

Revision Sheet

A-Level Physics · Unit 18 Electric fields

6 vocabulary items · 34 marks of exam questions (5 questions)

Part 1 · Vocabulary review (6 items). The terms this unit is examined on most. Mark it yourself from the answer key.

Section A · Chinese to English

Write the English word.

1.

[1]
2.

[1]
3.

[1]
4.

[1]
5.

[1]
6.

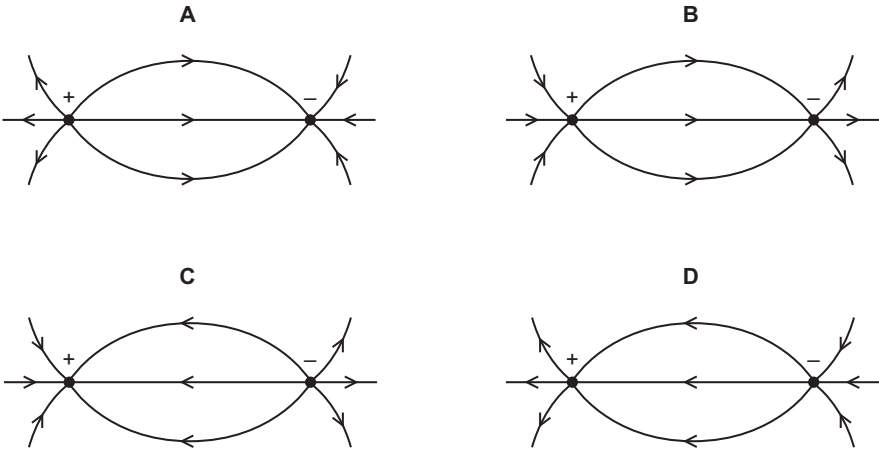
[1]

Part 2 · Exam questions (34 marks, 5 questions) begins on the next page. They are ordered easy to difficult and none of them has been set before.

7 Four diagrams representing the electric field between two oppositely charged point charges are shown.

☐

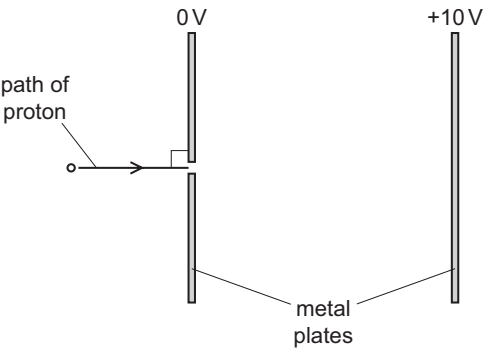
Which diagram correctly shows the electric field lines?



8 A proton enters the uniform electric field between two parallel vertical metal plates in a vacuum.

☐

One plate is at a potential of 0 V and the other plate is at a potential of +10 V, as shown.



What is the initial change in the motion of the proton caused by the electric field, immediately after the proton enters the field?

- A** It begins to move downwards.
- B** It begins to move upwards.
- C** Its speed decreases.
- D** Its speed increases.

9 (a) State Coulomb's law.

[2]

(b) Two charged metal spheres A and B are situated in a vacuum, as illustrated in Fig. 4.1.

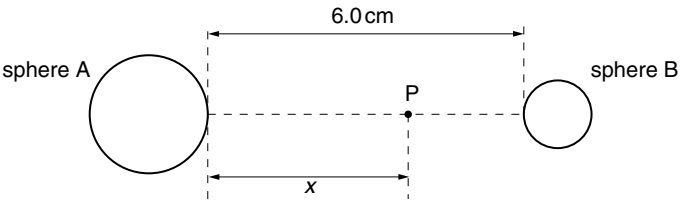


Fig. 4.1

The shortest distance between the surfaces of the spheres is 6.0 cm.

A movable point P lies along the line joining the centres of the two spheres, a distance x from the surface of sphere A.

The variation with distance x of the electric field E at point P is shown in Fig. 4.2.

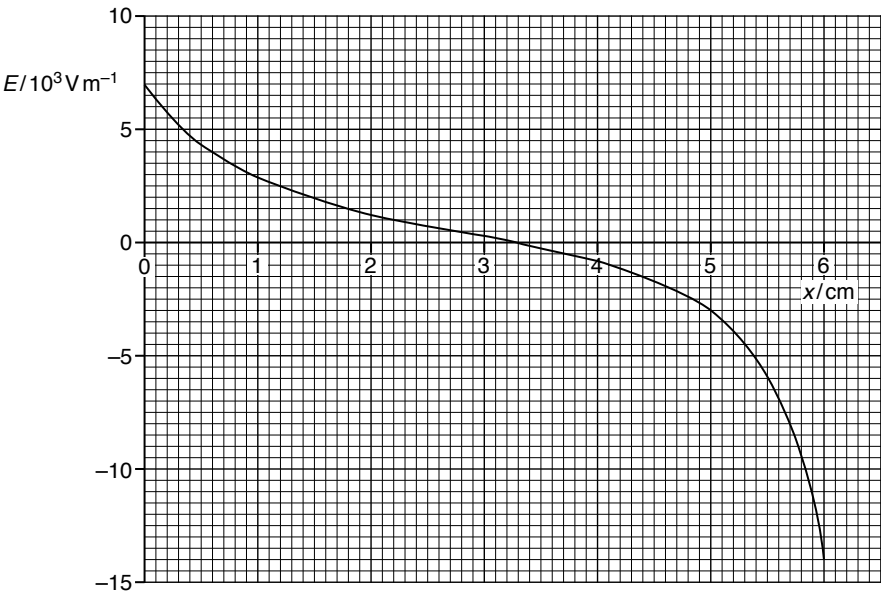


Fig. 4.2

(i) Use Fig. 4.2 to explain whether the two spheres have charges of the same, or opposite, sign.

[2]

(ii) A proton is at point P where $x = 5.0$ cm.
Use data from Fig. 4.2 to determine the magnitude of the acceleration of the proton.

acceleration = m s^{-2} [3]

(c) The electric potential gradient is related to the electric field.

Use data from Fig. 4.2 to state the value of x at which the magnitude of the electric potential gradient is maximum. Give a reason for the value you have chosen.

[2]

[Total: 9]

10 (a) (i) Define gravitational field.

..... [1]

(ii) Define electric field.

[1]

(iii) State **one** similarity and **one** difference between the gravitational potential due to a point mass and the electric potential due to a point charge.

similarity:

.....

difference:

[2]

(b) An isolated uniform conducting sphere has mass M and charge Q . The gravitational field strength at the surface of the sphere is g . The electric field strength at the surface of the sphere is E .

(i) Show that

$$\frac{M}{Q} = \alpha \frac{g}{E}$$

where α is a constant.

[3]

(ii) Show that the numerical value of α is $1.35 \times 10^{20} \text{ kg}^2 \text{ C}^{-2}$.

[1]

(c) Assume that the Earth is a uniform conducting sphere of mass 5.98×10^{24} kg. The surface of the Earth carries a charge of -4.80×10^5 C that is evenly distributed.

(i) Use the information in **(b)** to determine the electric field strength at the surface of the Earth. Give a unit with your answer.

electric field strength = unit [2]

(ii) State how the direction of the electric field at the surface of the Earth compares with the direction of the gravitational field.

..... [1]

[Total: 11]

- 11 (a) State what is indicated by the direction of an electric field line.
-
- [2]
- (b) Fig. 4.1 shows a pair of parallel metal plates with a potential difference (p.d.) of 2400 V between them.

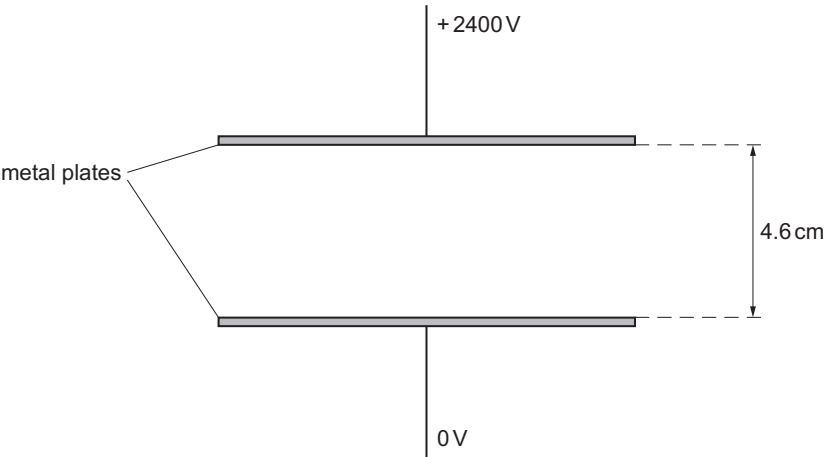


Fig. 4.1

The plates are separated by a distance of 4.6 cm. The plates are in a vacuum.

- (i) On Fig. 4.1, draw five lines to represent the electric field in the region between the plates. [3]
- (ii) Calculate the strength of the electric field between the plates.

electric field strength = NC⁻¹ [2]

- (c) A moving proton enters the region between the plates from the left, as shown in Fig. 4.2.

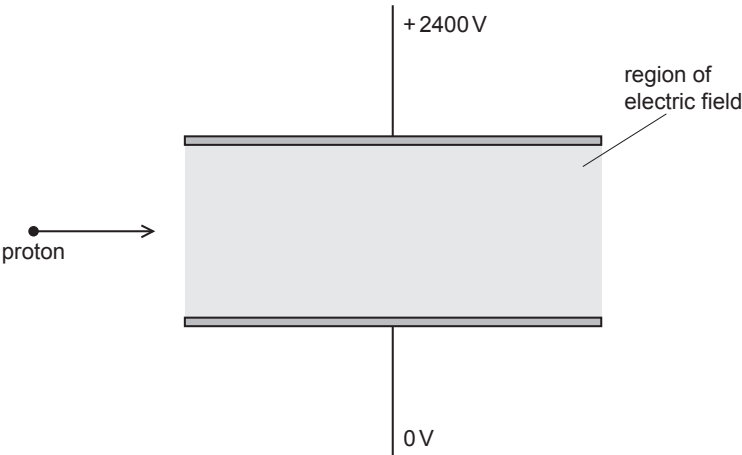


Fig. 4.2

- (i) The proton is deflected by the electric field.
- On Fig. 4.2, draw a line to show the path of the proton as it moves through and out of the region of the electric field. [2]
- (ii) A helium nucleus (${}^4_2\text{He}$) now enters the region of the electric field along the same initial path as the proton and travelling at the same initial speed.

State and explain how the final speed of the helium nucleus compares with the final speed of the proton after leaving the region of the electric field.

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..... [3]

[Total: 12]