

## YEAR 2 | MODULE 6 | PACK 03

# Parallel-plate capacitors and permittivity

Official past-paper questions

2017-2023 | OCR A H556 | 6.2.3(a)-(b); links to 6.1 capacitance

## 18 marks | 5 question entries

One practice session

**Use:** attempt the session after learning its content. Try without notes; record any help used. Mark the session, identify the reason for lost marks, then revisit those questions after a few days.

**Format:** all MCQs appear first with their complete answer boxes. Written extracts retain the original paper's answer space. Only the subparts named in the source reference are assigned.

These questions also appear in the Capacitance electric-field links pack. If you have already done that pack, use this as spaced review. The independent Electric Fields test uses different source questions.

**Sources:** the 2024 and 2025 exams are not used in these topic packs. These files contain official examination questions only; no sample, specimen or practice papers.

Name: \_\_\_\_\_

First attempt: \_\_\_\_\_ Score: \_\_\_\_\_ / 18

[Official data, formulae and relationships booklet](#)

# Question index

EF identifiers are stable across the question packs and mark schemes; Q numbers refer to this pack. This pack has no selected MCQs.

| Question / source                    | Marks    | Page     |
|--------------------------------------|----------|----------|
| <b>Q01   EF11</b>                    | <b>2</b> | <b>3</b> |
| June 2017   H556/02   Q21(a)         |          |          |
| <b>Q02   EF12</b>                    | <b>4</b> | <b>4</b> |
| June 2019   H556/02   Q22(a)(i)-(ii) |          |          |
| <b>Q03   EF13</b>                    | <b>4</b> | <b>6</b> |
| June 2022   H556/02   Q22(a)         |          |          |
| <b>Q04   EF14</b>                    | <b>6</b> | <b>7</b> |
| June 2018   H556/02   Q22(b)         |          |          |
| <b>Q05   EF15</b>                    | <b>2</b> | <b>9</b> |
| June 2022   H556/02   Q22(b)(ii)2    |          |          |

## Q01 | EF11

2 marks

June 2017 | H556/02 | Q21(a)

- 21 (a)** A capacitor of capacitance  $7.2\text{ pF}$  consists of two parallel metal plates separated by an insulator of thickness  $1.2\text{ mm}$ . The area of overlap between the plates is  $4.0 \times 10^{-4}\text{ m}^2$ . Calculate the permittivity of the insulator between the capacitor plates.

permittivity = .....  $\text{F m}^{-1}$  [2]

## Q02 | EF12

4 marks

June 2019 | H556/02 | Q22(a)(i)-(ii)

- 22 (a) Fig. 22.1 shows two horizontal metal plates in a vacuum.

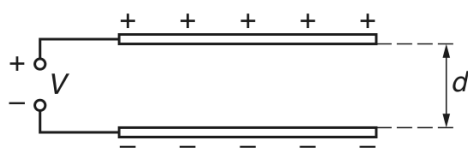


Fig. 22.1

The plates are connected to a power supply. The potential difference  $V$  between the plates is constant. The magnitude of the charge on each plate is  $Q$ . The separation between the plates is  $d$ .

Fig. 22.2 shows the variation with  $d$  of the charge  $Q$  on the positive plate.

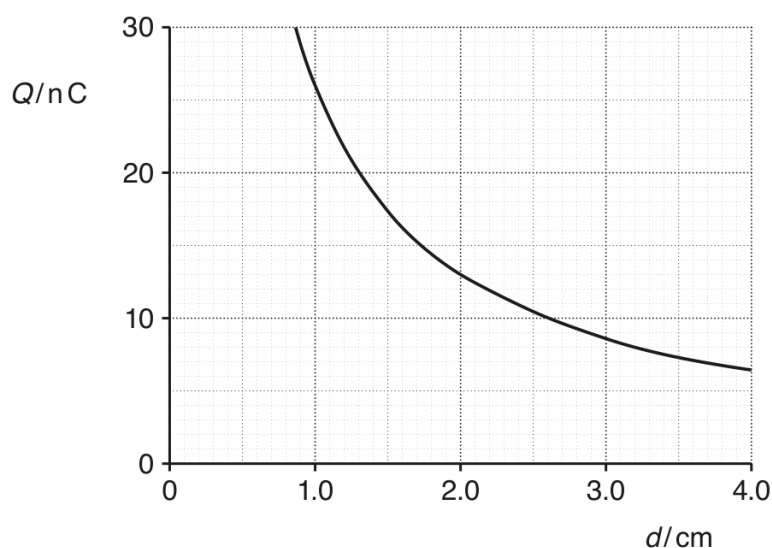


Fig. 22.2

- (i) Use Fig. 22.2 to propose and carry out a test to show that  $Q$  is inversely proportional to  $d$ .

Test proposed:

.....  
 .....

Working:

**Q02 | EF12 - continued****4 marks**

June 2019 | H556/02 | Q22(a)(i)-(ii)

- (ii) Use capacitor equations to show that  $Q$  is inversely proportional to  $d$ .

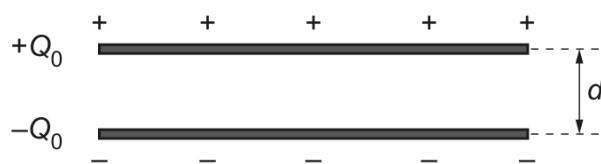
**[2]**

## Q03 | EF13

4 marks

June 2022 | H556/02 | Q22(a)

22 (a) The diagram below shows a simple capacitor.



The capacitor consists of two horizontal metal plates in a vacuum. The magnitude of the charge on each plate is  $Q_0$ . The potential difference (p.d.) between the plates is  $V_0$ . The capacitor plates have capacitance  $C_0$ . The separation between the plates is  $d$ . The energy stored by the capacitor is  $E_0$ .

The top plate is moved vertically upwards. The new separation between the plates is  $2d$ . The charge on each plate remains the **same**.

The energy stored by the capacitor **increases**.

(i) Determine the new:

1 capacitance in terms of  $C_0$

capacitance = .....  $C_0$  [1]

2 p.d. between the plates in terms of  $V_0$

p.d. = .....  $V_0$  [1]

3 energy stored in terms of  $E_0$ .

energy = .....  $E_0$  [1]

(ii) Explain, in terms of forces between the plates, why the energy stored increases.

.....  
 ..... [1]

## Q04 | EF14

6 marks

June 2018 | H556/02 | Q22(b)

**22** A student wishes to determine the permittivity  $\epsilon$  of paper using a capacitor made in the laboratory.

The capacitor consists of two large parallel aluminium plates separated by a very thin sheet of paper.

The capacitor is initially charged to a potential difference  $V_0$  using a battery. The capacitor is then discharged through a fixed resistor of resistance  $1.0\text{ M}\Omega$ .

The potential difference  $V$  across the capacitor after a time  $t$  is recorded by a data-logger. The student uses the data to draw the  $\ln V$  against  $t$  graph shown in Fig. 22.

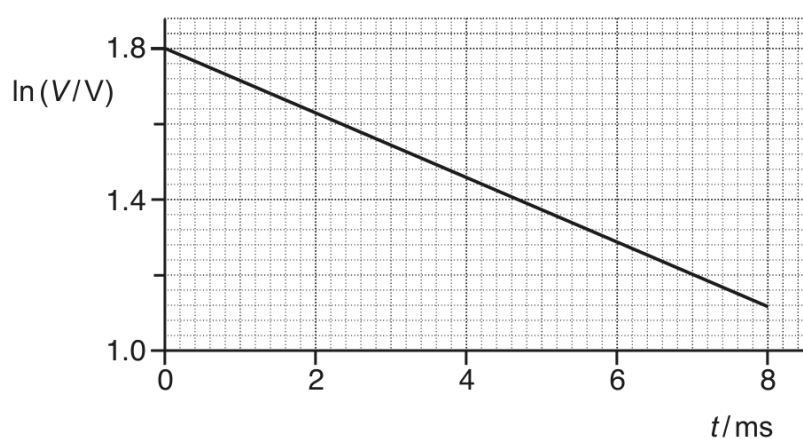


**Fig. 22**

The original capacitor-discharge description and graph are retained as context. Only the six-mark investigation in (b) is assigned.

**6 marks**

**(b)\*** Use Fig. 22 to determine the capacitance  $C$  of the capacitor. Describe how the student can then use this value of  $C$  to determine a value for  $\epsilon$ .  
In your description, mention any additional measurements required on the capacitor.

..... [6]

8

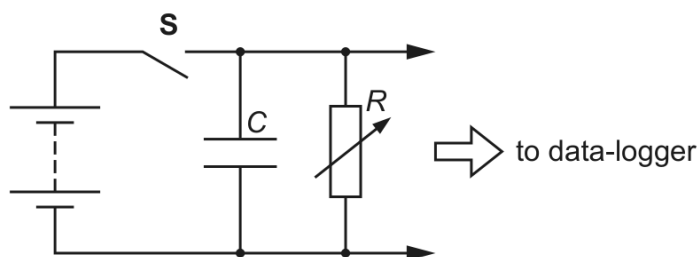
## Q05 | EF15

2 marks

June 2022 | H556/02 | Q22(b)(ii)2

Given result from omitted (b)(ii)1: the capacitance  $C$  is  $7.8 \times 10^{-9} \text{ F}$ .

- (b) A student discharges a capacitor of capacitance  $C$  through a variable resistor of resistance  $R$  using the arrangement below.



The capacitor is made from two parallel metal plates separated by a sheet of paper of thickness  $8.0 \times 10^{-5} \text{ m}$ . The area of overlap between the plates is  $3.1 \times 10^{-2} \text{ m}^2$ .

The capacitor is charged fully by closing switch **S**. At time  $t = 0$ , **S** is opened and the capacitor discharges through the resistor. After  $t = T$ , the potential difference across the capacitor is halved. The student repeats this for several values of  $R$ .

- 2 Use your answer in (ii)1 to calculate the permittivity  $\epsilon$  of the paper.

$$\epsilon = \dots\dots\dots \text{ F m}^{-1} \text{ [2]}$$

Only (b)(ii)2 is assigned. The earlier capacitance result is supplied explicitly, so the omitted graph calculation is not needed.