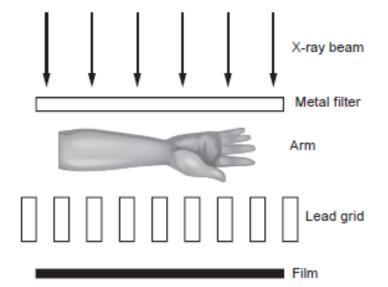
Physics

Question	Maximum Mark	Mark Awarded
#1	20	
#2	20	
#3	20	
#4	20	
Total	80	



Disclaimer: The questions in this revision paper have all been taken from actual examinations that have taken place. Whilst the questions are the property of Eduqas, this revision paper was created using an online tool and Eduqas take no responsibility for the content within it.

12. (a) When taking an X-ray image of a person's arm a metal filter is placed between the X-ray tube and the arm, and a lead grid between the arm and the film as shown.



Explain the purpose of both the metal filter and the lead grid. [4]	
(b) An X-ray tube operates at a pd of 30 kV producing a tube current of 15 mA.	
(i) Calculate the number of electrons that strike the target element every second. [2]	

	(ii) Calculate	the force exerted b	y the electron beam on the ta	rget. [3]
(c)	You have the cl	hoice of the following	g forms of medical imaging a	vailable:
	MRI scan	PET scan	ultrasound B-scan	CT scan
	Evaluate the eff	fectiveness of each	type of imaging in detecting a	cancerous tumour on a
	,			[9]
				[c]
				[0]
				[0]

(i)	Radioactive tracers can be used to measure the volume of blood in a patier Describe one other use of radioactive tracers naming the part of the body they a diagnosing.
(ii)	An isotope of sodium, Na-24, has a half-life of 15 hours and an initial activity of 160 Bq when injected into a patient. Seven hours later a sample of 5 cm ³ of block was taken and found to have an activity of 0.12 Bq. Estimate the volume of blood the patient.
(iii)	Ultrasound of frequency 3.0 MHz was used to measure the rate of flow of bloo A shift of 0.50 kHz was detected. The measurement was taken at an angle of 30° the direction of flow and the speed of ultrasound through the blood is 1500 ms. Calculate the speed of blood flow.
(iii)	A shift of 0.50 kHz was detected. The measurement was taken at an angle of 30° the direction of flow and the speed of ultrasound through the blood is 1500 ms
(iii)	A shift of 0.50 kHz was detected. The measurement was taken at an angle of 30° the direction of flow and the speed of ultrasound through the blood is 1500 ms
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Question taken from Eduqas examination paper 842103, June 2018

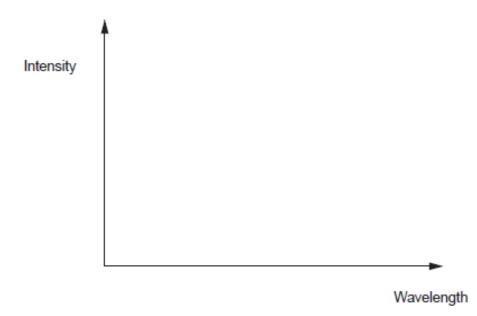
		Intensity 1
		Wavelength / nm
	(i)	Draw on the above diagram an intensity spectrum for the same X-ray tube with a higher operating voltage. [1]
	(ii)	If the operating voltage of the tube is 30 000 V, determine the minimum wavelength of the X-rays produced. [2]
	(iii)	If the anode current is 120mA and the X-ray tube has an efficiency of 0.450% calculate the rate of production of heat at the anode. [2]
	(iv)	Explain whether it would be possible to reduce the minimum wavelength to zero.
<i>(b)</i>	(i)	An ultrasound probe (A scan) can be used to determine the thickness of a lens in the human eye. Explain how a piezoelectric transducer can be used to produce ultrasound.
	(ii)	A typical ultrasound A scan used to determine the thickness of a lens is given in the diagram below. The spike labelled 'ant lens' corresponds to the front of the lens and the spike labelled 'post lens' corresponds to the back of the lens. probe/ ant post lens lens retina sclera retina sclera orbital tissues Use the information in the diagram to calculate the lens thickness. The speed of ultrasound in the lens is 1640 ms ⁻¹ .
(c)	Justif	nave the choice of the following forms of medical imaging: X-ray ultrasound A scan radioactive tracer CT scan fying the reasons for your answer, state which of the above you would use to detect allowing: A cerebral haemorrhage (bleed in the brain).
	(ii)	An underactive thyroid gland. [2]
(d)	spec	fRI (magnetic resonance imaging) scanner has a magnetic field that varies from T to 1.40T along its length. Calculate the wavelength of electromagnetic waves red to scan a slice halfway along its length and state which part of the electromagnetic trum they belong to. [4]

Question taken from Eduqas examination paper 842103, November 2020

now a piezoelectric transducer can be used to produce ultrasound.	beam becomes attenuated. The thickness of bone needed to reduce intensity by 50% is known as the half value thickness, x_1 . Show that $x_2 = \mu$ is the attenuation coefficient. (ii) A beam of X-rays is used to detect a fracture in a bone. If the half value for these X-rays in bone is 1.5cm, calculate the thickness of bone that r incident intensity by 60% of the original intensity. (iii) X-ray imaging is not suitable for diagnosing brain turnours. Explain why, as a more suitable technique giving your reasons. (iii) X-ray imaging is not suitable for diagnosing brain turnours. Explain why, as a more suitable technique giving your reasons. (iii) An uitrasound probe can be used to check the development of an unborn ballow a piezoelectric transducer can be used to produce uitrasound. (iii) Complete the table by calculating the different values for acoustic impediance of the fraction of uitrasound reflected at a boundary is given by the coefficient, <i>R</i> , where:		ive prietly ho	iow A-rays are prod	uced in an X-ray tube	s.
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	A typical MRI scanner operates with a Larmor frequency of 64MHz. Cal magnetic field strength, B , that would be needed to provide this, and state which would not be able to undergo MRI scans.					

Question taken from Eduqas examination paper 842103, June 2017

(i) Sketch graphs to show how the intensity of X-rays from an X-ray tube varies with wavelength for a tube operating at two different voltages. Label the main features of the graphs and indicate which curve represents the higher voltage. [4]



electrons strike the target. [2]
(iii) Calculate the minimum wavelength of the X-ray photons produced by these electrons. [2]

(b)	(i)	Ultrasound can be used to carry out either an amplitude scan (A-scan) or a brightness scan (B-scan). Explain which of these two methods you would use to determine the depth of the tumour. Justify your answer. [2]
	(ii)	An ultrasound scan can be used to indicate the thickness of fat on a person's body. Typically fat has a density of $930\mathrm{kgm^{-3}}$ and an acoustic impedance of $1.35\times10^6\mathrm{kgm^{-2}s^{-1}}$. If the time delay for the ultrasound pulse is $0.040\mathrm{ms}$. Determine the thickness of fat.

(c)	(i)	Explain two properties of a radioactive isotope used as a tracer in medicine. [2]
	(ii)	A small volume of Human Serum Albumin (HSA) labelled with iodine-125 of activity 160 Bq is injected into the bloodstream of a patient. A sample of 0.8 cm³ of blood was taken a few hours later and was found to have an activity of 0.025 Bq. If the half-life of iodine-125 is 60 days, calculate the volume of blood in the patient. State any assumptions you make.
(d)	In a alon appr Fran	magnetic resonance imaging (MRI) scanner a large magnetic field of 1.5T is used g with short pulses of radio waves. Dr Francis suggests that radio waves of wavelength oximately 5 m would be suitable for this MRI scanner. Determine whether or not Dr icis is correct.

Question taken from Eduqas examination paper 842103, June 2019