Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

The mark scheme gives some guidance as to what statements are expected to be seen in a 1 or 2 mark (L1), 3 or 4 mark (L2) and 5 or 6 mark (L3) answer. Guidance provided in section 3.10 of the '*Mark Scheme Instructions*' document should be used to assist in marking this question.

Level	Criteria
L3 **6 marks**	The candidate shows a good understanding of the way **both** systems operate. They propose a valid and reasoned solution for both Island **B** and Oil rig **C**. They use technical terms correctly, the answer has structure and clearly conveys the information required.
L3 **5 marks**	The candidate shows a good understanding of the way **both** systems operate. They propose a valid and reasoned solution for both Island **B** and Oil rig **C**. However, there may be minor gaps in knowledge OR the style / structure may lead to a lack of clarity in some of the information being presented.
L2 **4 marks**	The candidate shows a general understanding of the material but one of the systems or supported solutions will be treated superficially. Structure and technical language used is generally good.
L2 **3 marks**	The candidate shows a general understanding of the material but one of the systems or supported solutions will be treated superficially. There may be some lack of clarity either through the structure or in use of technical terms.
L1 **2 marks**	The candidate shows a basic understanding of the way **one** system operates. They propose a supported valid solution for either Island **B** or Oil rig **C**. There may be some lack of clarity in structure, there is good use of technical terms.
L1 **1 marks**	The candidate shows a basic understanding of the way **one** system operates. They propose an unsupported but valid solution for either

	Island **B** or Oil rig **C**. There may be some lack of clarity either through the structure or in use of technical terms.
L1 **0 marks**	The work contains no significant analysis of the question asked.

Proposed solution:

Island B

Initial phase – use of satellite link

- Quick and easy to set up mobile sat unit(s).
- Initial usage and platform range likely to be low, hence lower bandwidth / data rates not an issue.
- Some difficulties with two-way conversations due to signal delay.
- Higher maintenance costs and possible interference problems due to EM noise and security issues.

Later phase – install submarine cable

- More forward planning / expense needed to put this in – cable ship / terminations / internal network Heavier usage as development proceeds and wider platform support – hence more bandwidth / larger data rate required.
- More reliable link
- Low security issues and immune to EM interference.

Oil rig C

Satellite link

- Fibre optic cable not an option due to mobile nature of the rig.
- Satellite link is a low-cost short-term solution.
- Light use and limited platform requirement so reduced bandwidth / lower data rate not critical.
- Some difficulties with two-way conversations due to signal delay.
- Reliability issues.

[6]

Q2.

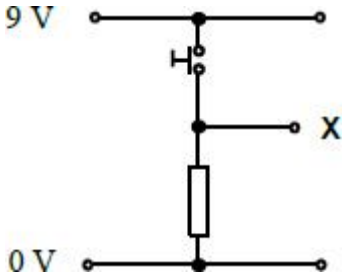
(a)

Inputs			Output
C	B	A	Q
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

*All Q **states** correct for 1 mark*

1

(b)



Correct orientation for resistor & switch ✔

Correct tap-off point for ***X*** ✔

2

(c) $Q = \overline{(C.A)+(C.B)}$ Two correct brackets ✓

+ with full bar ✓

Allow for 1 mark: $Q = \overline{C.(A+B)}$

2

(d) The gate acts as an inverter ✔

Accept 'NOT' as the function

1

(e) Must be a reason and a consequence for the mark. ✔

eg Uses only one type of logic gate so need to hold less stock

OR

Uses only one chip rather than two so circuit board can be smaller / less power needed / cheaper

Do not allow: Less complex circuit

1

[7]

Q3.

(a) Photoconductive mode

Accept 'reverse bias'

1

(b) Dark currents will become a source of noise – need to keep S:N as high as possible OWTTE

OR

Need to have a large difference in signal when detector is in light and dark ✔

Must include idea of 'noise'

OR

Must include concept of large signal change to represent digital signal

1

(c) At 850 nm, R_λ = 0.50 A/W ✔

Reading from graph

Allow 0.49 A/W to 0.51 A/W

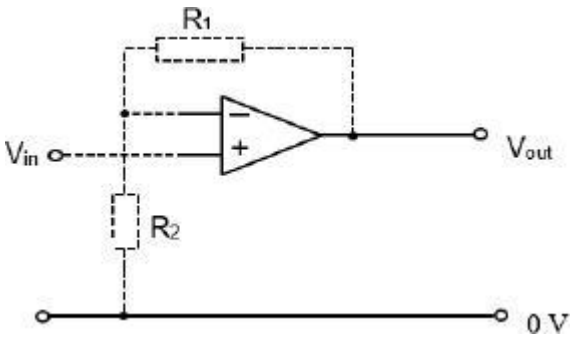
Using $R_\lambda = \frac{I_p}{P}$ $I_p = R_\lambda \times P$ $0.50 \times 4 \times 10^{-6} = 2\ \mu A$ ✓ ecf

$V_{out} = I_p \times R$ 2 µA × 560 kΩ = +1.12 V ✔

Accept voltage in range of 1.10 V to 1.14 V
Accept value without + sign

3

(d)



Correct configuration of R_1 and R_2 ✔

R_1 : R_2 ratio 3 : 1 in suggested range ✔

Label the input point which must have a direct connection to the non-inverting input ✔

One mark only

An inverting op amp configuration with a voltage gain –4.

3

[8]