M1.(a)   Principal focus is the point on the principal axis through which rays which were parallel to the principal axis pass after refraction by the lens ✓

Allow suitable labelled diagram

1

Power is reciprocal of focal length measured in m ✓

Allow 1 / f measured in m

1

(b)   First correct ray ✓

1

Second correct ray with labelled image ✓

1

(c)   Myopia or short sight ✓

1

(d)   1 / -0.33 = 1 / 0.25 + 1 / *v* ✓

1

v=(-)0.14 m   ✓

1

(e)   Cones active / simulated ✓

1

Cones stimulated by images must be separated by at least 1 unstimulated cone ✓

1

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Page 2

M2.(a) At 1Hz, individual flashes of light seen ✓
At some frequencies the flashes appear to join to form continuous light so that no flashing seen at 40Hz ✓
Process is called persistence of vision ✓

> *Need reference to change from flash to continuous around a given frequency*
> *Allow 'sight' for 'vision'*

3

(b) (i) $(1 / f = 1 / u + 1 / v)$ $1.75 = 1 / 0.250 + 1 / v$ ✓
$v = (-) 44.4$ cm ✓ 3 sig figs ✓

> *Sig fig mark stands alone. Allow 'x' for 'v'*

3

(ii) This is the (defective eye's) unaided near point ✓
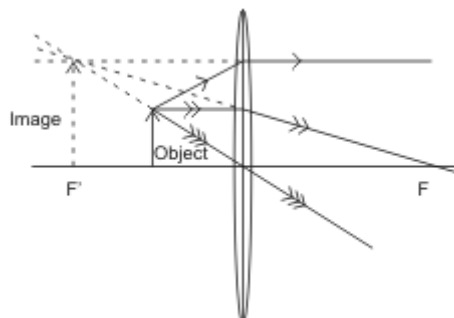
> *Allow uncorrected near point*

1

(c) Long sight / presbyopia / hypermetropia ✓

1

(d) 1 correct ray ✓
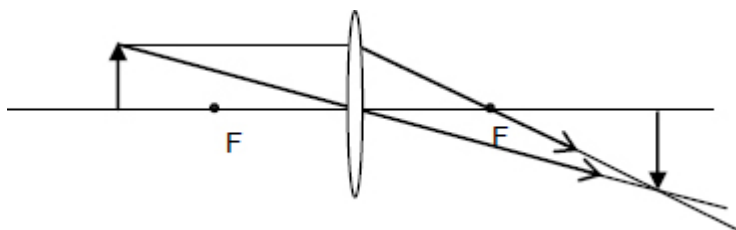2nd correct ray with labelled image and foci ✓

> *Which refers to a virtual image*

2

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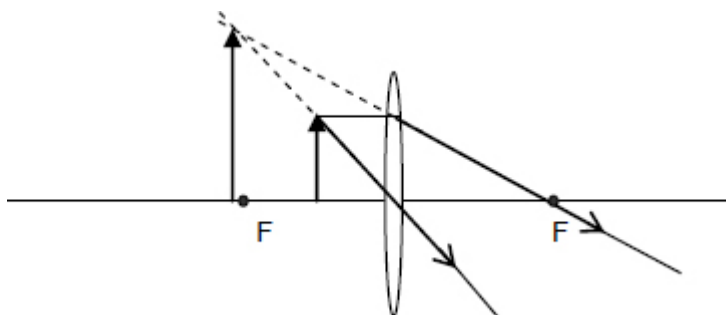**M3.** (a) (i) Two correct rays, one through marked focal point. ✓

to form a magnified real image ✓

2

(ii) Two correct rays ✓

to form virtual image ✓

2

(b) (i) use of $1/f = 1/u + 1/v$

to give $1/145 = 1/112 + 1/v$ ✓

and $v = -492$ mm ✓

3 sf ✓

3

(ii) virtual, magnified, upright ✓

1

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