18 Galileo is credited with inventing the first telescope in 1610. The picture shows an early demonstration of the telescope.

A converging lens was positioned at one end of the telescope. A diverging lens was placed at the other end and a person looked through this lens.

(a) The converging lens produced an image at a distance equal to the focal length of the lens.

Explain what can be concluded about the object being viewed.

(2)

....

....

....

....

(b) The final image produced by the telescope is described as virtual and upright.

State what is meant by virtual and upright.

(2)

Virtual

....

....

Upright

....

....

(c) The image, I, produced by the converging lens is at a distance from the diverging lens equal to the focal length of the diverging lens, as shown. This image acts as an object for the diverging lens.
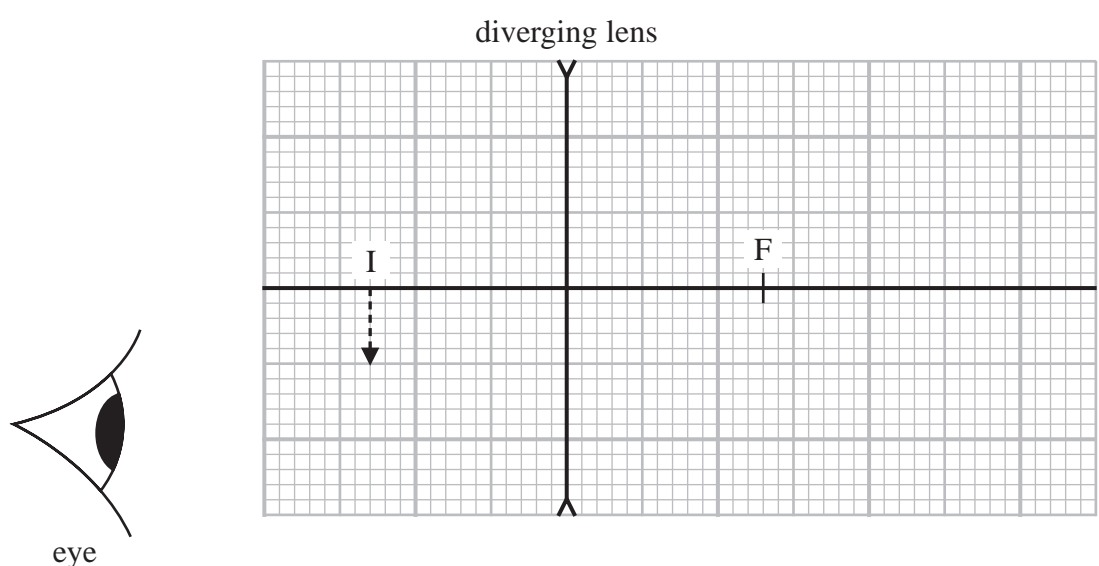
diverging lens

The distance equal to the focal length on the other side of the lens is marked with F.

Draw the ray diagram for the diverging lens.

(3)

(d) Galileo's first telescope had a magnification of 10, and a distance between the centres of the two lenses of 90 cm.

The magnification of the telescope $= \dfrac{\text{focal length of converging lens}}{\text{focal length of diverging lens}}$

Calculate the focal length of each lens.

(2)

Focal length of converging lens = ...

Focal length of diverging lens = ...

(e) Galileo was the first person to observe Jupiter's larger moons.

Ganymede is Jupiter's largest moon. The distance between the centre of Ganymede and the centre of Jupiter is 1.07×10^6 km. Ganymede takes 171 hours to complete an orbit around Jupiter.

Calculate the mass of Jupiter.

(5)

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....

Mass of Jupiter = ...

(Total for Question 18 = 14 marks)