Practice Question Set For A-Level
**Subject : Physics**
**Paper-3 Topic: Section B (Section 10_ Medical Physics)**

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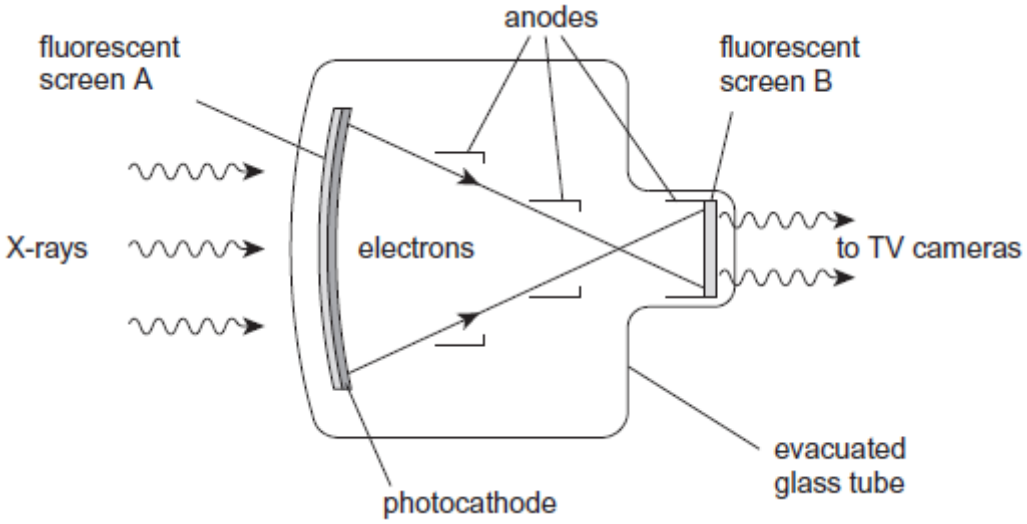
**Name of the Student**:_____
**Max. Marks : 20 Marks** **Time : 20 Minutes**

## Q1.

(a) The diagram below shows a fluoroscopic image intensifier.




State the purpose of each of the following components of the intensifier.

(i) fluorescent screen A,

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_____

**(1)**

(ii) photocathode,

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_____

**(1)**

(iii) anodes,

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_____

_____

_____

**(2)**

(iv) fluorescent screen B.

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**(1)**

(b) A patient is asked to swallow a suspension of barium sulfate before X−ray images are to be obtained. This is known as a barium meal technique.
Explain why the patient needs to swallow the barium sulfate.

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**(2)**

**(Total 7 marks)**

## Q2.

(a) When ultrasound is incident at an interface between two different media some energy is transmitted and some is reflected. The ratio of the reflected energy intensity $I_r$ to the incident energy intensity $I_i$ depends on the relative acoustic impedances of the two substances.
Acoustic impedance $Z$ is a property of the substance and is given by $Z = \rho v$
where $\rho$ is the density of the substance and $v$ is the velocity of the ultrasound wave.
The ratio is given by

$$\frac{I_r}{I_i} = \left(\frac{Z_2 - Z_1}{Z_2 + Z_1}\right)^2$$

$Z_1$ is the acoustic impedance of the substance into which the wave is reflected.
$Z_2$ is the acoustic impedance of the substance into which the wave is transmitted.

The table below shows the density and velocity of waves in two different substances.

| Substance | Density / kg $m^{-3}$ | Velocity / m $s^{-1}$ |
|---|---|---|
| 1 | 1050 | 1540 |
| 2 | 925 | 1450 |

(i) Calculate the percentage of incident energy that is reflected when ultrasound is incident on a surface while travelling from substance 1 into substance 2.

percentage reflected _____ %

**(3)**

(ii) An ultrasound wave of frequency 2.00 MHz travels in substance 1.

Calculate the wavelength of the ultrasound in metres.

wavelength _____ m

**(2)**

(b) Describe how ultrasound is used to produce an image of different tissues within the body.

Your answer should include:
- an explanation of how the image is produced
- an explanation of how the differences in acoustic impedance of body tissues affect the quality of the image produced.

The quality of your written communication will be assessed in your answer.

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**(6)**

(c) The resolution of an image is an important factor in the design of ultrasound equipment.

State what is meant by **resolution** and explain why the wavelength of the ultrasound determines the resolution of the image.

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**(2)**

**(Total 13 marks)**