

## 8.5 Electric Flux

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 10 marks

**KEY WORDS** electric flux • gaussian surface • gauss's law  
 • area vector • uniform

### Objective

Build the skills to answer exam questions on **electric flux**.

You must be able to:

- define **electric flux** through a surface as  $\Phi_E = \int \vec{E} \cdot d\vec{A}$
- relate flux to the component of  $\vec{E}$  perpendicular to the surface
- calculate the flux through flat surfaces in a uniform field
- see how a convenient **Gaussian surface** simplifies a flux calculation

### 1 Key knowledge and worked examples

Study these first. Each one shows the method for a question type used later.

#### ■ Electric flux

$\Phi_E = \int \vec{E} \cdot d\vec{A}$ . For a **uniform** field through a **flat** surface this is  $\Phi_E = EA \cos \theta$ , where  $\theta$  is the angle between  $\vec{E}$  and the area vector (the normal).

#### ■ Only the perpendicular part counts

Flux is greatest when the surface **facing** the field ( $\theta = 0$ ) and zero when the field lies **along** the surface ( $\theta = 90^\circ$ ).

#### ■ Closed surface

The **net** flux out of a closed surface depends on how much field enters versus leaves – the basis of Gauss's law.

## 2 Practice

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**2.1** Find the flux through a  $0.20 \text{ m}^2$  flat surface placed face-on to a uniform  $500 \text{ N C}^{-1}$  field. [2]

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**2.2** State when the flux through a flat surface is zero, relative to the field. [1]

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**2.3** State what the net flux through a closed surface depends on. [1]

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## 3 Exam-style questions

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**3.1** The electric flux through a flat surface in a uniform field is [1]

- ☐ **A**  $EA$   
**B**  $EA \cos \theta$   
**C**  $E/A$   
**D**  $EA^2$

**3.2** The flux through a surface is zero when the field is [1]

- ☐ **A** perpendicular to the surface  
**B** parallel to the surface (grazing it)  
**C** very strong  
**D** uniform

**3.3** A uniform field of  $300 \text{ N C}^{-1}$  passes through a  $0.40 \text{ m}^2$  square.

- (a) Find the flux when the square faces the field. [2]  
(b) Find the flux when the square is tilted so its normal is  $60^\circ$  from the field. [2]

## Solutions

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Each answer shows the steps, then the **result**.

### 2.1

- $\Phi_E = EA = 500 \times 0.20 = 100 \text{ N m}^2 \text{ C}^{-1}$

### 2.2

- when the field is parallel to the surface (perpendicular to its normal)

### 2.3

- the net charge enclosed by the surface

### 3.1 B

- $EA \cos \theta$ .

### 3.2 B

- parallel to the surface (grazing it).

### 3.3

(a)

- $\Phi_E = EA = 300 \times 0.40 = 120 \text{ N m}^2 \text{ C}^{-1}$

(b)

- $\Phi_E = EA \cos 60^\circ = 120 \times 0.5 = 60 \text{ N m}^2 \text{ C}^{-1}$