A-LEVEL
ELECTRONICS

Further Electronics ELEC2
Mark scheme

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COMPONENT NUMBER: ELEC2

COMPONENT NAME: Further Electronics

Question	Part	Sub part	Marking Guidance	Mark	Comments
1	(a)		correct substitution into voltage gain formula ✓ gain = 100 ✓	2	Award 2 marks for correct answer
1	(b)		a correctly wired amplifier, inverting or non inverting ✓ non-inverting amplifier ✓ resistor ratios to give Gv of |100| ✓ all resistors between 1k and 4M7 ✓	4	
1	(c)	(i)	**Example** Voltage gain x bandwidth is a constant ✓ **Or** Large gain = small bandwidth ✓	1	
1	(c)	(ii)	voltage gain × frequency = 10^6 => gain at 40kHz is 25 ✓ 25 x 40mV = 1V ✓	2	
1	(c)	(iii)	**Example** Set up two amplifiers each with a voltage gain of 10 ✓ and cascade them ✓ **Or** Add an amplifier to the output ✓ with a gain of 4 ✓	2	
2	(a)		exponential charging curve through 0V ✓ (not quite) touching V_s ✓	2	

2	(b)		time = 0.69RC = 0.69 × 6200 × 0.0068 ✓ 29.1s ✓ **Accept** 29	2	
2	(c)		statement of suitable time (**example**) 1 hour (3600s) ✓ => R = 3600 / (0.69 × 0.0068) R = 767kΩ ✓ **Accept** the correct R – 6.2 **Accept** 1MΩ (as 767 resistors don't exist!)	2	
2	(d)		leakage current ✓ comment on charging current close to leakage current ✓ so that Vs/2 is never reached ✓	**3**	
2	(e)		gate 1 output goes low ✓ diode conducts discharging capacitor through 1kΩ resistor ✓	2	
3	(a)		discharge to junction of R_A and R_B ✓ trigger linked to threshold ✓ threshold to junction of R_B and C ✓	3	
3	(b)		graph between 4 and 8V ✓ charging curve when output goes high ✓ discharging curve when output goes low ✓	3	
3	(c)		substitution into correct 555 frequency formula ✓ correct rearrangement ✓ Calculated value of 35.5kΩ ✓	3	

3	(d)		substitution into correct 555 frequency formula and correct rearrangement ✓ calculated value = approx. 680K ✓	2	
4	(a)	(i)	Biases the MOSFETs ✓	1	
4	(a)	(ii)	Provides power gain ✓	1	
4	(b)	(i)	substitution into a gain formula ✓ correct value = 40kΩ ✓	2	
4	(b)	(ii)	**Example** Overall voltage gain of the amplifier includes the voltage gain of the source followers ✓ Voltage gain of source followers < 1 ✓	2	
4	(c)	(i)	The op-amp does not saturate at the supply voltages ✓	1	
4	(c)	(ii)	power output formula ✓ substitution $P = (7^2/2x4)$ ✓ P = 6.125W ✓	3	
4	(c)	(iii)	Increase power supply voltages ✓	**1**	
5	(a)		all Rs to 0V ✓ all flip-flops D connected to Qbar ✓ Q to following flip-flop CK ✓ input to first CK ✓	**4**	

5	(b)		summing amplifier formula and attempt at substitution ✓ correct substitution ✓ output voltage = -6.875V ✓	3	

5	(c)		correct down counter shape ramp ✓ correct polarity –ve, which returns to 0V every 16 clock pulses ✓ correct amplitude (9.375V) ✓ evidence of steps in ramp ✓	**4**	

6	(a)		on the rising edge of the clock pulse ✓ the value of D is transferred to **Q** ✓ some correct mention of S and/or R ✓ some correct mention of $\overline{\mathbf{Q}}$ ✓	3 max	

6	(b)		first data input labelled as **serial data input** and label of **clock input** correct ✓ all clock inputs connected together ✓ Q connected to following D ✓ Resets not left floating ✓	4	

6	(c)		**Example** 4-input NOR gate **or equivalent** ✓ output to serial data input ✓ inputs from all Qs or all $\overline{\mathbf{Q}}$s ✓	3	

6	(d)		Q_A goes high on rising edge of first clock pulse for one clock pulse ✓ repeats only on 6^{th} clock pulse ✓	2	