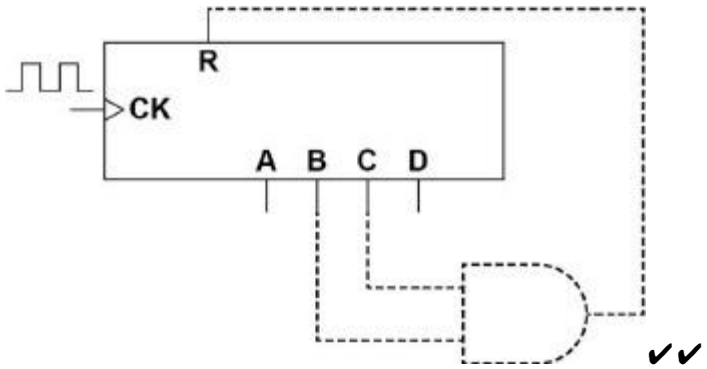
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a)



✔✔

1 mark for use of the correct counter outputs
*1 mark for the correct logic gate connected to reset **R***

2

(b) input **C**
segment **b** ✔

Both input and segment needed for the mark
*Do not allow **B** for **b***

1

(c) **f** ✔

*Allow **F** for **f***

1

(d)

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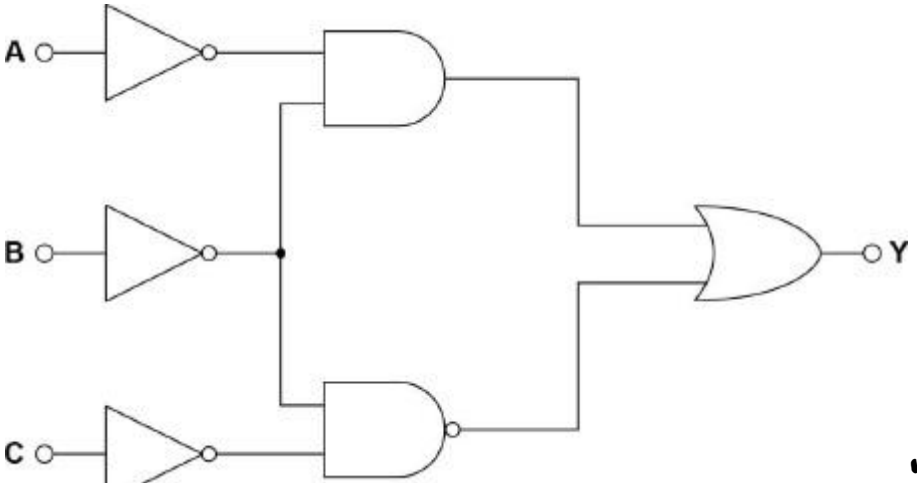

✔✔✔

MP1*: all inputs inverted (accept a shorted-out NAND or NOR gates for the inverters)*

MP2: *for correct use of AND and NAND*

Condone a NOT following an AND for the NAND gate.

MP3: *for final gate being OR*

3

[7]

Q2.

(a) Method indicated for calculation of potential at **X** ✔

MP1*: expect to see use of potential divider formula / other method (e.g V=IR) explained*

Correct calculation to give voltage at **X** = 5.00(125) V ✔

MP2*: Correct calculation for potential at **X***

Reading = their value for potential at **X** - 5 V ✔

MP3*: Expect to see 1.25 mV*

Allow 1.2 mV or 1.3 mV to 2 sf.

3

(b) A resistor (used instead of strain gauge **B)** would not have same response to temperature changes as strain gauge **A**

OR

Using strain gauge **B** will have same response to temperature as strain gauge **A** ✔

By using two strain gauges the (voltmeter) reading will only be affected by changes in strain (as temperature effects will cancel)

OR

use of a resistor will cause the (voltmeter) reading to change due to strain and temperature changes ✔

Do not allow just the phrase:

'for temperature compensation'

2

(c)

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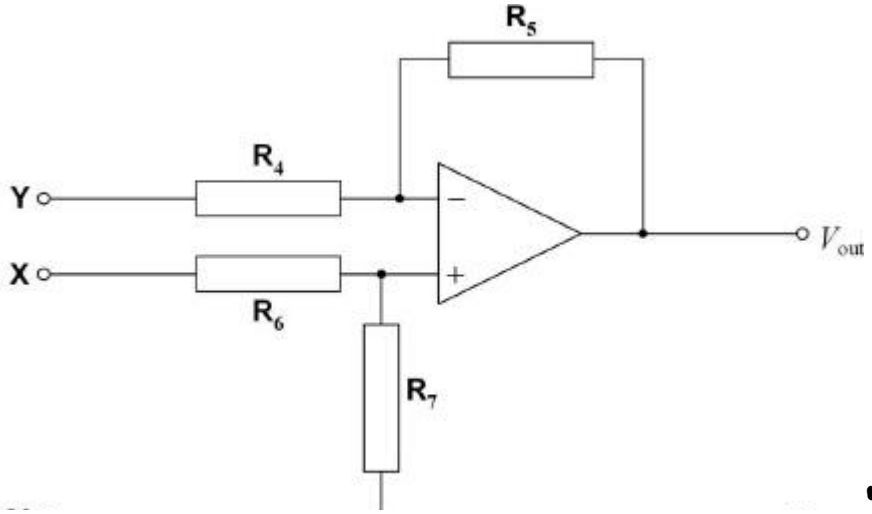

✔✔✔

MP1: *for correct configuration*

Condone incorrect op amp terminal signs in ***MP1****.*

MP2: *for* ***X*** *and* ***Y*** *leading to correct op amp terminals.*

MP3: *for* $R_5/R_4 = R_7/R_6 = 5$

Do not award ***MP3*** *if any resistance value is outside the range (10 kΩ-10 MΩ)*

3

[8]

Q3.

(a) modulator amplifier receiver demodulator ✔

1

(b) The up-link and down-link frequencies were made different. ✔

1

(c) Evidence of travel time calculation using:

distance travelled in single/return journey ÷ speed of e-m wave (in free space) ✔

Single journey time

= 80×10^6 *m* $\div 3 \times 10^8$ *m* $s^{-1} = 267$ *ms*

OR

Return journey time

= 160×10^6 *m* $\div 3 \times 10^8$ *m* $s^{-1} = 533$ *ms (accept 534 ms)*

Do not allow use of 40×10^6 *m*

Processing time = time delay - travel time ✔

Must be a round-trip calculation for second mark.

E.g. Processing time = 900 ms - 533 ms = 367 ms

Accept their ***return*** *journey travel time as ecf in MP2*

2

(d) **USA** - Geostationary satellite provides permanent link ✔

UK - idea that the satellite is in communication with UK and USA (only) for (short) periods of time. ✔

Accept reference to additional time delay for live events in UK due to extra distance travelled by e-m wave.

2

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(e) any two from ✔✔

- more secure - need to break into the cable to read data in transition.
- continuous communication as link is always connected.
- larger bandwidth.
- reduced time delay between signal transmission and reception due to shorter distance travelled (even allowing for slower signal speed in cable).
- reduced interference - e-m noise will not interfere with optical transmission.

Allow other correct answers.

2

[8]

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