Electronics Mark Scheme 3

Level	International A Level
Subject	Physics
Exam Board	CIE
Торіс	Electronics
Sub Topic	
Paper Type	Theory
Booklet	Mark Scheme 3
Time Allowed:	71 minutes
Score:	/59
Percentage:	/100
A* A	B C D E U
>85% '77.5%	70% 62.5% 57.5% 45% <45%

1	(a) (e.g. i	nfinite input impedance / resistance zero output impedance / resistance infinite gain infinite bandwidth		
		(an	<i>y three, 1 each</i>)	В3	[3]
	(b)	(i)	with switch open, V^- is less (positive) than V^+ output is positive with switch closed, V^- is more (positive) than V^+ so output is negative (allow similar scheme if V^- more positive than V^+ treated first)	M1 A1 A1	[3]
		(ii)	 diodes connected correctly between output and earth green identified correctly (<i>do not allow this mark if not argued in (i)</i>) 	M1 A1	[2]
2	(a	(i)	point X shown correctly	B1	[1]
		(ii)	op-amp has <u>very large</u> / infinite gain non-inverting input is at earth (potential) / earthed / at 0 V if amplifier is not to saturate, inverting input must be (almost)	M1 M1	
			at earth potential / 0 (V) same potential as inverting input	A1	[3]
	(b)	l	total input resistance = $1.2 \text{ k}\Omega$ (amplifier) gain (= $-4.2 / 1.2$) = -3.5 (voltmeter) reading = -3.5×-1.5	C1 C1	
			(total disregard of signs or incorrect sign in answer, max 2 marks)	A1	[3]
		(ii)	(less bright so) resistance of LDR increases (amplifier) gain decreases (voltmeter) reading decreases	M1 M1 A1	[3]

3	(a	(i)	fraction of the output (signal) is added to the input (signal) out of phase by 180° / π rad / to inverting input	M1 A1	[2]
		(ii)	e.g. reduces gain increases bandwidth greater stability reduces distortion		
			(any two, 1 mark each)	B2	[2]
	(b)	(i)	gain = 4.4 / 0.062 = 71	A1	[1]
		(ii)	71 = 1 + 120/R R = $1.7 \times 10^3 \Omega$	C1 A1	[2]
	(c)	for max sup	the amplifier not to saturate eximum output is $(71 \times 95 \times 10^{-3} =)$ approximately 6.7 V oply should be +/– 9 V	B1 M1 A1	[3]

4	at 16 °C, V ⁺ = 1.00 V and V ⁻ = 0.98 V or V ⁺ > V ⁻	B1	
	at 16 °C, output is positive	M1	
	diode R is 'on' <u>and</u> diode G is 'off'	A1	
	as temperature rises, diode R goes 'off' <u>and</u> diode G goes 'on'	B1	[4]

[Total:	4]
---------	----

5	 (a) e.g. reduces gain increases bandwidth less distortion greater stability 1 each, max 2) 	B2	[2]
	(b) gain = $-R_{\rm F}/R_{\rm H}$		
	= -8.0 / 4.0 numerical value is 2	M1 A0	[1]
	(c) (2, 6 and 7	A1	[1]
	(ii) e.g. digital-to-analogue converter (allow DAC) adding / mixing signals with 'weighting'	B1	[1]
		[Tota	l: 5]
6	6 (a) (part of) the output is added to /returned to / mixed with the input and is out of phase with the input / fed to inverting input	B1 B1	[2]
	(b) $25 = 1 + (120 / R)$ $R = 5 k\Omega$	C A1	[2]
	(c) (i) −2 V	A1	[1
	(ii) ⁹ VHEMISTRYONLIN	NE A1	[1]

7	(a)	 (i) 1. inverting (amplifier) 2. gain of op-amp is very large / infinite non-inverting input is at earth / 0V for amplifier not to saturate, P must be at about earth / 0V 			[1] [3]
		(ii)	input resistance is very large (so) current in R_1 = current in R_2 $I = V_{IN} / R_1$ $I = -V_{OUT} / R_2$ (minus sign can be in either of the equations) hence gain = $V_{OUT} / V_{IN} = -R_2 / R_1$	B1 B1 B A0	[4]
	(b)	(feedback resistance = 33.3 kΩ gain (= 33.3 / 5) = 6.66 V_{OUT} (= 6.66 × 1.2) = 8.0 V (+ or – acceptable, allow 1 s.f.) feedback resistance = 8.33 kΩ V_{OUT} (= {6.66 × 1.2} / 5) = 2.0 V (+ or – acceptable, allow 1 s.f.) 	C1 C1 A1 C1 A1	[3] [2]
		(ii)	(Increase in lamp-LDR distance gives) decrease in intensity <u>Feedback</u> / <u>LDR</u> resistance increases voltmeter reading increases / becomes more negative	M1 M1 A1	[3]

