4 An α-particle and a proton are at rest a distance 20 μm apart in a vacuum, as illustrated in Fig. 4.1.

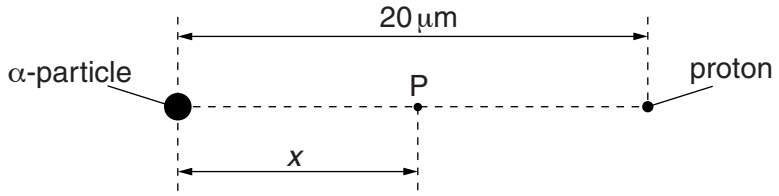

Fig. 4.1

(a) (i) State Coulomb's law.

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.....[2]

(ii) The α-particle and the proton may be considered to be point charges. Calculate the electric force between the α-particle and the proton.

force = ... N [2]

(b) (i) Define *electric field strength*.

.....

.....

.....[2]

(ii) A point P is distance x from the α-particle along the line joining the α-particle to the proton (see Fig. 4.1). The variation with distance x of the electric field strength E_α due to the α-particle alone is shown in Fig. 4.2.

For Examiner's Use

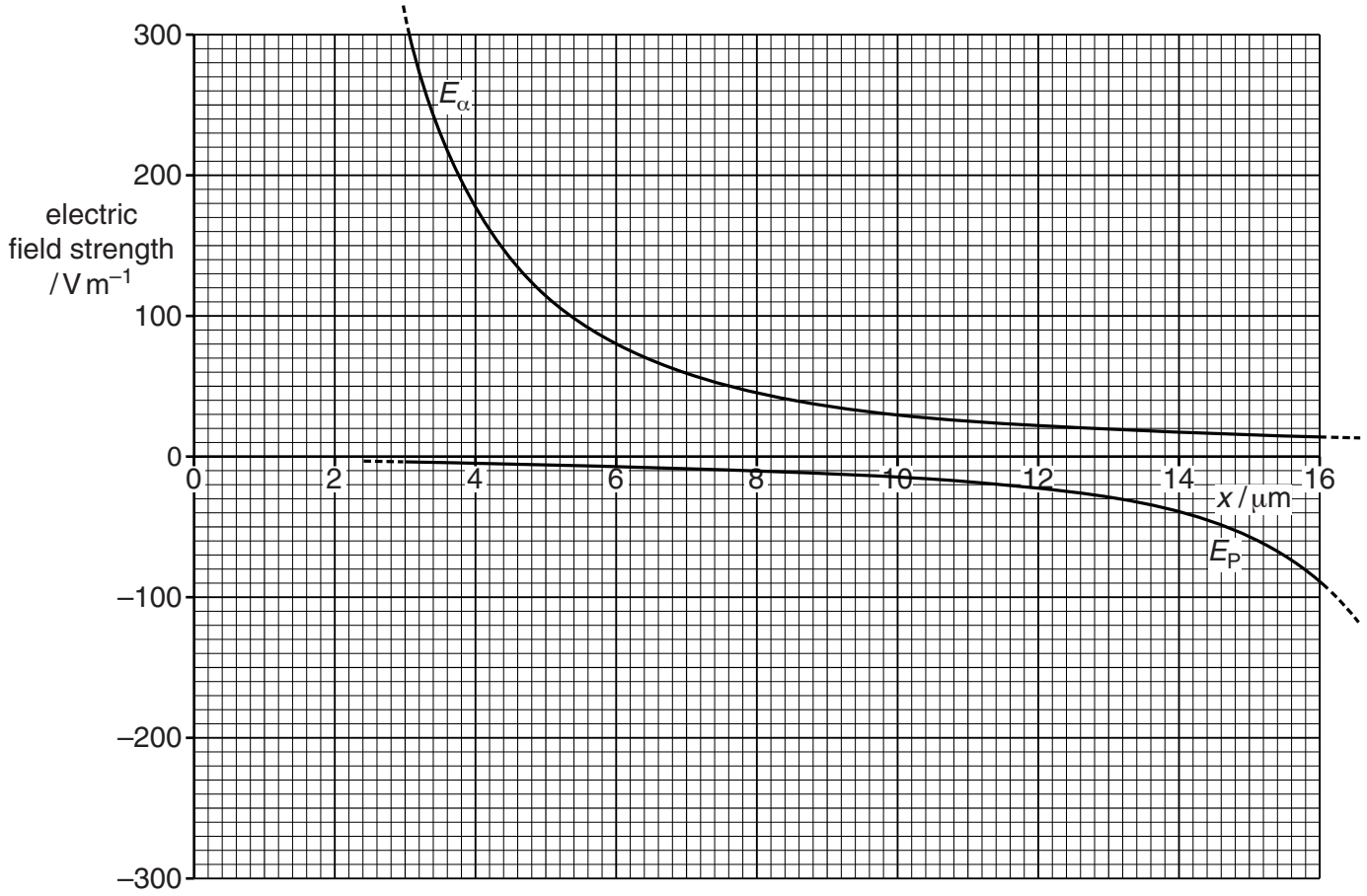

Fig. 4.2

The variation with distance x of the electric field strength E_P due to the proton alone is also shown in Fig. 4.2.

1. Explain why the two separate electric fields have opposite signs.

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.....[2]

2. On Fig. 4.2, sketch the variation with x of the combined electric field due to the α-particle and the proton for values of x from 4 μm to 16 μm. [3]