



SURNAME: PENNY

FORENAME(S): LUKE DORAN

12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

1	Student Number	1810356
2	Title of Examination Paper	ACOA 5009 EMR
3	Module Code	5009
4	Date and Time of Examination	3/5/22 10:00
5	Examination Venue	002
6	Seat Number	/
7	Number of Answer Books handed in	

[illegible]

- 1) Radiowaves - able to induce a current in a conductor.
 Microwaves - able to induce a current in a conductor and produce heat in non-conductors.
 IR - not able to induce a current in conductors but can induce heat in both conductors and non-conductors.
 Visible - seen by the human eye.
 UV - not seen by the human eye and biologically harmful.
 Xray - ionising radiation produced by electrons.
 Gamma - ionising radiation produced by nuclei.

7

7

- Refraction - change of direction of a wave as it passes through one medium into another.
 Diffraction - bending of light around an obstacle or through an aperture.
 Dispersion - the separation of frequencies in a wave.
 Specular Reflection - a mirror reflection where the angle of the incoming light is the same as the reflected light.
 Diffuse reflection - a scattering of light when in contact with a media.
 Transmission - ~~the energy imparted into the material from the wave in contact~~
 the passage of a wave through a media without any absorption.
 Absorption - the energy imparted into a material from the wave.

7

Q1 = 4

2) a) $\text{wavelength} = \frac{v}{f} = \frac{3 \times 10^8}{433 \times 10^6} = 0.693$

2

$\text{quarter length} = \frac{0.693}{4} = 0.173 \text{ m}$

- b) - Line of sight
 - Pitch + Yaw of missile
 - Ground plane / Earth
 - Ionising exhaust fumes.

3

c) inverse square law

$$\frac{10 \times 270^2}{90^2} = 90 \text{ mW}$$

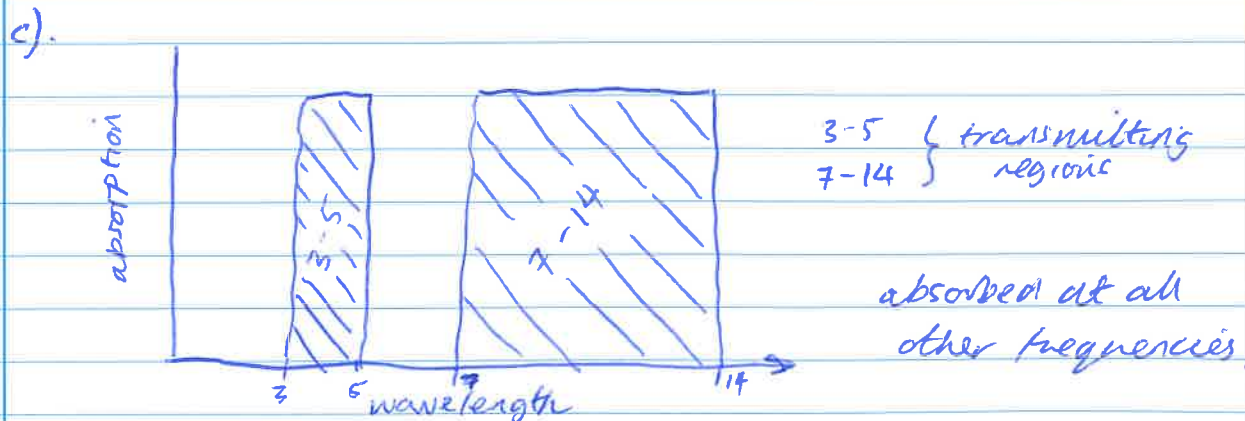
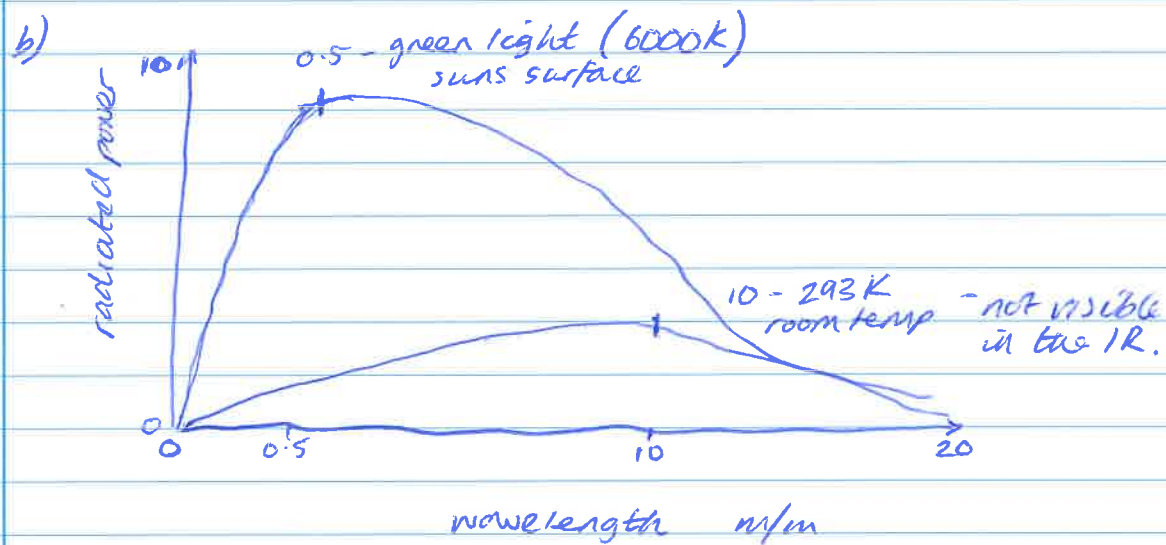
d) High gain directional antenna - Yagi.

e) $6 \times 8 = 48$

$$\frac{40000}{48} = 833.3 \text{ bits/s}$$

Q2 = 9

3) a) a black body radiator is an object that absorbs all electromagnetic radiation at all frequencies, at all angles of incidence.



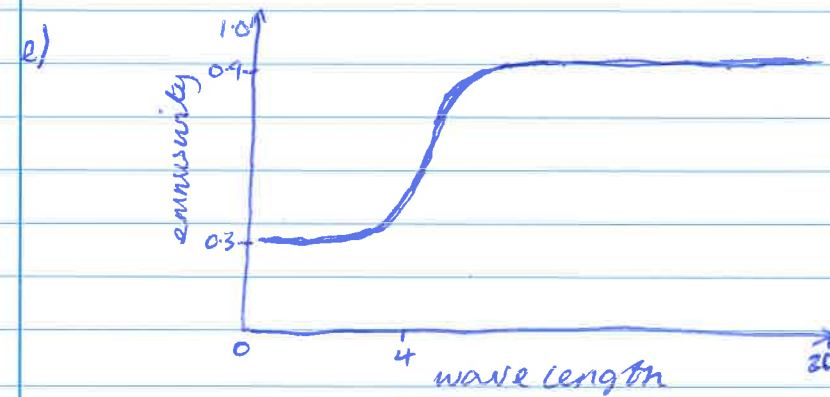
- Gases in the Earth's atmosphere absorb at different frequencies.

d) Emmissivity - is the ratio of emittance from a material compared to the ^{energy emitted from} absorbance of a black body.

Polished silver - 0.02

Black body - 0.98

metal oxide emmissivity



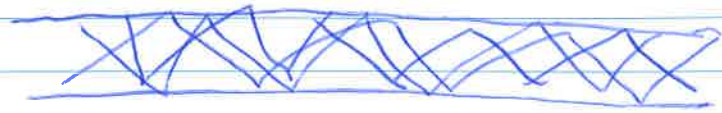
f) white paint ~~reflects~~ wants to absorb smaller wavelengths poorly and larger wavelengths better, so it radiates at its own temperature and reflects the wavelength corresponding to the sun's temperature.

Q3 = 15

4) a) - Cheaper

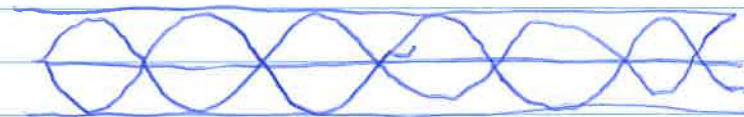
- Higher data rate
- more secure
- more distance
- Reliability
- Multi directional signal
- Lighter (thinner diameter)
- more robust

b) Step index multi-mode



the signal is scattered down the fibre not in a uniform fashion.

Graded index multi-mode



the signal positively reinforces its self with the centre line.

mono-mode



the signal travels straight down the fibre with no refraction.

Step index

- 1mb/s speed
- 1km range
- Cheap, very robust
- Used for short range applications

Graded index

- 10 mb/s speed
- 10km range
- more expensive but larger range and speed.

mono-mode

- 1 Gb/s speed
- 100km range
- Very expensive, used for long range precision purposes.



c) The choice of fibre required depends on the distance you require your signal to go and how complex the signal is. The factors for selecting the right fibre:

- Distance
- Data rate
- Robustness / Reliability
- Cost.

I would suggest the use of either the multi-mode step or multi-mode graded index.

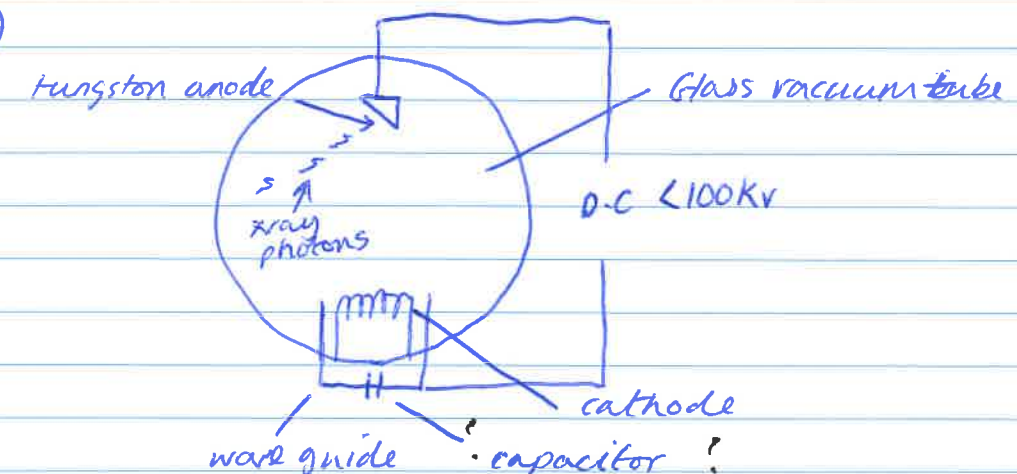
These would be sufficient in sending the signal the required distance for the correct data rate. The multi-mode step index is the most robust fibre so probably the best choice to use when undergoing extreme pressures from launch. It is the cheapest also so would keep overall costs to a minimum.

Q4 = 22

5) a) NDT - non destructive testing

Flash xray
Security / scanning
Crystallography

b)



c) When the tungsten anode receives an adequate amount of ~~energy~~ energy from the D.C, the electron in the inner orbital is knocked off and replaced by an electron from the outer shell. The electron jumping to the inner orbital is what emits an xray photon. The D.C replaces the electron in the outer shell so the anode does not degrade and the process repeats itself over a very short period of time.

4

|

d) Compton effect - when gamma particles are charged they give off a magnetic field.

1

e) Atomic mass / number
Depth of penetration
Density of material
Power supply

-1

-1

4

f).

-4

g) the compton effect.

-3

Q5 = 17

6) b) ~~1 tesla~~ 1 tesla = 1 newton.

4 -10

5

$$c). L = \frac{\mu N^2 A}{l}$$

$$\frac{L}{N^2} = \frac{\mu A}{l} \quad N_2 = \frac{L \mu A}{l}$$

$$\frac{(40 \times 10^{-3}) (4\pi \times 10^{-7}) (20)}{10 \times 10^{-3}}$$

$$= \sqrt{1.01 \times 10^{-4}} = 0.01$$

-2

Q6 = 8

3

|