



Prifysgol Cymru
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Complete, fold and seal
(see note 2 below)

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1 of 1

Examination Answer Books

12 Pages

Instructions to Candidates

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	1810310
2	Title of Examination Paper	ELECTROMAGNETIC RADIATION
3	Module Code	ACDA5009
4	Date and Time of Examination	11 AM 03-05-22
5	Examination Venue	1Q002
6	Seat Number	
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	17
2	10
3	16
4	17
5	21
6	15
Total	

(Gweler yr ochr arall am y fersiwn Cymraeg)

1

a

- 1 Gamma ~~ray~~
- 2 X-Ray
- 3 Infrared
- 4 Visible light
- 5 Ultraviolet
- 6 Microwave
- 7 Radio wave

7

b

- ✓ 1 Ionising Produced by Nuclei
- ✓ 2 Ionising Produced by electrons
- x 3 Non conducting can heat conductor and non conductor
- ✓ 4 Can be seen with human eye
- x 5 Can induce current in conductors harmful to organic matter
- ✓ 6 can induce current in conductors and heat in dielectrics
- ✓ 7 Can induce current in conductors with long waves

5

c

Refraction is the change in direction of a wave through two different medium

d

Diffraction is waves ability to travel around corners after an obstacle or collimation

e

x Dispersion is how a wave can separate ...

f

Specular Reflection is how a wave changes direction after hitting a medium the wave does NOT Disperse i.e. Mirror

x

-1

1 cont
g diffuse reaction is how a wave changes direction and disperses when hitting a medium

h Transmission is a wave travelling through a medium without imparting any energy

i Absorption is the wave imparting energy into a medium

Q1 = 17

2
a Calculate ideal Antenna Length (IAL)

$$IAL = \frac{\text{Speed of light}}{\text{carrier wave}} = \frac{3E^8}{433E^6} = 0.693m$$

For quarter wave Antenna

$$\frac{IAL}{4} = \underline{\underline{0.173m}}$$

b Factors that can affect communication between missile and ground station

- ground Plane
- Orientation of Antenna
- obstructions or Interference

c After losing signal at 90m Calculate Power to reach 270m using initial 10mW out put
Inverse square law

$$I_2 d_1^2 = I_1 d_2^2$$

2c
continued

∴

$$\frac{I_1 d_2^2}{d_1^2} = I_2$$

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

d to maintain signal with 10mW a directional Antenna such as Yagi array could be used

e to calculate shortest time interval for 6 degrees of freedom in 8-bit resolution

$$\text{Data Rate} = \text{No. of signals} \times \text{Resolution}$$

$$= 6 \times 8$$

$$= 48$$

$$\text{Time interval} = \frac{\text{Data rate}}{\text{carrier wave}}$$

$$= \frac{48}{40E^3}$$

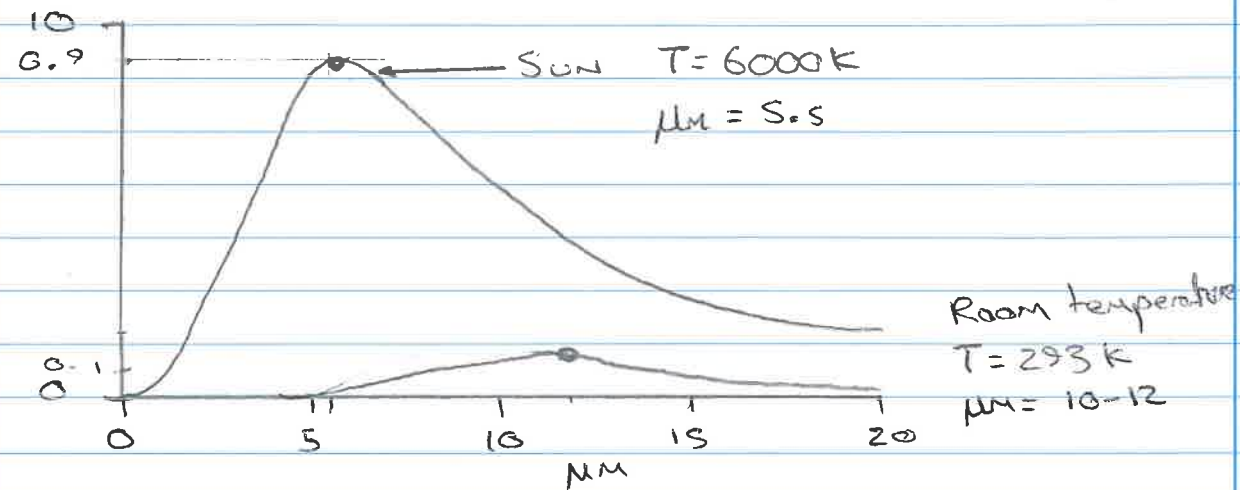
$$= 1.2E^{-5} \text{ Seconds}$$

$$= 1.2 \text{ milliseconds}$$

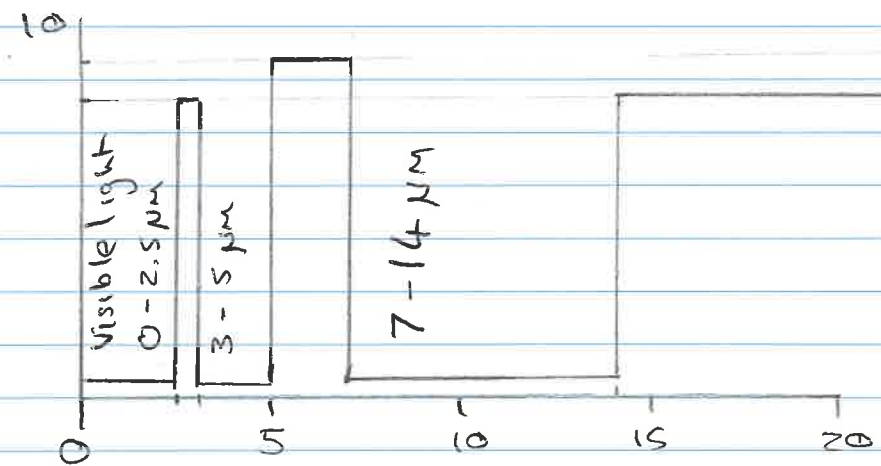
3.

a A BLACK-BODY radiator Absorbs all waves at all frequencies and Angles OF incidence

b Radiated Power OF SUN against Room temperature



c Absorption in Atmosphere



d emissivity is A mediums Ability to radiate energy when compared with a black body
where a blackbody = 1
black paint would be ~ 0.98
And polished Silver would be ~ 0.02

2

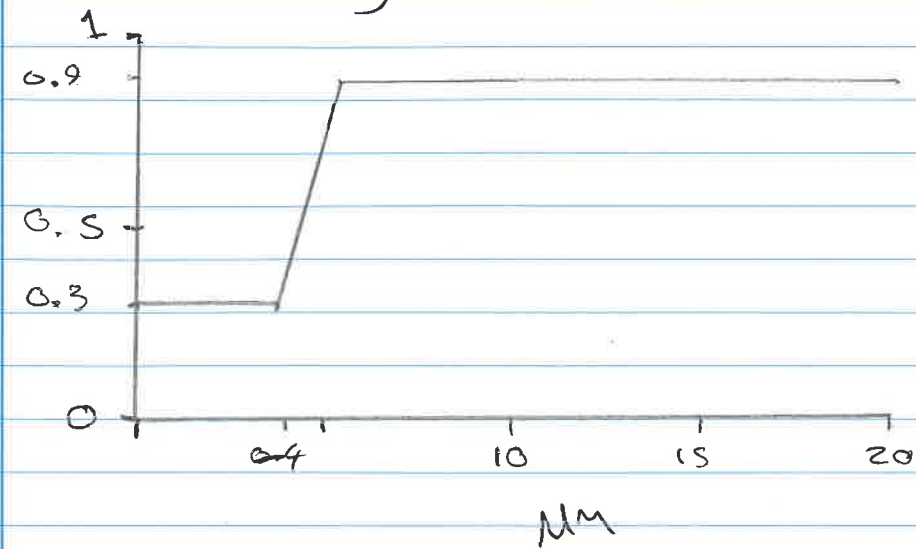
3

4

3

3e

Emissivity curve for titanium oxide



f dark olive green paint much like black paint will absorb heat energy whereas white paint containing titanium oxide will reflect lower wave lengths and radiate ~~low~~ higher ones meaning it will not store as much heat.

Q3=16

4

a Advantages of optical fibre over Copper wire

- ✓ - cheaper
- ✓ - works at greater Distance
- ✓ - Smaller / Light weight
- ✓ - more secure
- ✓ - duplex operation
- ✓ - higher Bandwidth

- EM immunity
Reliability

②

2

2

6

4. b

fibre type	Light transmission	Advantages + Disadvantages
Step Index multi mode	multiple light paths	cheap Robust small diameter Short Range and data rate
graded Index multi mode	'steered' light path	Intermediate scoring of all above
Mono mode	central light guide	expensive Large diameter Long range high data rate high Precision

-3

C Spearfish torpedo fibre upgrade factors

Distance
Robustness
Data rate
Cost

given spearfish has operation range of around 10km step index would not suffice, graded index can manage data rate of control is reasonably hardwareing can Ascertain distance And is the lower costing of both remnant options would be my choice

Q4 = 17

5

a

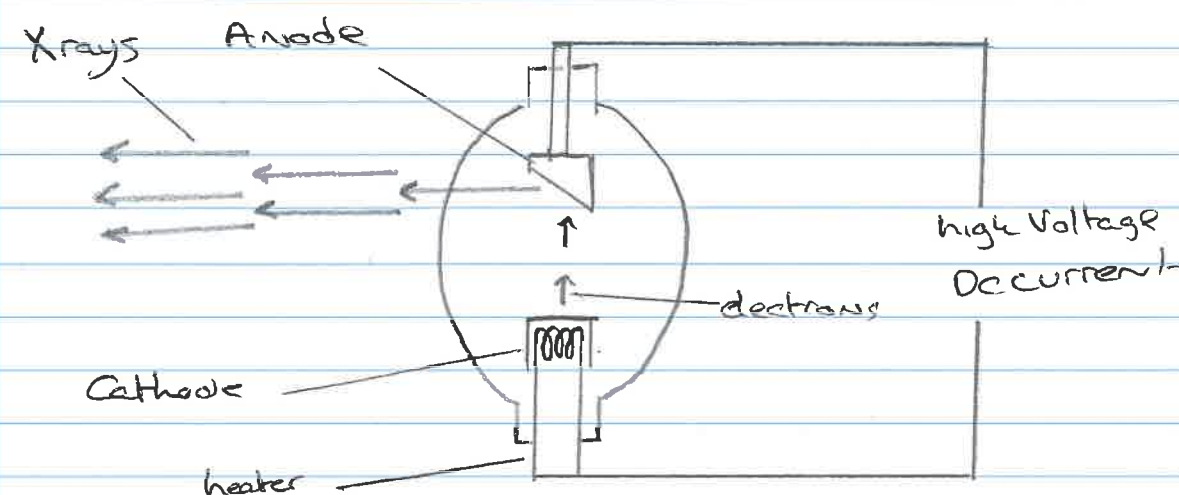
Xray and Gamma radiation uses in ONE

- Inspection
- Detection
- Quality Control
- Flash X-ray

-1

3

b Electron beam Xray Generator



4

c electrons hit the anode and dislodge inner most electron then electron from outer ring moves in to take its place producing an X-ray

4

d the Compton effect is how an electron produces photons when moving about layers

-2

5

5e Factors Affecting X-ray Absorption

- ↳ Thickness
- ↳ density
- ↳ Atomic mass and Number
- ↳ Magnitude of X-ray energy

f

$$\mu \propto \frac{\rho Z^4}{A E^3}$$

(-2)

g a nuclear explosion generates an electromagnetic pulse using the Compton effect to induce currents in surrounding conductors effectively overloading them

Q5 = 21

6a for inferences of Biot-Savart Law

Directly $\propto$ to Conductor length
Magnitude of force
Density

(-5)

Inversely $\propto$ to the square of the distance

b

~~X Test~~ = 1 Newton

6d

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

make N subject

$$\frac{L \times L}{\mu \times A} = N^2$$

$$\sqrt{\frac{L \times L}{\mu \times A}} = N$$

$$L = 40 \times 10^{-6} \text{ H}$$

$$\mu = 4\pi \times 10^{-7} \text{ Wb/A.m}$$

$$l = \cancel{0.01} \text{ m } 0.1 \text{ m}$$

$$A = \pi r^2 = \pi (0.01)^2 = 3.142 \times 10^{-4} \text{ m}^2$$

$$\sqrt{\frac{4 \times 10^{-6}}{3.948 \times 10^{-10}}} = \text{Number of turns} = 100.653$$

$$\therefore N = 101 \text{ turns}$$