Practice Question Set For A-Level
Subject : Physics
Paper-3 Topic: Section B (Section 13_ Electronics)

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Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Mark Schemes

Q1.

(a)

comparator	✔
differential amplifier	
inverting amplifier	
non-inverting amplifier	

1

(b) Photodiode current from graph = 80 µA ✔

Allow ± 5 µA in reading from the graph

Voltage across resistor V_R
$V_R = I \times R = 80 \times 10^{-6} \times 39 \times 10^3$
V_R = 3.12 V ✔

Allow a V_R = 2.93 V to 3.32 V

Voltage at non-inverting pin (V_+) = (5 – 3.12) = 1.88 V ✔

Allow a V_+ value of 2.07 V to 1.68 V

3

(c) Voltage at inverting pin (V–) is 2.2 V ✔
V– > V+ so output is low / 0 V so LED will light / on ✔

***First mark** is for correct value of (V–)*

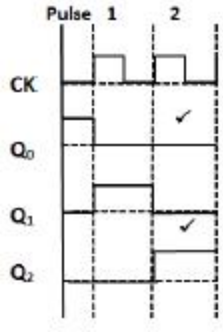
***Second mark** is for correct application / conclusion using V_+ = 1.9 V together with their value for (V–)*

2

[6]

Q2.

(a)

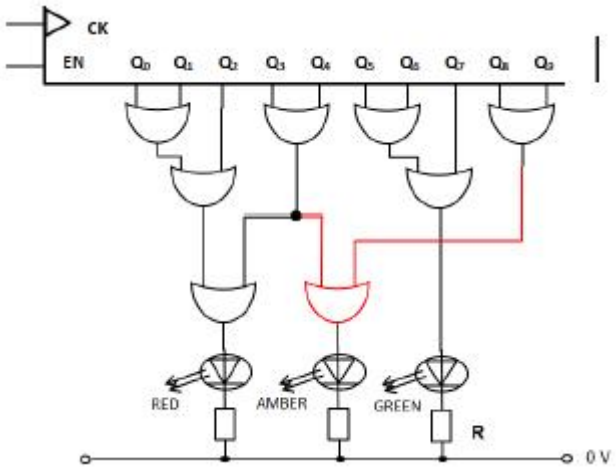


Flat line of Q_0 - 1 mark

Correct fall of Q_1 and rise of Q_2 - 1 mark

2

(b)



Logic OR gate correctly connected in position for 1 mark

1

(c) The ON time for the green LED is determined by:

the frequency of the clock ✔

the number of adjacent outputs that are OR'ed ✔

Accept reference to the period of the clock pulse.

2

(d) **R** = V_R / I ; **R** = (9 – 2.1) V ✔ / 9 mA

R = 6.9 V / 9 mA ; **R** = 767 Ω ✔

Minimum resistor value that can be used in order not to exceed 9 mA is 767 Ω.

The 720 Ω resistor range is (684 to 756) Ω and falls below this value so should not be used. ✔

OR

Calculation using 720 Ω ±5% Resistor range = (684 to 756) Ω ✔ leading to smallest current of 9.1 mA ✔

This current will exceed the permitted value of 9 mA. Don't use. ✔

[1]One mark for voltage across the resistor

[2]One mark for a suitable I-V-R calculation

3One mark for conclusion with reason.

Use of error range to give max resistance must be seen in either 2 or 3 for that mark to be awarded.

3

[8]

Q3.

(a) difference amplifier ✔

1

(b) $V_{out} = (V_+ – V_–) \times (R_f / R_{in})$

$V_{out} = (0\ V – 150\ mV) \times (1\ M\Omega / 100\ k\Omega)$ ✔

$V_{out} = –1.5\ V$ ✔

1 mark for the correct resistor substitution / resistor ratio (10)

1 mark for −1.5 V (must have correct sign)

2

(c) Signal 2 is subtracted from signal 1 by the difference amplifier ✔

Noise is common to both so will be reduced / eliminated when subtracted ✔

Signals will also be subtracted resulting in an addition (re-enforcement) of the signal. ✔

Accept arguments based on the 'phase' relationship

3

[6]