Electronics

Mark Scheme 4

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Electronics
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 4

Time Allowed: **63 minutes**

Score: **/52**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1	(a	blocks labelled sensing device / sensor / transducer	B1	
		processor / processing unit / signal conditioning	B1	[2]
	(b) **(i)**	two LEDs with opposite polarities *(ignore any series resistors)*	M1	
		correctly identified as red and green	A1	[2]
	(ii)	correct polarity for diode to conduct identified	M1	
		hence red LED conducts when input (+)ve or *vice versa*	A0	[1]

2 **(a)** **(i)** - 9 V

(ii) + 9 V (*both* ***(i)*** *and* ***(ii)*** *correct for the mark*) .... B1 [1]

(b) ✗ ✗ B1
✓ ✗ B1
✓ ✓ .... B1 [3]
(*no e.c.f. from* ***(a)***)

(c) **(i)** cct: thermistor and resistor in series ……………………………………………...M1
output connections across thermistor ....A1 [2]

(ii) as temperature decreases, thermistor resistance increases B1
p.d. across thermistor $= R_T / (R + R_T) \times V$ M1
as R_T increases, output increases ....A1 [3]

3 **(a)** e.g. infinite (voltage) gain
infinite input impedance
zero output impedance
infinite bandwidth
infinite slew rate
(*any three, 1 each*) B [3]

(b) **(i)** negative (feedback) B1 [1]

(ii) **1** gain (= 5.8/0.069) = 84 B1 [1]

(ii) **2** gain = 1 + 120/X C1
84 = 1 + 120/X
X = 1.45 kΩ A1 [2]

(iii) gain increases OR bandwidth reduced OR output increases B1 [1]

4 **(a** V_B = 1000 mV — C1

when strained, V_A = 2000 × 121.5 / (121.5 + 120.0)

= 1006.2 mV — M1

change = 6.2 mV (*allow 6 mV)* — A1 [3]

(b) (i) 1. resistor between V_{IN} and V^- **and** V^+ connected to earth — B1

resistor between V^- and V_{OUT} — B1 [2]

2. P / + sign shown on earth side of voltmeter — B1 [1]

(ii) ratio of R_F / R_{IN} = 40 — M1

R_{IN} between 100 Ω and 10 kΩ — A1 [2]

(any values must link to the correct resistors on the diagram)

5 **(a)** any value greater than, or equal to, 5 kΩ — B1 [1]

(b) (i) 'positive' shown in correct position — B1 [1]

(ii) V^+ = (500/2200) × 4.5

≈ 1 V — B1

$V^- > V^+$ so output is negative — M1

green LED on, (red LED off) — A1 [3]

(allow full ecf of incorrect value of V^+)

(iii) *either* V^+ increases *or* $V^+ > V^-$ — M1

green LED off, red LED on — A1 [2]

6 **(a)**	thin / fine metal wire	B1	
	lay-out shown as a grid	B1	
	encased in plastic	B1	[3]
(b) **(i)**	gain (of amplifier)	B1	[1]
(ii)	for $V_{OUT} = 0$, then $V^+ = V^-$ *or* $V_1 = V_2$	C1	
	$V_1 = (1000/1125) \times 4.5$	C1	
	$V_1 = 4.0\,V$	A1	[3]
(iii)	$V_2 = (1000 / 1128) \times 4.5$		
	$= 3.99\,V$	C1	
	$V_{OUT} = 12 \times (3.99 - 4.00)$		
	$= (-)\ 0.12\,V$	A1	[2]
7 **(a)** **(i)**	strain gauge	B1	[1]
(ii)	piezo-electric / quartz crystal / transducer	B1	[1]
(b) circuit:	coil of relay connected between sensing circuit output and earth	B1	
	switch across terminals of external circuit	B1	
	diode in series with coil with correct polarity for diode	B1	
	second diode with correct polarity	B1	[4]