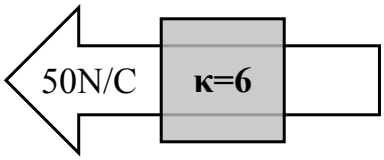
Name:_____

Physics 2140

Sample Exam 2

1. Suppose I place a piece of plastic ($\kappa = 6$) in an electric field which points to the left, with a strength of 50 N/C.

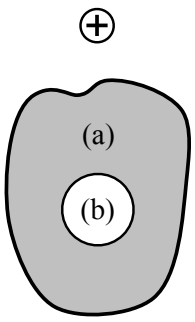


[3] (a) _____ In which direction does the net electric field inside the plastic point?
A) $\leftarrow$ **B)** $\rightarrow$

[3] (b) _____ What is the magnitude of the net electric field inside the plastic?
A) 0.12 N/C **B)** 8.3 N/C **C)** 300 N/C

2. Here is a lump of metal with a large air bubble inside (not visible from the outside). A positive charge is placed above the block as shown.

[3] (a) _____ The electric field inside the *metal*
A) points ↑ **B)** is zero **C)** points ↓



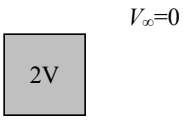
[3] (b) _____ The electric field inside the *bubble*
A) points ↑ **B)** is zero **C)** points ↓

[2] (c) _____ The positive charge is . . . the metal lump.
A) attracted to **B)** repelled by

3 3. _____ The potential of a particular metal block is 2 V, if the potential at infinity is $V_\infty = 0$ V. The block is

A) positively charged **B)** neutral **C)** negatively charged

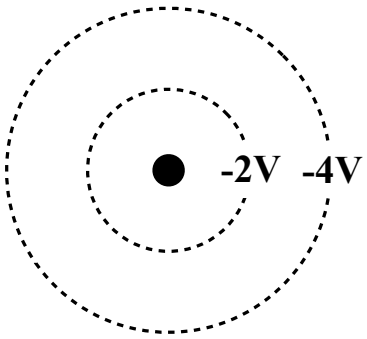
D) the block *can't* have a potential of 2 V



3 4. _____ Which is the *higher* potential?

A) -4V **B)** -2V

5. The figure shows a charge (the black dot) surrounded by a couple of equipotential surfaces it creates.



3 (a) _____ This charge is

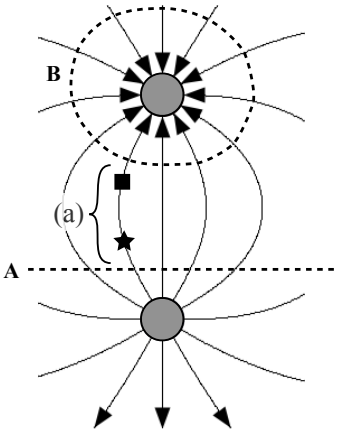
A) positive **B)** neutral **C)** negative

3 (b) _____ If there are no other charges in the universe, then the potential at infinity is

A) positive **B)** zero **C)** negative

D) our choice

6. The figure shows the field lines of a dipole. Two locations are marked with a star and a square.



3 (a) _____ At which point is the electric potential V higher?

A) the star **B)** the square

C) both have the same potential

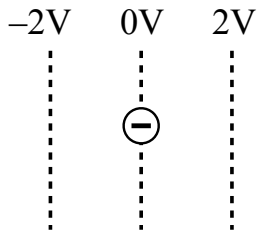
3 (b) _____ Which of the dashed lines is an equipotential line?

A) A (the vertical line) **B)** B (the ovalish line)

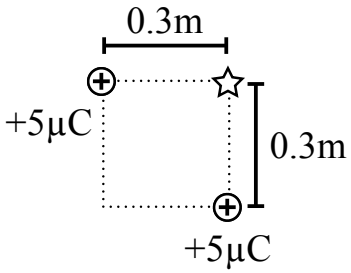
C) Both are equipotential lines.

3 7. _____ If I place a negative charge on the zero equipotential line in the figure, what happens next?

A) it starts moving to the left
B) it starts moving to the right
C) it doesn't move at all

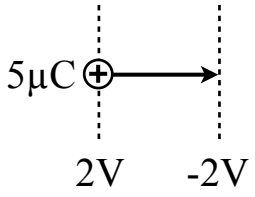


3 8. Two 5×10^{-6} C charges lay on opposite corners of a square with side 0.3 m. If $V_\infty = 0$, what is the electric potential at the star?



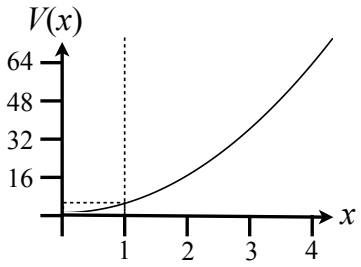
9. A $+5 \times 10^{-6}$ C charge is moved from a 2 V line to a -2 V line.

3 (a) _____ The potential energy of the charge
A) increases **B)** decreases



3 (b) _____ What is the magnitude of the change of potential energy, $|\Delta PE|$?
A) 0.4 μJ **B)** 1.25 μJ **C)** 2.5 μJ **D)** 10 μJ **E)** 20 μJ

10. The electric potential in a particular region has the functional form $V(x) = 4x^2$. (This would be weird, but go with it.)

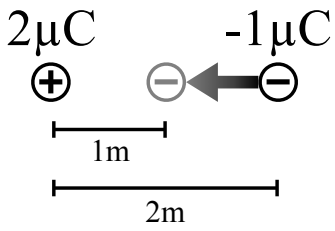


3 (a) _____ What direction does the electric field point at $x = 1$?
A) In the $+\hat{x}$ direction **B)** In the $-\hat{x}$ direction
C) The field is zero there

3 (b) _____ What is the magnitude of the electric field at $x = 1$?
A) 2 N/C **B)** 4 N/C **C)** 8 N/C

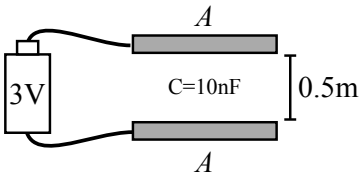
11. A -1×10^{-6} C charge is initially 2 meters from a 2×10^{-6} C charge. It is then moved closer, so that it is 1 meter from the positive charge.

3 (a) _____ The potential energy of the system
A) increases **B)** decreases



3 (b) Find the change in potential energy ΔPE, including the correct sign.

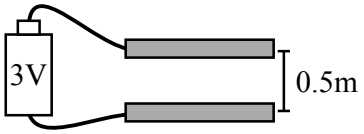
12. A parallel-plate capacitor has a capacitance of 10 nF, and the plates are 0.05 m apart. The capacitor is connected to a 3 V battery.



3 (a) What is the area of the top plate?

3 (b) How much charge is on the top plate?

13. A battery is connected to a parallel-plate capacitor, whose plates are 0.5 m apart. When the voltage supply is set to $\Delta V = 3\,\text{V}$, the top plate has a charge of $6\,\mu\text{C}$.



3 (a) What is the capacitance of the plates?

3 (b) If I move the plates together, so that they're only 0.25 m apart, what is the capacitance?

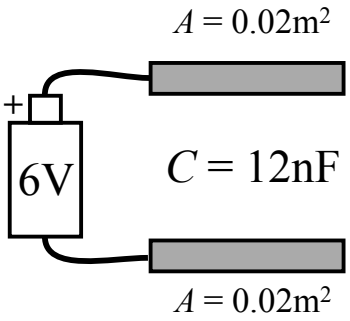
3 14. _____ A metal cone with capacitance $C = 2\,\mu$F is connected by a long metal wire to a metal cone with capacitance $C = 6\,\mu$F. If some positive charge is placed on the smaller cone, charge flows along the wire until

A) all the charge ends up in the large cone.
B) both cones have the same charge Q.
C) both have the same potential V.
D) both have the same surface charge density σ.
E) both have the same volume charge density ρ.
F) None of these: all the charge stays on the small cone.

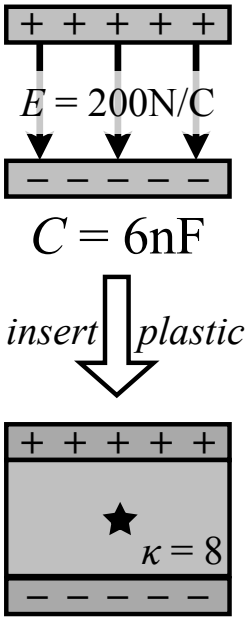
15. A two-piece capacitor with $C = 12\,$nF is made up of two metal plates, each with area $A = 0.02\,\text{m}^2$. The plates are connected to a 6 V battery as shown.

3 (a) How far apart are the plates?

3 (b) What is the charge on the top plate?



16. Consider a parallel-plate capacitor with capacitance 6 nF which holds a charge, so that the electric field between the plates is 200 N/C pointing downward. (Notice: there is no battery connected to the plates.) Then, a piece of plastic with dielectric constant $\kappa = 8$ is slid between the plates. Once the plastic is fully inserted,

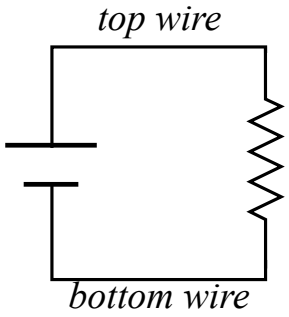


3 (a) _____ the capacitance of the plates is now
A) 0.75 nF **B)** 6 nF **C)** 48 nF **D)** 8 F

3 (b) _____ & the net electric field in the plastic (at the star) is
A) 25 N/C ↑ **B)** 192 N/C ↑ **C)** 200 N/C ↑
D) 25 N/C ↓ **E)** 200 N/C ↓ **F)** 1600 N/C ↓

2 (c) _____ When the plastic is slid between the plates, the potential energy stored in the capacitor
A) increases **B)** stays the same **C)** decreases

17. The figure shows a resistor attached to a battery.

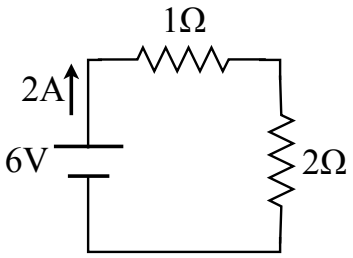


2 (a) _____ The current I through the *resistor*, as usually defined, flows
A) up **B)** down

2 (b) _____ The electrons in the resistor are moving
A) up **B)** down

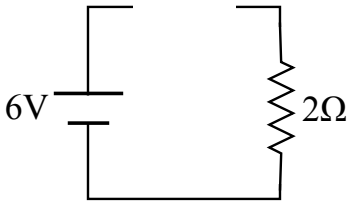
3 (c) _____ Which wire has more current?
A) the top wire **B)** the bottom wire **C)** both wires have the same current

18. In this circuit, the current through the battery is 2 A.



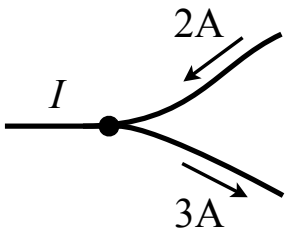
3 (a) _____ What is the potential difference ΔV across the 2 Ω resistor?
A) 2 V **B)** 4 V **C)** 6 V

3 (b) _____ Suppose I remove the 1 Ω resistor, leaving a gap in the circuit. What is the potential difference across the 2 Ω resistor now?
A) 0 V **B)** 2 V **C)** 4 V **D)** 6 V **E)** ∞ V



3 19. _____ What is the current I in the leftmost wire?

A) 5 A to the left **B)** 1 A to the left
C) 1 A to the right **D)** 5 A to the right



3 20. _____ Compared to a certain wire, which of the following wires has *less* resistance?

A) Wire A, which is made of a material with less conductivity
B) Wire B, which is longer
C) Wire C, which has a larger radius

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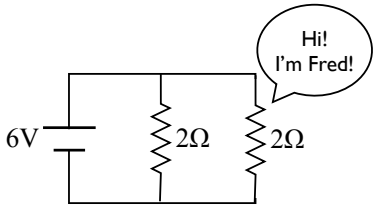
21. In this circuit, the resistor on the right is named "Fred".

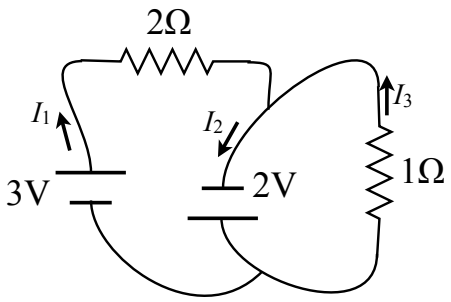


3 (a) _____ What is the potential difference across Fred?
A) 1.5 V **B)** 3 V **C)** 6 V **D)** 12 V

3 (b) What is the current through Fred?

3 (c) How much power is output by Fred?

22. In this circuit,



3 (a) _____ Which of the following is true?

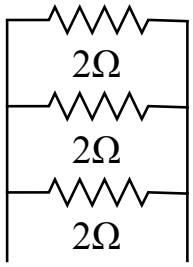
A) $I_1 = I_2 + I_3$
B) $I_2 = I_1 + I_3$
C) $I_3 = I_1 + I_2$
D) $I_1 + I_2 + I_3 = 0$

3 (b) Write a loop rule equation. (There are three options.)

3 (c) Find the current I_2 through the 2 V battery.

3 23. _____ The effective resistance of three $2\,\Omega$ resistors in parallel is

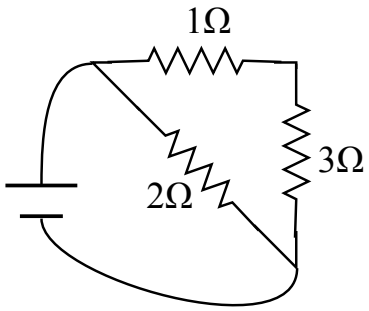
A) $\frac{1}{3}\,\Omega$ **B)** $\frac{2}{3}\,\Omega$ **C)** $1\,\Omega$ **D)** $\frac{3}{2}\,\Omega$ **E)** $2\,\Omega$ **F)** $6\,\Omega$



24. For the following combinations of resistors,

3 (a) _____ Which of the following is true?

A) The $2\,\Omega$ and $3\,\Omega$ resistors are in parallel.
B) The $1\,\Omega$ and $2\,\Omega$ resistors are in parallel.
C) The $1\,\Omega$ and $3\,\Omega$ resistors are in parallel.
D) All three resistors are in parallel.
E) The $1\,\Omega$ and $3\,\Omega$ resistors are in series.
F) All three resistors are in series.



3 (b) Find the effective resistance of all three resistors via resistance reduction.