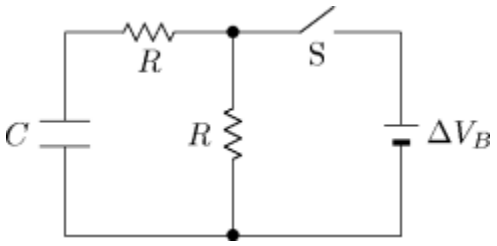
Name: _____ Date: _____

1. A 20-F capacitor is charged to 200 V. Its stored energy is:

A) 4000 J
B) 4 J
C) 0.4 J
D) 2000 J
E) 0.1 J

2. In the circuit shown, both resistors have the same value *R*. Suppose switch S is initially closed. When it is then opened, the circuit has a time constant τ_a. Conversely, suppose S is initially open. When it is then closed, the circuit has a time constant τ_b. The ratio τ_a/τ_b is:

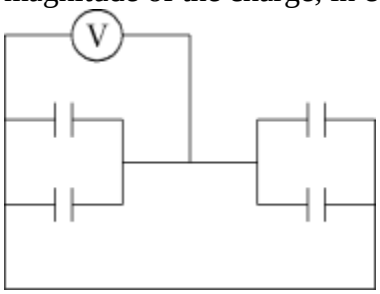


A) 1
B) 2
C) 0.5
D) 0.667
E) 1.5

3. Two parallel-plate capacitors with the same plate area but different capacitance are connected in parallel to a battery. Both capacitors are filled with air. The quantity that is the same for both capacitors when they are fully charged is:

A) potential difference
B) energy density
C) electric field between the plates
D) charge on the positive plate
E) plate separation

4. Each of the four capacitors shown is 500 μF. The voltmeter reads 1000 V. The magnitude of the charge, in coulombs, on each capacitor plate is:



A) 0.2
B) 0.5
C) 20
D) 50
E) none of these

5. Capacitors C_1 and C_2 are connected in series. The equivalent capacitance is given by:

A) $C_1C_2/(C_1 + C_2)$
B) $(C_1 + C_2)/C_1C_2$
C) $1/(C_1 + C_2)$
D) C_1/C_2
E) $C_1 + C_2$

6. Two capacitors are identical except that one is filled with air and the other with oil. Both capacitors carry the same magnitude charge on their plates. The ratio of the electric fields E_{air}/E_{oil} is:

A) between 0 and 1
B) 0
C) 1
D) between 1 and infinity
E) infinite

7. A parallel-plate capacitor has a plate area of 0.3 m^2 and a plate separation of 0.1 mm. If the charge on each plate has a magnitude of 5×10^{-6} C then the force exerted by one plate on the other has a magnitude of about:

A) 0
B) 5 N
C) 9 N
D) 1×10^4 N
E) 9×10^5 N

8. If the plate area of an isolated charged parallel-plate capacitor is doubled:

A) the electric field is doubled
B) the potential difference is halved
C) the charge on each plate is halved
D) the surface charge density on each plate is doubled
E) none of the above

9. An initially uncharged capacitor C is connected in series with resistor R. This combination is then connected to a battery with a potential difference ΔV_B. Sufficient time elapses so that a steady state is reached. Which of the following statements is NOT true?

A) The time constant is independent of ΔV_B
B) The final charge on the positive plate of C is independent of R
C) The total thermal energy generated by R is independent of R
D) The total thermal energy generated by R is independent of ΔV_B
E) The initial current (just after the battery was connected) is independent of C

10. In the capacitor discharge formula $q = q_0 e^{-t/RC}$ the symbol t represents:

A) the time constant
B) the time it takes for C to lose the fraction $1/e$ of its initial charge
C) the time it takes for C to lose the fraction $(1–1/e)$ of its initial charge
D) the time it takes for C to lose essentially all of its initial charge
E) none of the above

11. If both the plate area and the plate separation of a parallel-plate capacitor are doubled, the capacitance is:

A) doubled
B) halved
C) unchanged
D) tripled
E) quadrupled

12. A 2-μF and a 1-μF capacitor are connected in series and charged from a battery. They store charges *P* and *Q*, respectively, on their positive plates. When disconnected and charged separately using the same battery, they have charges *R* and *S*, respectively, on their positive plates. Then:

A) $R > S > Q = P$
B) $P > Q > R = S$
C) $R > P = Q > S$
D) $R = P > S = Q$
E) $R > P > S = Q$

13. A battery is used to charge a parallel-plate capacitor, after which it is disconnected. Then the plates are pulled apart to twice their original separation. This process will double the:

A) capacitance
B) surface charge density on each plate
C) stored energy
D) electric field between the two places
E) charge on each plate

14. A charged capacitor stores 10 C at 40 V. Its stored energy is:

A) 400 J
B) 4 J
C) 0.2 J
D) 2.5 J
E) 200 J

15. The plate areas and plate separations of five parallel plate capacitors are
capacitor 1: area A_0, separation d_0
capacitor 2: area $2A_0$, separation $2d_0$
capacitor 3: area $2A_0$, separation $d_0/2$
capacitor 4: area $A_0/2$, separation $2d_0$
capacitor 5: area A_0, separation $d_0/2$
Rank these according to their capacitances, least to greatest.

A) 1, 2, 3, 4, 5
B) 5, 4, 3, 2, 1
C) 5, 3 and 4 tie, then 1, 2
D) 4, 1 and 2 tie, then 5, 3
E) 3, 5, 1 and 2 tie, 1, 4

16. The capacitance of a single isolated spherical conductor with radius R is proportional to:

A) R
B) R^2
C) $1/R$
D) $1/R^2$
E) none of these

17. The time constant RC has units of:

A) second/farad
B) second/ohm
C) 1/second
D) second/watt
E) none of these

18. To charge a 1-F capacitor with 2 C requires a potential difference of:

A) 2 V
B) 0.2 V
C) 5 V
D) 0.5 V
E) none of these

19. Capacitors 1 and 2 are connected in series and a potential difference is applied to the combination. If the capacitor that is equivalent to the combination has the same potential difference, then the charge on the positive plate of the equivalent capacitor is the same as:

A) the charge on the positive plate of capacitor 1
B) the sum of the charges on the positive plates of the two capacitors
C) the difference of the charges on the positive plates of the two capacitors
D) the product of the charges on the positive plates of the two capacitors
E) none of the above

20. Two parallel-plate capacitors with different plate separation but the same capacitance are connected in series to a battery. Both capacitors are filled with air. The quantity that is NOT the same for both capacitors when they are fully charged is:

A) potential difference
B) stored energy
C) electric field between the plates
D) charge on the positive plate
E) dielectric constant

21. The capacitance of a spherical capacitor with inner radius a and outer radius b is proportional to:

A) a/b
B) $b - a$
C) $b^2 - a^2$
D) $ab/(b - a)$
E) $ab/(b^2 - a^2)$

22. If the charge on a parallel-plate capacitor is doubled:

A) the capacitance is halved
B) the capacitance is doubled
C) the electric field is halved
D) the electric field is doubled
E) the surface charge density is not changed on either plate

23. Capacitors C_1 and C_2 are connected in parallel. The equivalent capacitance is given by:

A) $C_1C_2/(C_1 + C_2)$
B) $(C_1 + C_2)/C_1C_2$
C) $1/(C_1 + C_2)$
D) C_1/C_2
E) $C_1 + C_2$

24. A parallel-plate, air-filled capacitor is charged by a battery, after which the battery is disconnected. A slab of glass dielectric is then slowly inserted between the plates. As it is being inserted:

A) a force repels the glass out of the capacitor
B) a force attracts the glass into the capacitor
C) no force acts on the glass
D) a net charge appears on the glass
E) the glass makes the plates repel each other

25. Two identical capacitors, each with capacitance C, are connected in parallel and the combination is connected in series to a third identical capacitor. The equivalent capacitance of this arrangement is:

A) $2C/3$
B) C
C) $3C/2$
D) $2C$
E) $3C$

Answer Key

1. C
2. B
3. A
4. B
5. A
6. D
7. B
8. B
9. C
10. E
11. C
12. A
13. C
14. E
15. D
16. A
17. E
18. A
19. A
20. C
21. D
22. D
23. E
24. B
25. A