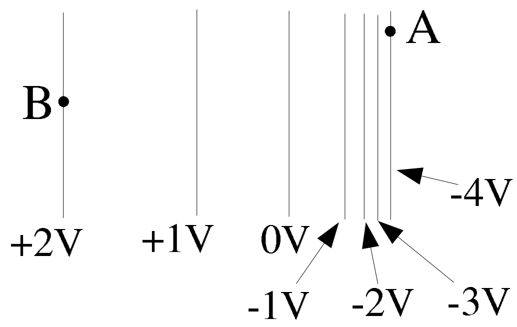
Physics 262, Spr. 06, test 2, section B **Name: Solutions**

1. The lines on the diagram below correspond to equipotential surfaces.



(a) In which direction is the electric field pointing (left, right, up or down)? [3 points]

(b) In which region of the diagram is the electric field the strongest (left, right, up or down)? [3 points]

(c) If the object has charge $+3\,\mathrm{C}$ and starts with $30\,\mathrm{J}$ of kinetic energy at point A (on the $-4\,\mathrm{V}$ line), how much kinetic energy does it have when it reaches point B (on the $+2\,\mathrm{V}$ line)? (Assume there are no other forces acting on the object.) [14 points]

Answer

1. To the right (Electric field points in the direction of decreasing electric potential).

2. The right (Equipotential lines are closer together, therefore $|\Delta V/\Delta x|$ is the largest.)

3. Use conservation of energy: $K_{\text{final}} + U_{\text{final}} = K_{\text{initial}} + U_{\text{initial}}$, where K is kinetic energy and U is potential energy. Here,

$$\begin{aligned} K_{\text{initial}} &= 30\,\mathrm{J} \\ U_{\text{initial}} &= QV_{\text{initial}} = (+3\,\mathrm{C})(-4\,\mathrm{V}) = -12\,\mathrm{J} \\ U_{\text{final}} &= QV_{\text{final}} = (+3\,\mathrm{C})(+2\,\mathrm{V}) = 6\,\mathrm{J} \end{aligned}$$

Therefore

$$K_{\text{final}} = K_{\text{initial}} + U_{\text{initial}} - U_{\text{final}} = 30\,\mathrm{J} + (-12)\,\mathrm{J} - 6\,\mathrm{J} = 12\,\mathrm{J}.$$

Alternatively: Let W be the work done by the electric field on the object. Then $W = -Q\Delta V$. Therefore $K_{\text{final}} = K_{\text{initial}} + W = 30\mathrm{J} + [-(+3\mathrm{C})(6\,\mathrm{V})] = 12\mathrm{J}$.

2. A $1\,\Omega$ and a $2\,\Omega$ resistor are connected to a $6\,$V battery (with zero internal resistance).

(a) If the resistors are connected to the battery in parallel, what is the power dissipated in the (i) $1\,\Omega$ and (ii) $2\,\Omega$ resistor? [10 points]

(b) If the resistors are connected to the battery in series, what is the power dissipated in the (i) $1\,\Omega$ and (ii) $2\,\Omega$ resistor? [10 points]

Answer

1. Since resistors are in parallel, the voltage drop across each resistor is $6\,$V. The power dissipated is $P = VI = V^2/R$ (since $V = IR \Rightarrow I = V/R$), hence,

$$\text{(i) } P_{1\Omega} = (6\text{V})^2/1\Omega = 36\,\text{W}$$
$$\text{(ii) } P_{2\Omega} = (6\text{V})^2/2\Omega = 18\,\text{W}$$

2. The equivalent resistance of the two resistors in series is the sum of the resistances, $1\Omega + 2\Omega = 3\Omega$. Therefore the current through the resistors is $I = V/R = 6\,\text{V}/3\Omega = 2\,\text{A}$. The power dissipated is $P = VI = I^2R$ (since $V = IR$), hence

$$\text{(i) } P_{1\Omega} = (2\text{A})^2\,1\Omega = 4\,\text{W}$$
$$\text{(ii) } P_{2\Omega} = (2\text{A})^2\,2\Omega = 8\,\text{W}$$

Answer Key to Section A

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