OCR
Oxford Cambridge and RSA

Cambridge National

Engineering

Unit **R113:** Electronic principles

Level 1/2 Cambridge National Award/Certificate in Systems Control in Engineering

Mark Scheme for January 2019

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Annotations

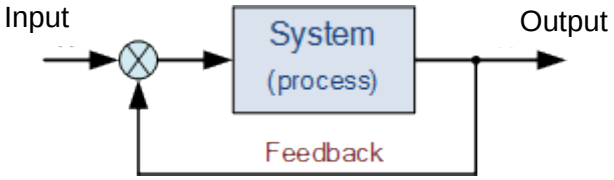
Annotation	Meaning
BP	Blank page
VG	Vague
	Tick
SEEN	Noted but no credit given
REP	Repeat
K	Knowledge
EG	Example/Reference
DEV	Development
	Cross
BOD	Benefit of doubt
	Unclear
L3	Level 3
L2	Level 2
L1	Level 1

Question			Answer	Mark	Guidance
1	(a)		**Quantity** — **Unit** *Current* — *amp (A)* Electromotive force — henry (H) Frequency — hertz (Hz) Capacitance — farad (F) Inductance — volt (V)	4	Award one mark for each correct response. Current – amp (A) is given.
1	(b)		$R = R_1 + R_2$ $= 4 + 6$ $= 10\,\Omega$	2	Award one mark for $R = R_1 + R_2$ or $4 + 6$. Award one mark for 10.
1	(c)		$I = V/R$ $= 6/300$ $= 0.02$ A	2	Award one mark for $I = V/R$ or $6/300$. Award one mark for 0.02.
1	(d)		$W = Pt$ $= 500 \times 2$ $= 1000$ Wh or 1 kWh	2	Award one mark for $W = Pt$ or 500×2 or 1000 or 1 without unit. Correct unit required for 2 marks.
			Total	10	

Question			Answer	Mark	Guidance
2	(a)		**A** Variable Resistor **B** Light Dependent Resistor (LDR) **C** Lamp or Signal Lamp **D** Transistor or npn transistor	**4**	Award one mark for each correct response.
2	(b)		A fuse is connected in the circuit to protect it from damage (1) by disconnecting the circuit when a fault occurs. (1).	**2**	Award one mark for reference to 'protection' etc. and one mark for reference to 'disconnecting' etc.
2	(c)		$V_{out} = V_{in} (R_2/\{R_1 + R_2\})$ $= 9(20/\{30 + 20\})$ $= 9 \times 0.4$ $= 3.6\,V$	**4**	Award one mark for $V_{out} = V_{in} (R_2/\{R_1 + R_2\})$. Award one mark for $9(20/\{30 + 20\})$. Award one mark for 9×0.4. Award one mark for 3.6 or 3.6 V. Accept other types of correct responses.
			Total	**10**	

Question			Answer	Mark	Guidance
3	(a)		Benefits will include: The circuit does not need to be physically constructed. The simulation can be saved. There is no need to stock components or test equipment The process is less expensive.. Modifications can be made quickly and more easily with simulated components.	3	Award one mark for each valid benefit up to a maximum of three marks. Accept other correct responses.
3	(b)	(i)	Voltage The amplitude of the wave form on the graph will change vertically up or down. To match the value of the voltage specified in properties. The voltage displayed will be plus and minus that specified.	2	Award one mark each for two valid points in the explanation.
3	(b)	(ii)	Frequency The signal / sine wave will spread horizontally. To match the specified frequency. The time scale will alter to match the specified frequency.	2	Award one mark each for two valid points in the explanation.
3	(c)	(i)	Astable signal	1	Accept multi-vibrator or oscillator or rectangular signal.
3	(c)	(ii)	The time for a single wave is given by T The frequency is 1 second divided by T or 1/T or 1/period or 1/periodic time	2	Award one mark each for two valid points in the description.
			Total	10	

<table>
<tr><th colspan="3">Question</th><th>Marks</th><th>Mark</th><th>Answer</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>
<table>
<tr><th>Device</th><th>(✓)</th></tr>
<tr><td>Diode</td><td>✓</td></tr>
<tr><td>Pressure switch</td><td></td></tr>
<tr><td>Operational amplifier</td><td>✓</td></tr>
<tr><td>Touch Screen</td><td></td></tr>
<tr><td>OR gate</td><td>✓</td></tr>
<tr><td>LED 7 segment display</td><td></td></tr>
</table>
</td><td>3</td><td>Award one mark for each correct response.</td></tr>
<tr><td>4</td><td>(b)</td><td>(i)</td><td>gate 1: XOR
gate 2: AND</td><td>2</td><td>Award one mark for each correct response.</td></tr>
<tr><td>4</td><td>(b)</td><td>(iii)</td><td>
<table>
<tr><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td></tr>
</table>
</td><td>2</td><td>Award one mark for column C.
Award one mark for column D.</td></tr>
<tr><td>4</td><td>(c)</td><td></td><td>Pin 8 is the negative power supply.
Pin 14 is the input for the signal that advances the count.
Pin 15 resets the count to 0.</td><td>3</td><td>Award one mark for each correct response. Allow marks for understanding shown</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>10</td><td></td></tr>
</table>

Question			Answer	Mark	
5	(a)			3	Award one mark for each correct label. i.e. Input, output and feedback.
5	(b)		Flow/wave solder process Pick and place robot Manual component placement	3	Award one mark for each correct response.
5	(c)		Surface mount Through hole	2	Award one mark for each correct response.
5	(d)		Automatic test Visual inspection	2	Award one mark for each correct response.
			Total	**10**	

Question			Answer	Mark	Guidance
6	(a)*		**Level 3 (5–6 marks)** • Detailed discussion showing a thorough understanding of the function **and** applications of a reed switch **and** a micro switch in electronic circuits. • Information is presented clearly and accurately, with correct use of appropriate technical language and engineering terminology. • Accurate use of spelling, punctuation and grammar. **Level 2 (3–4 marks)** • Adequate discussion showing some understanding of the function **and/or** applications of a reed switch **and** a micro switch in electronic circuits. • Information is presented clearly and with some accuracy. • Appropriate technical language and engineering terminology is used on some occasions. • Occasional errors in spelling, punctuation and grammar. **Level 1 (1–2 mark(s))** • Basic discussion showing limited understanding of the function and/or applications of a reed switch and/or a micro switch in electronic circuits. • Information presented is basic and may be ambiguous or badly presented. • There will be little or no use of technical language and engineering terminology. • Errors of spelling, punctuation and grammar may be intrusive. **Level 0 (0 marks)** • A response that is irrelevant and/or not worthy of a mark. • Annotate with 'Seen' at end of response.	**6**	Discussion points. **Reed Switch** **A reed switch is** a small device. Inside a capsule there are two ferrous materials. When the reed switch is exposed to a magnetic field, the two ferrous materials inside the switch pull together and the switch closes. When the magnetic field is removed, the reeds separate and the switch opens. The reed switch is a non-contact switch. **Applications** Relays – Automatic test equipment/modems and pagers/cable testers/faxes and scanners/high voltage switching. Position sensors – door/weather meters/demand pacemakers/brushless motors/coil winder tension/bridge control in airports/petrol pump holsters. Pulse counting – audio volume control/fluid metering/satellite TV dish positioning/gear and chain speed/petrol pump flow meter. **Micro switch** A switch that is actuated by a small physical force, through the use of a tipping-point mechanism,. A small movement at the actuator button produces a relatively large movement at the electrical contacts. The actuator of these switches often has a hinged wheel placed above a push button. A micros switch is sometimes called a miniature snap action switch **Applications** Open/shut mechanism for microwave oven/ Lift leveller/jam detection in photocopies/gate valves on fire extinguishers/vending machines/solenoid control/sensors for pressure, flow and temperature/limit switches controlling electrically-driven machinery or machine tools. Accept other correct responses for either switch.

Question			Answer	Mark	Guidance
6	(b)		$C = 400\,\mu F = 400 \times 10^{-6}$ F $T = RC$ $= 800 \times 400 \times 10^{-6}$ $= 0.32$ s	4	Award one mark for $C = 400\,\mu F = 400 \times 10^{-6}$ F. Award one mark for $800 \times 400 \times 10^{-6}$. Award one mark for 0.32. Award one mark for unit (s).
			Total	**10**	

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

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