patient gets out of bed at night.



6.1 Which of the following could be used as the 'bed occupied' detector?

- A LDR
- B LED
- C Pressure switch
- D Thermistor

6.2 Name the component X in the diagram.

- A AND gate
- B LED
- C NOT gate
- D OR gate

6.3 The processor contains . . . . .

- A an AND gate.
- B an OR gate.
- C both an AND gate and an OR gate.
- D neither an AND gate nor an OR gate.

**6.4** The output device must warn the nurse that a patient is out of bed, but it must not wake the other patients.

Which output device would be best to use?

- A Buzzer
- B Electric motor
- C Heater
- D LED

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

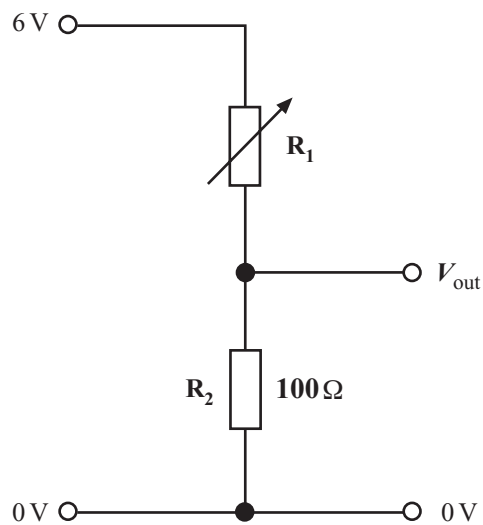
## QUESTION SEVEN

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

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

Potential dividers are used in electronic circuits.

$R_1$  is a variable resistor. Its resistance can change from 0 to 200  $\Omega$ .



7.1 The output  $V_{\text{out}}$  is fed to . . . . .

- A a processor.
- B a relay.
- C an input sensor.
- D an output device.

7.2 When the value of  $R_1$  is 0,  $V_{\text{out}}$  is . . . . .

- A 0 V
- B 3 V
- C 6 V
- D 100 V



**7.3** When the value of  $R_1$  is  $200\ \Omega$ , the value of  $V_{\text{out}}$  is . . . . .

- A** 0.33 V
- B** 2 V
- C** 3 V
- D** 4 V

**7.4** The value of  $R_1$  is kept at  $200\ \Omega$  and  $R_2$  is replaced by a capacitor.

The value of  $V_{\text{out}}$  will now . . . . .

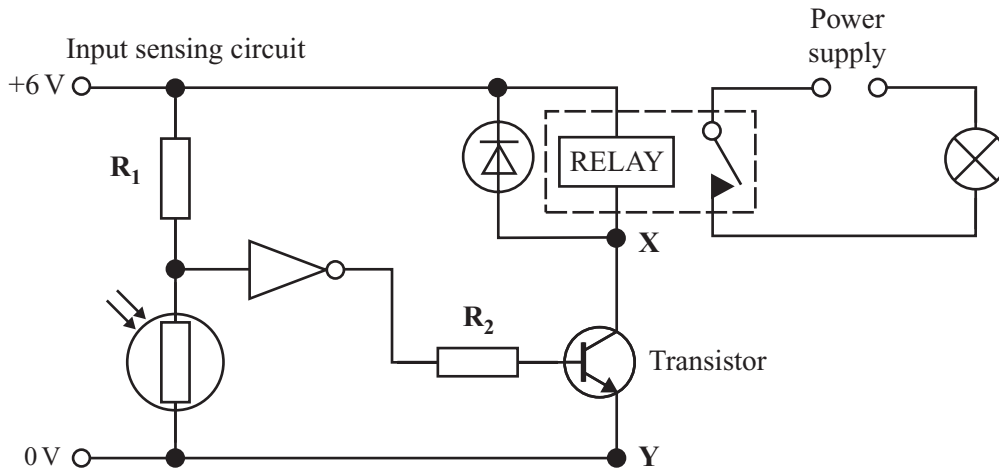
- A** be 0 V.
- B** be 6 V.
- C** decrease as the capacitor is charged.
- D** increase as the capacitor is charged.

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

## QUESTION EIGHT

The diagram shows the circuit of an electronic control system.



- 8.1 In this circuit, the diode . . . . .
- A amplifies the current.
  - B increases the potential difference (voltage).
  - C protects the transistor.
  - D switches the lamp on.
- 8.2 When will the lamp come on?
- A When it is dark, because the resistance of the LDR will be high
  - B When it is dark, because the resistance of the LDR will be low
  - C When it is light, because the resistance of the LDR will be high
  - D When it is light, because the resistance of the LDR will be low
- 8.3 How could you change the light intensity at which the lamp switches on?
- A Add a variable resistor at point X
  - B Add a variable resistor at point Y
  - C Make  $R_1$  a variable resistor instead of a fixed one
  - D Make  $R_2$  a variable resistor instead of a fixed one

**8.4** Which statement about this circuit is true?

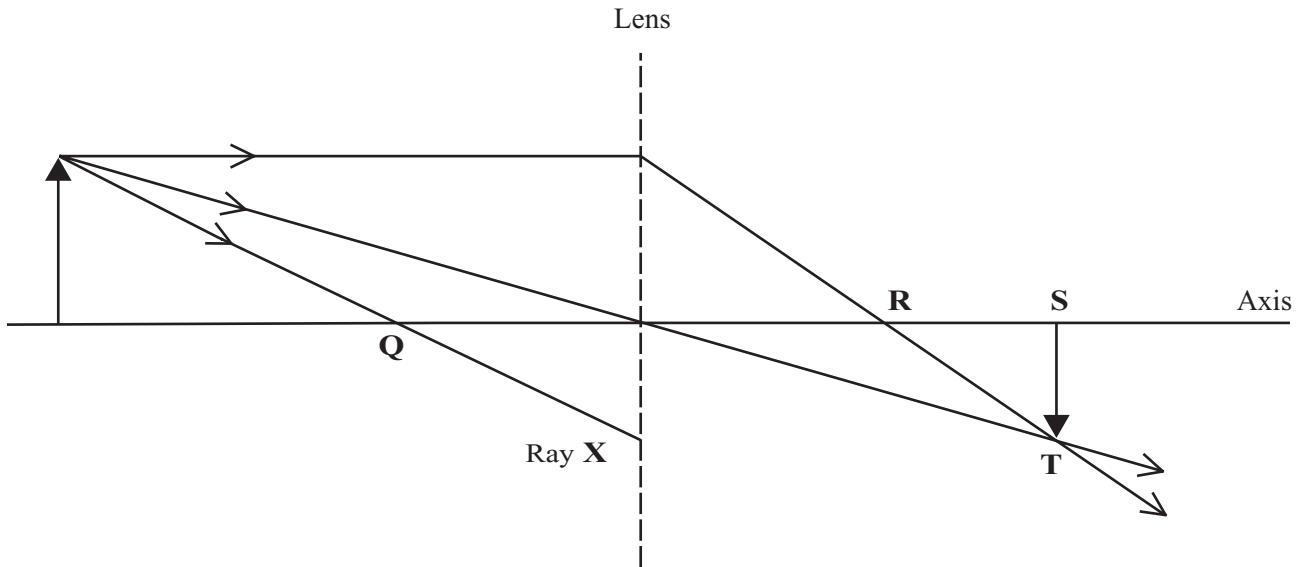
- A** A small current flowing through  $R_2$  controls a larger current flowing through the lamp
- B** If the input voltage is reversed, the circuit will still work correctly
- C** If the value of  $R_2$  is too high, the transistor could be damaged
- D** The currents at points **X** and **Y** will always be identical

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION NINE**

The diagram shows the paths of two rays of light from the top of an object passing through a lens.



**9.1** Which statement is correct?

- A The lens is a converging lens and the image is real
- B The lens is a converging lens and the image is virtual
- C The lens is a diverging lens and the image is real
- D The lens is a diverging lens and the image is virtual

**9.2** What happens to ray **X** when it emerges from the lens?

- A It travels through **R**
- B It travels through **S**
- C It travels through **T**
- D It travels on undeflected

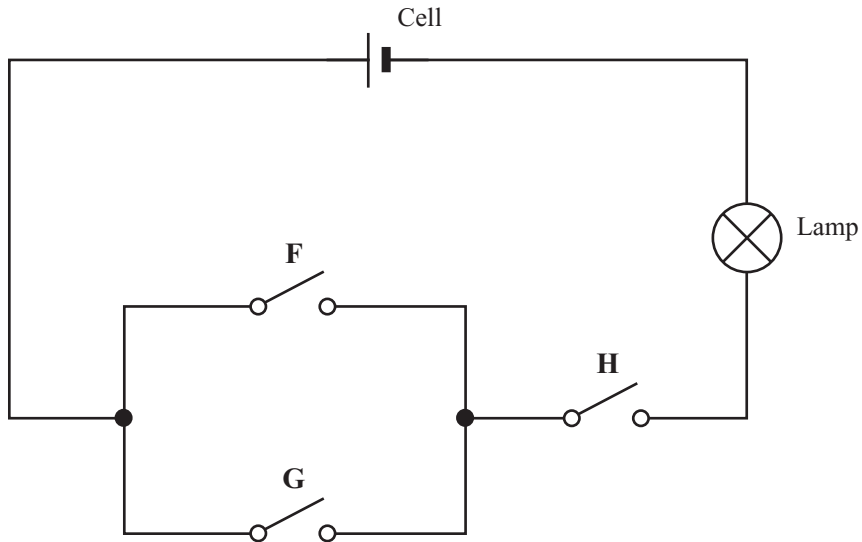
- 9.3** Which statement about points **R** and **S** is true?
- A** Point **R** is the focus and point **S** is where the image forms
  - B** Point **R** is the focus and point **S** is the object
  - C** Point **R** and point **S** are both a focus of the lens
  - D** Point **R** is where the real image forms and point **S** is where the virtual image forms
- 9.4** If the object was placed between **Q** and the lens, the image would be . . . . .
- A** upright, real and magnified.
  - B** upright, virtual and magnified.
  - C** upside down, real and diminished.
  - D** upside down, virtual and diminished.

**TURN OVER FOR THE NEXT QUESTION**

**Turn over ►**

**QUESTION TEN**

The circuit contains three switches, **F**, **G** and **H**, connected to a lamp and a cell.



An open switch represents the logic state 0.

A closed switch represents the logic state 1.

When the lamp is lit, the output of the circuit is 1.

When the lamp is not lit, the output of the circuit is 0.

**10.1** What type of logic gate is represented by the combination of switches **F** and **G**?

- A A NOT gate
- B An AND gate
- C An OR gate
- D An AND gate and a NOT gate

**10.2** Which row of the table, **A**, **B**, **C** or **D**, is correct for the circuit?

	<b>F</b>	<b>G</b>	<b>H</b>	<b>Lamp</b>
<b>A</b>	0	0	0	1
<b>B</b>	0	1	0	1
<b>C</b>	1	0	1	1
<b>D</b>	1	1	0	1

**10.3** The circuit is a model of an electronic system which operates the lock on a safe deposit box in a bank vault.

The lamp, when it is lit, represents the unlocked safe deposit box.

The switches represent keys held by three people:

**F** = the bank manager

**G** = the duty officer

**H** = the owner of the safe deposit box

Logic state 1 indicates that the key has been turned in the lock.

Who must be present to unlock the safe deposit box?

- A** Any one of the three key-holders
- B** The bank manager and the duty officer
- C** The owner and either the bank manager or the duty officer
- D** The owner only

**10.4** The bank has a CCTV system.

Which line of the table, **A**, **B**, **C** or **D**, best describes the advantages and disadvantages of the CCTV system?

	<b>Advantage</b>	<b>Disadvantage</b>
<b>A</b>	improved working practice	invasion of privacy
<b>B</b>	increased levels of crime	possible health hazard
<b>C</b>	increased security	innocent bystanders filmed
<b>D</b>	increased security	possible health hazard

**END OF TEST**