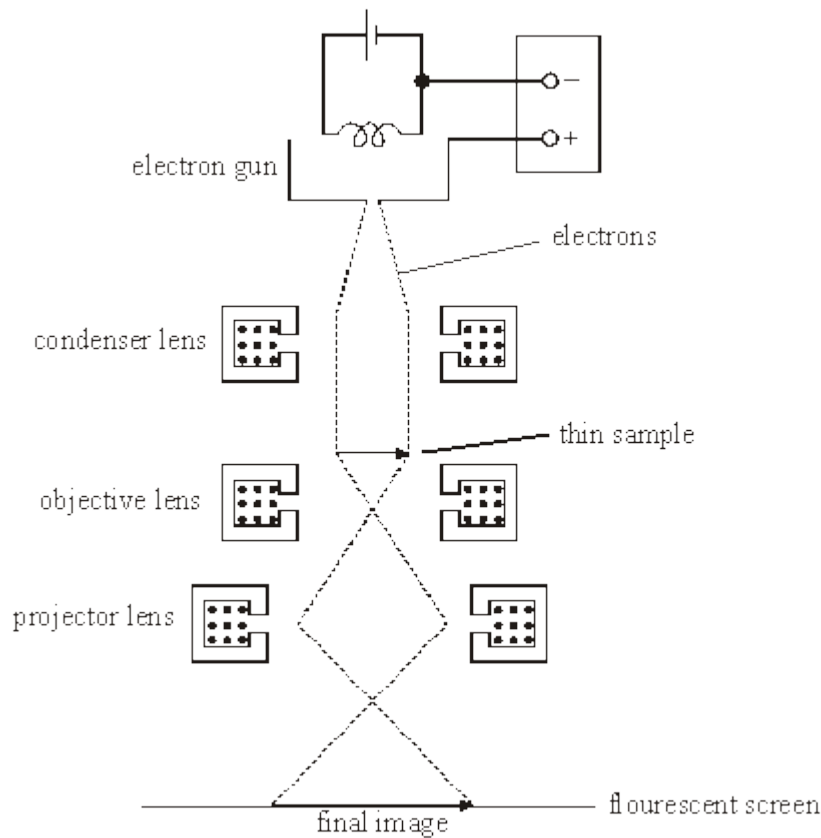


1

In a transmission electron microscope, electrons from a heated filament are accelerated through a certain potential difference and then directed in a beam through a thin sample. The electrons scattered by the sample are focused by magnetic lenses onto a fluorescent screen where an image of the sample is formed, as shown in the figure below.



- (a) State and explain **one** reason why it is important that the electrons in the beam have the same speed.

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(2)

(b) When the potential difference is increased, a more detailed image is seen. Explain why this change happens.

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(3)
(Total 5 marks)

2

Compare the advantages and disadvantages of optic fibre and copper wire for transmitting information.

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(Total 6 marks)

Mark schemes

1

- (a) force on an electron in a magnetic field depends on speed **(1)**
electrons at different speeds would be focussed differently so image
would be blurred **(1)**
[or electrons at different speeds would have different (de Broglie)
wavelengths
therefore resolution would be reduced]

2

- (b) increase in pd increases speed **(1)**
increase in speed/momentum/ E_k causes reduction of (de Broglie)
wavelength **(1)**
reduced (de Broglie) wavelength gives better resolution **(1)**

3

[5]

2

The mark scheme gives some guidance as to what statements are expected to be seen in a 1 or 2 mark (L1), 3 or 4 mark (L2) and 5 or 6 mark (L3) answer. Guidance provided in section 3.10 of the '*Mark Scheme Instructions*' document should be used to assist in marking this question.

Mark	Criteria	QoWC
6	All three aspects (physical, interference and signal carrying properties) covered: A clear discussion of the advantages / disadvantages of the two systems in terms of weight (and in some cases cost). There may also be a suggestion that optical fibres are harder to join together. A comparison of their relative vulnerability to external interference and security. A comparison of the two systems in terms of signal degradation, bandwidth and speed of transmission.	The student presents relevant information coherently, employing structure, style and sp&g to render meaning clear. The text is legible.
5	Two of the three aspects fully covered, with some detail missing from the third.	
4	One aspect fully covered, with some detail missing from the other two Or Two aspects fully covered, with little or no relevant information about the third.	The student presents relevant information and in a way which assists the communication of meaning. The text is legible. Sp&g are sufficiently accurate not to obscure meaning.
3	All three aspects partially covered, with some detail missing from each Or One aspect fully covered, with little or no relevant information about the other two	
2	Two aspects partially covered, with little or no relevant information about the third.	The student presents some relevant information in a simple form. The text is usually legible. Sp&g allow

1	One aspect partially covered, with little or no relevant information about the other two.	meaning to be derived although errors are sometimes obstructive.
0	Little or no relevant information about any of the three aspects.	The student's presentation, spelling punctuation and grammar seriously obstruct understanding.

		copper	optic fibre
<i>Physical</i>	<i>corrosion</i>	<i>Will corrode unless well-protected</i>	<i>Glass doesn't corrode</i>
	<i>weight / cost etc</i>	<i>Copper heavier / more expensive / easy to join</i>	<i>Thinner and less expensive. Harder to join</i>
<i>External interference</i>	<i>security</i>	<i>Can be 'tapped' without breaking cable</i>	<i>Cannot be tapped (unless cable broken into)</i>
	<i>electromagnetic interference</i>	<i>Can pick up noise / cross talk</i>	<i>Immune from noise / can be used in 'noisy' environments</i>
<i>Signal carrying properties</i>	<i>signal degradation / attenuation</i>	<i>High attenuation</i>	<i>Low attenuation but pulses can suffer smearing</i>
	<i>bandwidth / info carrying capacity</i>	<i>Relatively low / fewer channels</i>	<i>greater info-carrying capacity / more channels / possibility of sending more than one signal on optic fibre eg data + talk</i>

[6]