

X-RAYS

1. (a) Minimizing energy lost due to collisions; (1mk)
- | | |
|-------------------------------|-------------------------|
| (b) Hard | Soft |
| 1. Highly penetrative /Energy | Low penetrative /Energy |
| 2. Short wavelength | Long wavelength |
| 3. High frequency | Low frequency |
| 4. Produced at high voltage | produced at low voltage |
- Any one x 3 = (3mks)

2. Lead. 1
 Lead shields will stop the travel of X-rays. 1
 X rays are dangerous/ hazardous. 1

3. (a) Rays originating from target. 1
 Rays directed out of window. 1
 (b) Cathode 1
 (c) >10,000V (10kV) 1
 (d) Electrons are boiled/ given off 1
 Attracted/ accelerated towards anode 1
 (e)Anode becomes warm/ hot 1
 due to energy absorbed from electrons. 1
 (f) Electrons would bump into / ionise/ excite gas molecules 1
 Fewer electrons would reach the anode
 Or
 The electrons have not enough energy to make X-rays 1
 (g) Lead. 1
 Lead shields will stop the travel of X-rays. 1
 X rays are dangerous/ hazardous. 1
TOTAL / 13

4. Appropriate voltage:
- | | |
|--|---|
| kilovolt range [Not keV] (1) | 1 |
| Anode rotated: | |
| so heat spread out/not just one point (1) | 1 |
| Tube evacuated: | |
| So no collisions/obstruction/scattering of electrons with air molecules OR by atoms/particles OR equivalent (1) | 1 |
| Appropriate material: | |
| Lead (1) | 1 |

[4]

5. (i) thermionic emission; 1
- (ii) A description to include three from:
1. heat in filament (releases electrons);
 2. reference to 50 kV supply;
 3. KE (due to electric field);

- | | | |
|-------|---|---|
| | 4. wave energy/energy of X-rays/heat; | 3 |
| (iii) | (50 kV) power supply; [Reject heater filament] | 1 |