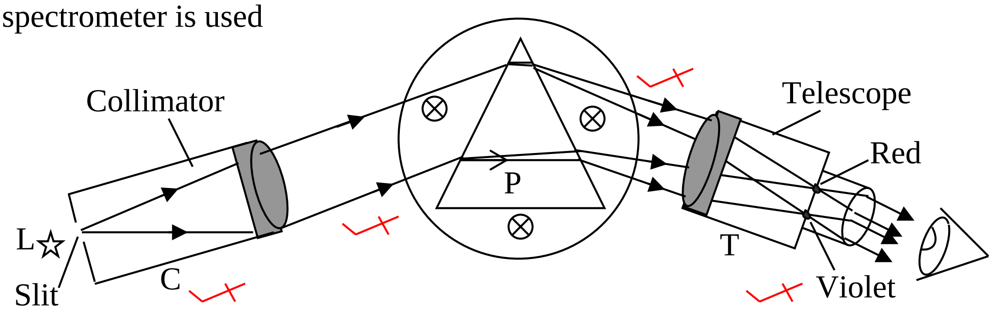
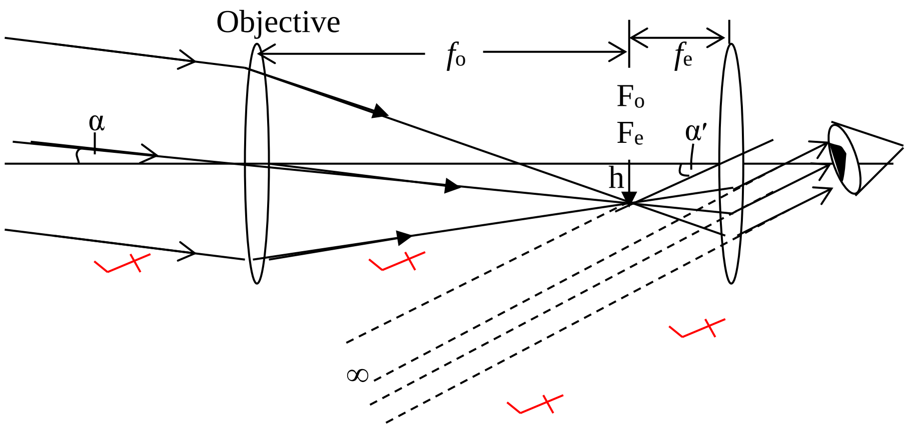
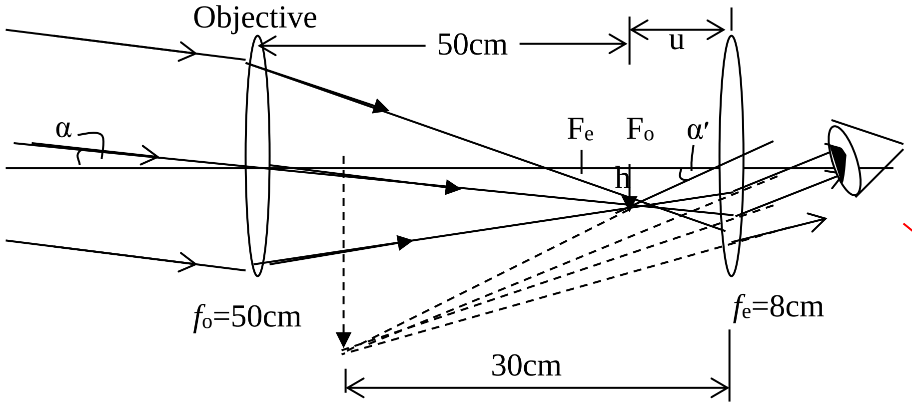
Qn	Answer	Marks
1 (a)	(i) The angle subtended at the eye by the object	1
	(ii) This is the ratio of the visual angle due to the final image due to the instrument to the visual angle when eye is unaided	1
	(iii) This is the coloring of the edges of the images produced by a lens due to dispersion of light.	1
(b)	A spectrometer is used 	½ ½ 1
	- The collimator slit is made very narrow. L is a bright source of white light.	½
	- Then the collimator C and telescope T are both adjusted for parallel beams of light.	½
	- A prism, P, is placed on the table to disperse the light from the collimator	½
	Rays refracted through P are now separated into a number of different colored parallel beams of light, and the telescope brings each coloured beam to a separate focus. A pure spectrum is seen through T, consisting of a series of monochromatic images of the slit.	½
(c)	(i) 	1 ½ ½
	F_o is the principal focus of the objective lens while F_e is that of the eyepiece.	
	- Rays from a point on a distant object arrive at the objective lens as a parallel beam.	½
	- The objective converges the rays to its focal plane and forms an intermediate image there.	½
	- The intermediate image then acts as the object for the eyepiece.	½

	- The arrangement of the lenses is such that their principal foci coincide so that the final image due to the eyepiece is at infinity.	½
	(ii) Rays, say from the top of the distant object, arrive as a parallel beam at an angle α to the principal axis of the lenses. So α is the visual angle at the unaided eye as well. At the same time, if the eye is close to the eyepiece, α′ is the angle subtended by the final image at the eye. Now, these are small angles and in radians, $\alpha \approx \tan\alpha$ and $\alpha' \approx \tan\alpha'$. Therefore if h is the length of the intermediate image I $\alpha^1 = h/f_e$ and $\alpha = h/f_o$ Angular magnification, $M = \frac{\alpha'}{\alpha} = \frac{h/f_e}{h/f_o} = \frac{f_o}{f_e}$	½ ½ ½ ½
(d)	(i)  For the eye piece, using $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ $\frac{1}{-30} + \frac{1}{u} = \frac{1}{8}$ ∴ $u = \frac{30 \times 8}{8 + 30} = 6.3$ cm ∴ Length of telescope = 50 + 6.3 = **56.3 cm**	1 1 1 1
	(ii) $\alpha = h/f_o$, $\alpha^1 = h/u$ Angular magnification, $M = \frac{\alpha'}{\alpha} = \frac{h/u}{h/f_o} = \frac{f_o}{u} = \frac{50}{6.3} = \mathbf{7.9}$	1 2
	Total = 20	
2.(a)	(i) The induced emf is in such a direction as to oppose the flux change causing it.	1

<table>
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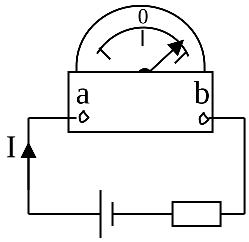
<td>(ii)


Reference circuit</td>
<td>½</td>
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<td>- A reference circuit is first connected, in which a current, I, is passed through a centre-zero galvanometer in a known direction and the corresponding direction of deflection of the pointer noted. This helps to relate the deflection to the direction of current flowing in the galvanometer.</td>
<td>½</td>
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<td>Experiment
- The source of emf in (i) is replaced with a coil whose sense of winding is clear.</td>
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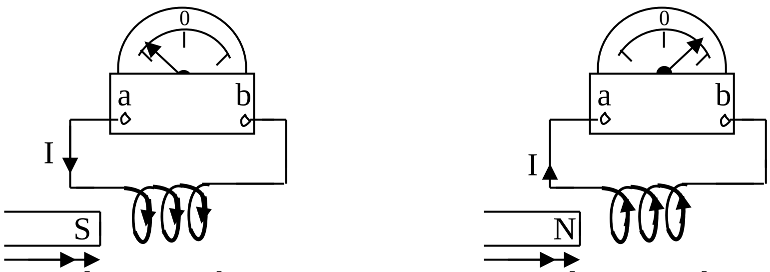
<td>

S-pole approaching N-pole approaching</td>
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<td>- Then a known magnetic pole is thrust towards one end of the coil along the axis of the coil while observing the deflection of the galvanometer.</td>
<td>1</td>
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<td>- By comparison with the reference circuit, the direction of the induced current through the galvanometer, and therefore through the coil is established.</td>
<td>½</td>
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<td>Finally, by following the current round the coil, it is established that when a certain magnetic pole is approaching an end, a like pole is induced there – to repel it from coming.</td>
<td>1</td>
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<td>- Further, when a pole is being withdrawn, an unlike pole is induced there – this time to attract it back. This agrees very well with Lenz's law.</td>
<td>½</td>
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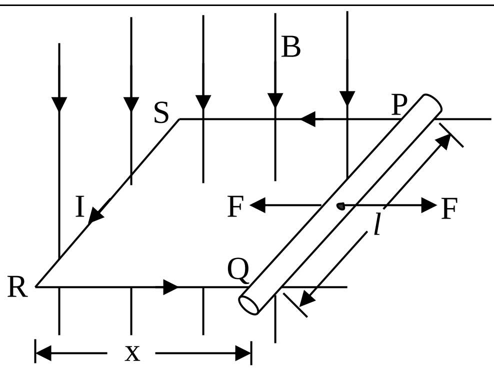
<td>(b)</td>
<td>
</td>
<td>½

½</td>
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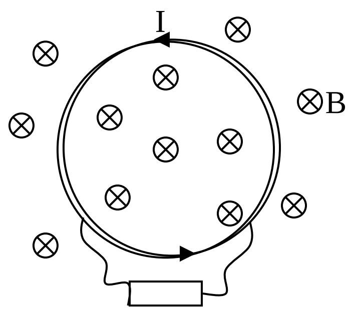
	Imagine a rod PQ lying parallel to a side RS of a rectangular frame of conductor PSRQ Suppose PQ is pulled with a uniform speed v by force F towards the right. According to Lenz's law, the induced emf will produce a force towards the left, and since PQ is not accelerating, this force must be equal to F. By consideration of energy, the mechanical work done per second by the external force equals the power supplied to the electrical circuit. Thus EI = BI*l*v (force x velocity), where E is the induced emf in the rod and I the induced current ∴ ***E* = *Blv*** ALTERNATIVELY The magnetic flux linkage of the circuit is Φ = B*l*x, where x is the distance between PQ and the side RS. The induced emf $E = -\frac{d\Phi}{dt} = Bl\frac{dx}{dt}$ But $\frac{dx}{dt} = v$, which is the speed of the rod Therefore **E = B*l*v**	1 1 ½ ½
(c)	(i) There is no deflection on the galvanometer. This is because the magnetic lines of force do not cut across the coil windings during rotation. So no emf is induced in the coil.	1 1

	(ii) The galvanometer deflects. This is because during rotation the magnetic lines of force cut across the coil windings and an emf is induced in the coil	1 1
(d)	(i)  I = current According to Lenz's law, the induced current must flow in such a direction as to produce a field out of the page, in order to oppose the rise of B. Such a current must be flowing anticlockwise	1 1 1
	(ii) The induced emf, $E = \frac{d\Phi}{dt} = NA\frac{dB}{dt} = \pi r^2 N\frac{dB}{dt}$ Current, $I = \frac{E}{R} = \frac{\pi r^2 N}{R}\frac{dB}{dt} = \frac{\pi \times 0.04^2 \times 50 \times 50}{6+2}$ = **1.57 A**	1 1 1
	Total = 20	