11.3 Capacitance

Question Paper

Course	DP IB Physics
Section	11. Electromagnetic Induction (HL only)
Topic	11.3 Capacitance
Difficulty	Hard

Time allowed: 20

Score: /10

Percentage: /100

Question 1

A fully charged capacitor of capacitance C = 1.00 μF is connected in parallel with a resistor with a resistance of R = 2.00 MΩ. The potential difference used to charge the capacitor is then removed. Initial current is denoted as I_O.

What length of time does it take for the current to decrease from $\dfrac{7I_0}{15}$ to $\dfrac{I_0}{15}$?
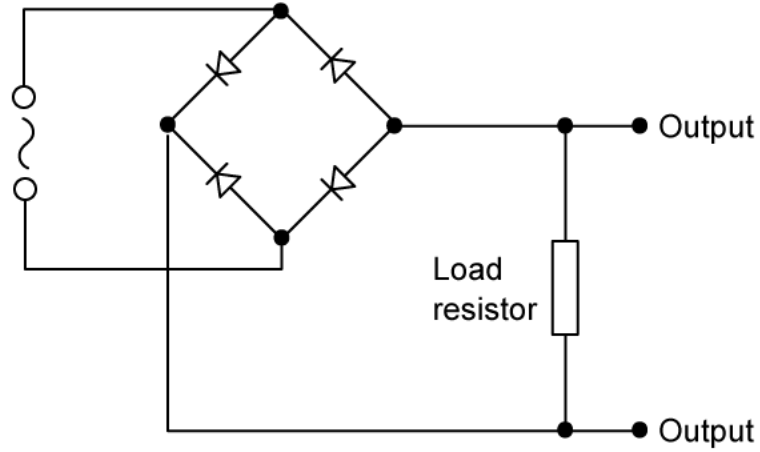
A. $\ln\left(\dfrac{8}{15}\right)$ s

B. $\ln(49)$ s

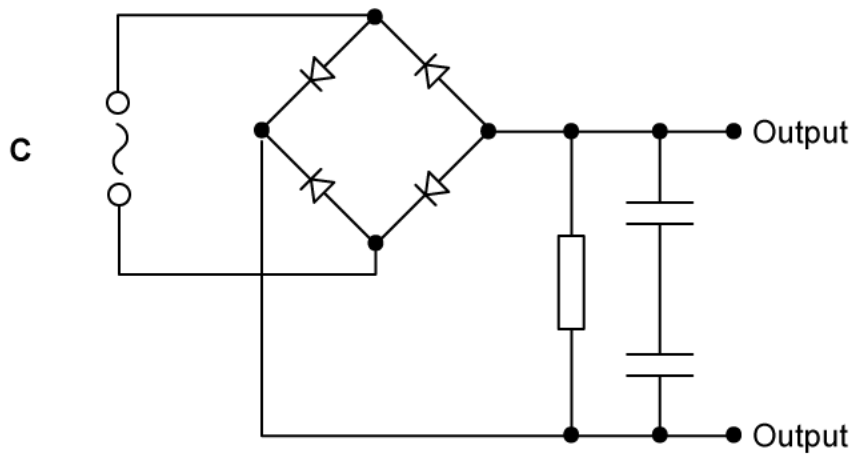C. $\ln(14)$ s

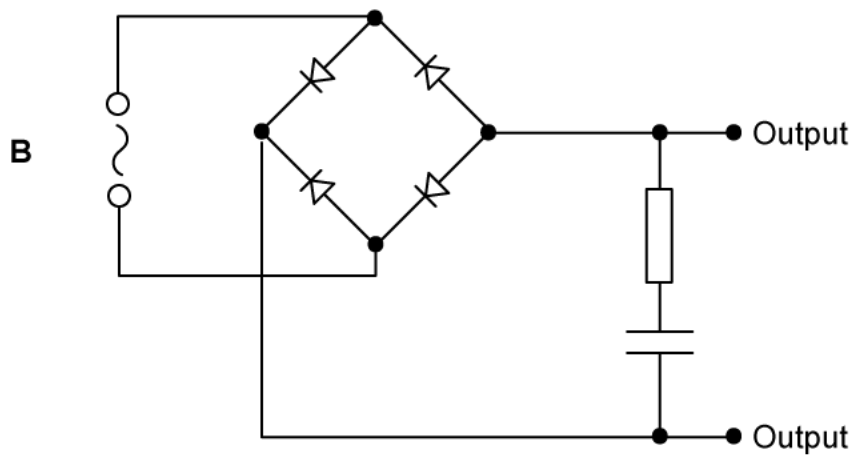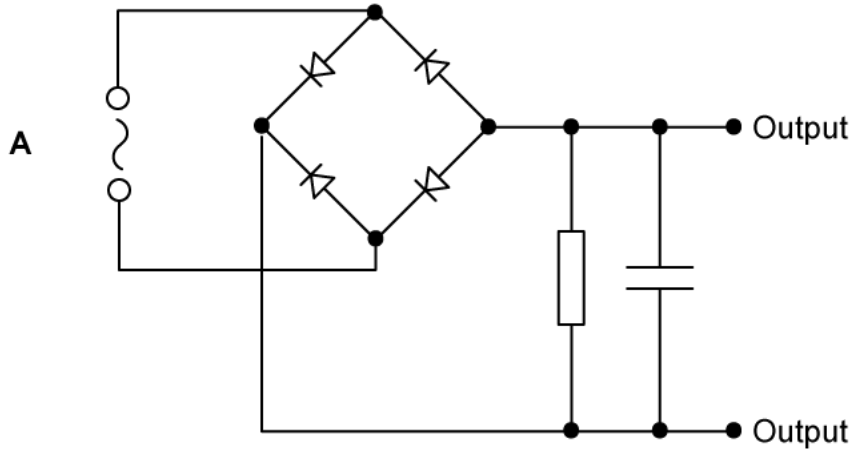D. $\ln\left(\dfrac{1}{14}\right)$ s
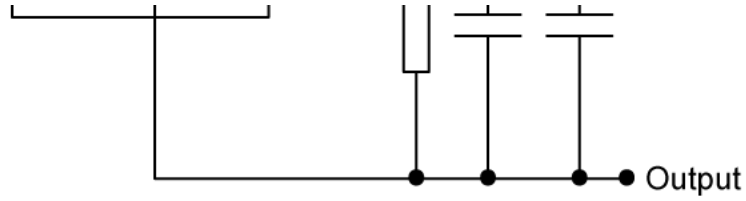
[1 mark]

Question 2

The diagram shows a diode bridge rectification circuit and a load resistor.

The input is a sinusoidal signal. Which of the following circuits will produce the smoothest output signal?
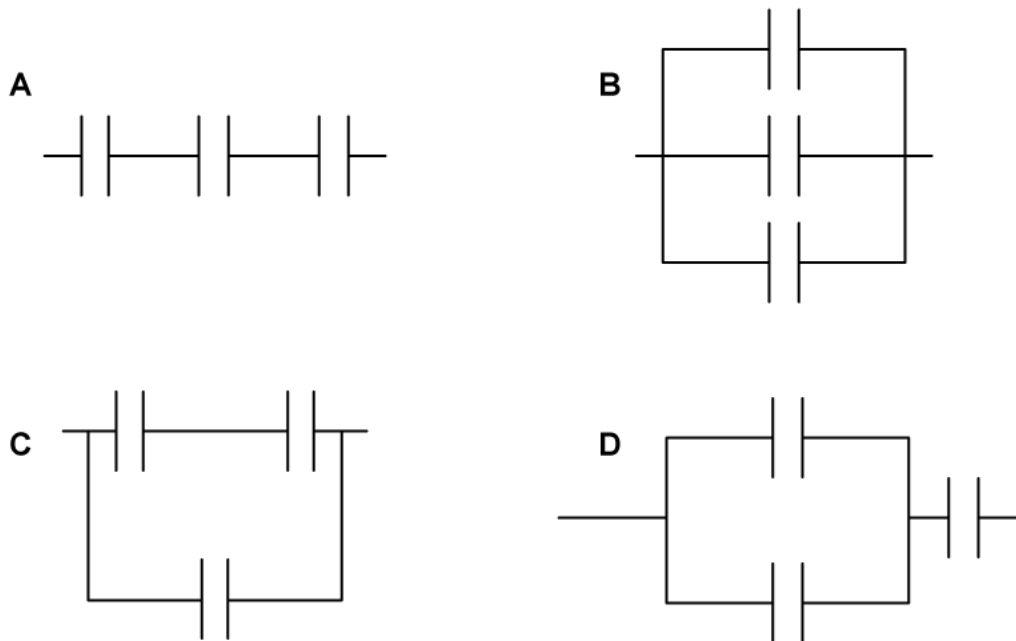
A

B

C

D

● Output
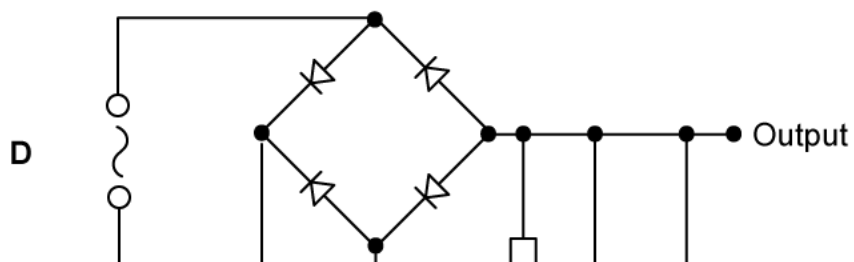
[1 mark]

Question 3

Three capacitors, each one with a capacitance C, are connected such that their combined capacitance is 1.5C. How are they connected?
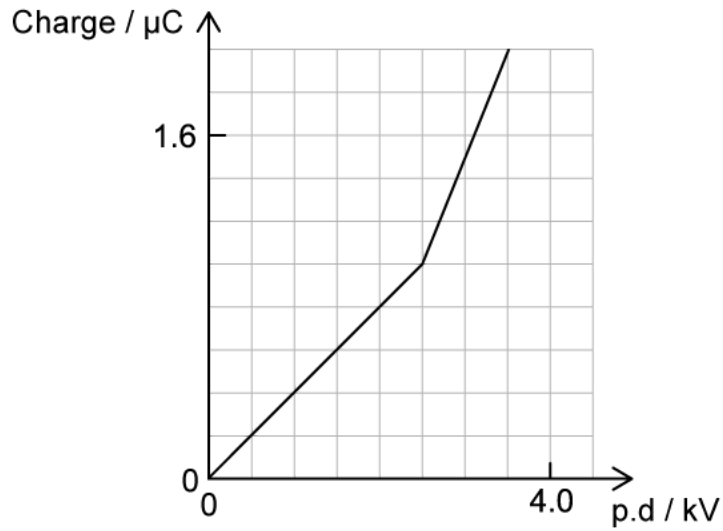

[1 mark]

Question 4

A variable capacitor is being charged, but the dial is accidentally knocked partway through the charging process.

What is the energy stored in this capacitor by the time the accumulated charge reaches 2.0 μC?

A. 4.25×10^{-3} J

B. 2.75×10^{-3} J

C. 2.75 J

D. 4.25 J

[1 mark]

Question 5

A capacitor with capacitance C discharges through a resistor of resistance R. The graph shows the variation with time t of the voltage V across the capacitor.
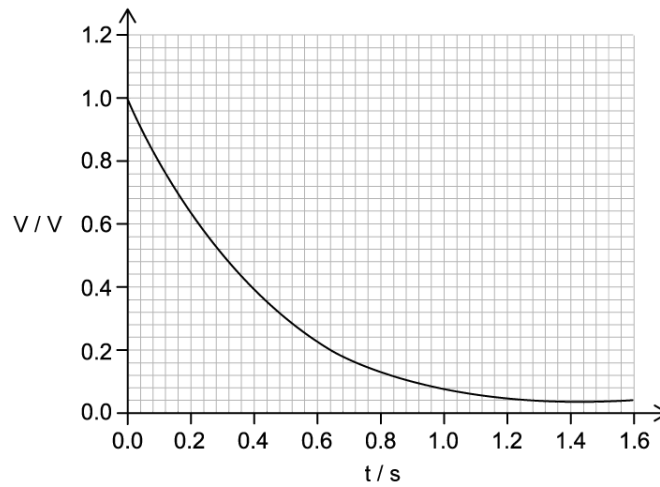
The capacitor is now changed to one with a capacitance of 2C and the resistor is changed to one with a value of 2R. Which graph shows the variation of V with t when the new configuration is discharged.

A

B

C

D
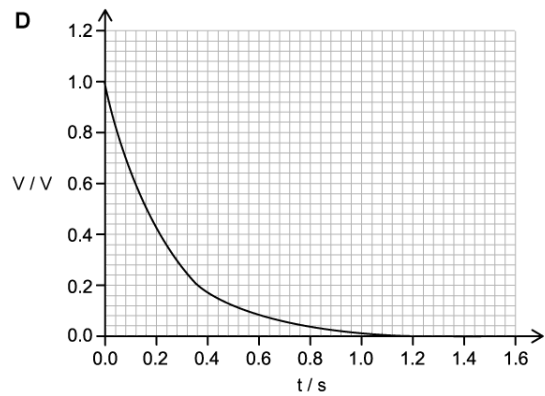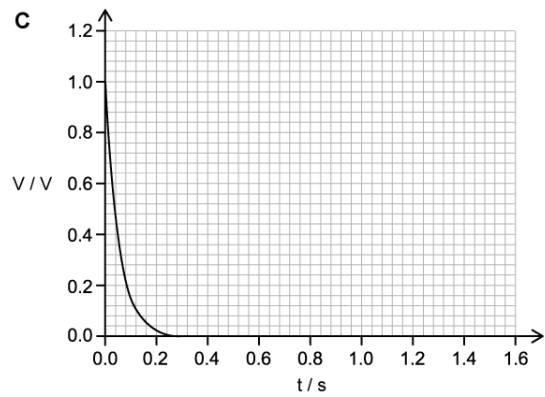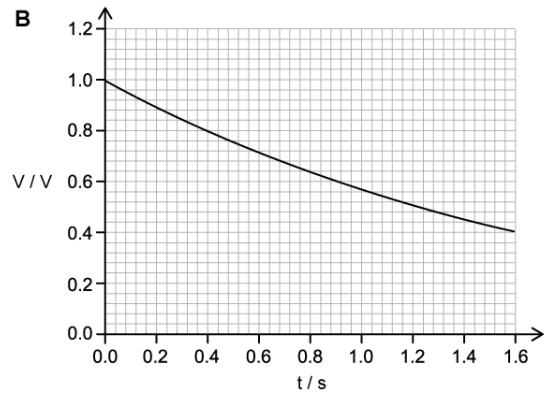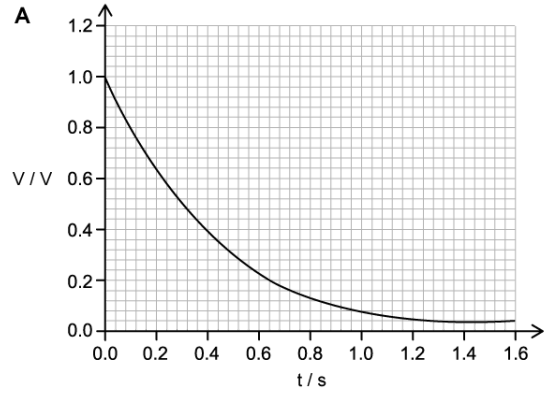
[1 mark]

Question 6

Which of the following can be used as a unit for capacitance?

A. $A^2 s^2 kg\, m^{-2}$

B. $A^2 s^4 kg^{-1} m^{-2}$

C. $A^2 kg\, m$

D. $A^2 s^2 kg^{-1} m$

[1 mark]

Question 7

A parallel–plate capacitor has square plates of length L separated by a distance $3L$ and is filled with air as its dielectric.

A second capacitor has square plates of length $3L$ separated by distance $6L$ and is filled with a different dielectric.

Both capacitors have the same capacitance.

What is the relative permittivity of the dielectric in the second capacitor?

A. $\dfrac{9}{2}$

B. $\dfrac{2}{9}$

C. $\dfrac{3}{2}$

D. $\dfrac{2}{3}$

[1 mark]

Question 8

A capacitor of capacitance C stores an amount of energy E when the pd across it is V.

Which line, A to D, in the table gives the correct stored energy and pd when the charge is decreased by 60%?

	Energy	Potential difference
A.	0.40	0.60
B.	0.16	0.60
C.	0.40	0.40
D.	0.16	0.40

[1 mark]

Question 9

An uncharged 200 nF capacitor is connected to a power supply and becomes fully charged. The potential difference across the capacitor is equal to 9.0 V and the load resistor has a resistance of 2.0 kΩ.

A switch is flipped and a highly precise digital data logger begins recording information about the capacitor at the exact moment that the capacitor begins discharging.

Approximately how many additional electrons are left on the negative plate after 0.60 ms have passed?

The following table of logarithm approximations may help you answer this question.
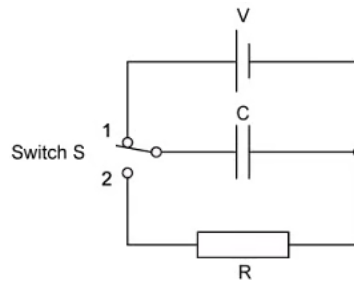
x	ln(x) to two decimal places
1.0	0.00
1.5	0.41
2.0	0.69
2.5	0.92
3.0	1.10
3.5	1.25
4.0	1.39
4.5	1.50
5.0	1.61
5.5	1.70
6.0	1.79

A. 1.5×10^{10} electrons

B. 5.2×10^{12} electrons

C. 2.5×10^{12} electrons

D. 1.5×10^{13} electrons

[1 mark]

Question 10

Switch S in the circuit is held in position 1, so that the capacitor C becomes fully charged to a potential difference *V* and stores energy *E*.

The switch is then moved quickly to position 2, allowing C to discharge through the fixed resistor R. It takes 55 ms for the pd across C to fall to $\dfrac{V}{2}$.

What period of time must elapse, after the switch has moved to position 2, before C has lost $\dfrac{255E}{256}$?

  A. 165 ms

  B. 110 ms

  C. 82.5 ms

  D. 220 ms

[1 mark]