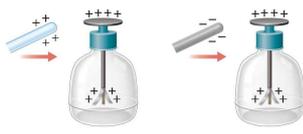
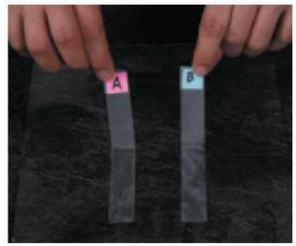
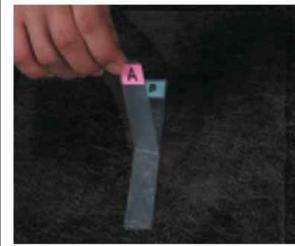
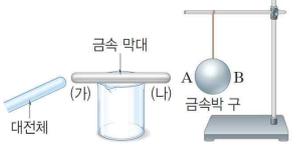
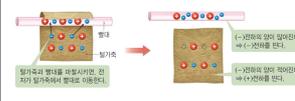
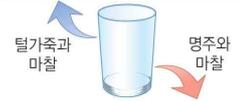
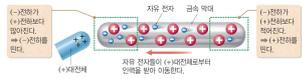
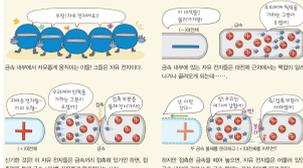


I. 전기와 자기

01. 정전기

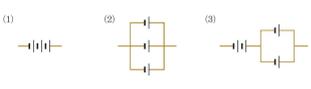
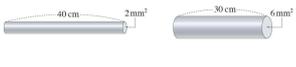
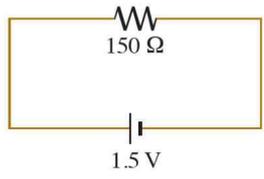
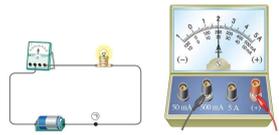
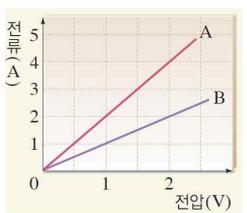
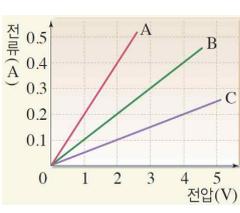
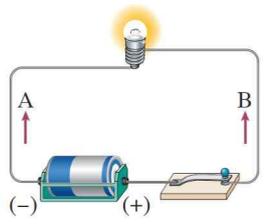
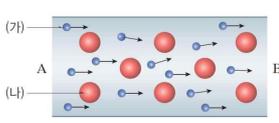
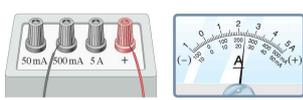
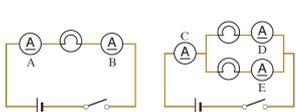
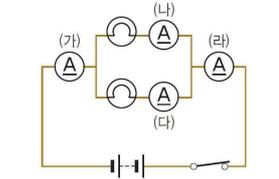
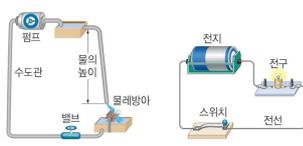
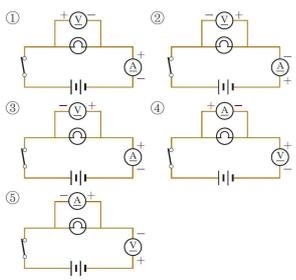
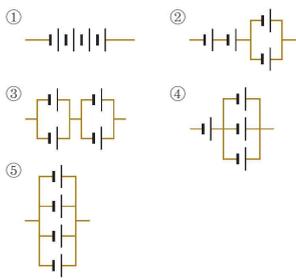
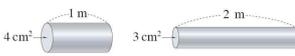
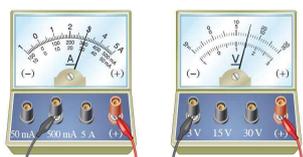
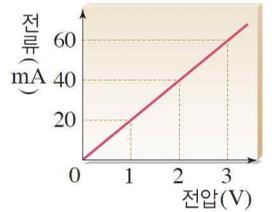
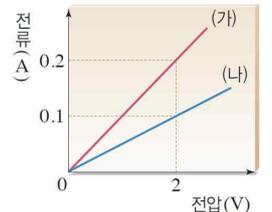
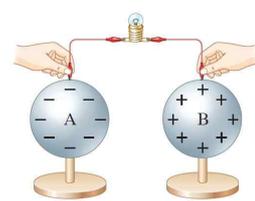
| | | | |
|----------------------|--------------------|--------------------|-----------------|
| 1-01-01(마찰 전기 발생 과정) | 1-01-02(대전열) | 1-01-03(전기력) | 1-01-04(정전기 유도) |
| | | | |
| 1-01-05(정전기 유도) | 1-01-06(검전기) | 1-01-07(금속의 대전) | 1-01-08(금속의 대전) |
| | | | |
| 1-01-09(금속의 대전) | 1-01-10(금속의 대전) | 1-01-11(마찰 전기 발생) | 1-01-12(대전열) |
| | | | |
| 1-01-13(전기력) | 1-01-14(정전기 유도) | 1-01-15(정전기 유도 관찰) | 1-01-16(금속의 대전) |
| | | | |
| 1-01-17(금속의 대전) | 1-01-18(정전기 유도 관찰) | 1-01-19(검전기) | 1-01-20(검전기) |
| | | | |

| | | | |
|---|---|--|--|
| 1-01-21(검전기) | 1-01-22(정전기 유도 관찰) | 1-01-23(마찰 전기 실험) | 1-01-24(마찰 전기 실험) |
|  |  |  |  |
| 1-01-25(마찰 전기) | 1-01-26(정전기 유도 관찰) | 1-01-27(검전기) | 1-01-28(마찰 전기) |
|  |  |  |  |
| 1-01-29(대전열) | 1-01-30(척력과 인력) | 1-01-31(원자의 구조) | 1-01-32(유리컵의 대전) |
|  |  |  | <p>유리가 털가죽보다 (-)전하로 대전되기 쉽다. → 유리컵은 (-)전하로 대전</p>  <p>유리가 명주보다 (+)전하로 대전되기 쉽다. → 유리컵은 (+)전하로 대전</p> |
| 1-01-33(정전기 유도) | 1-01-34(정전기 유도) | 1-01-35(검전기의 원리) | 1-01-36(검전기로 알 수 있는 사실) |
|  |  |  |  |
| 1-01-37(금속의 대전) | 1-01-38(검전기) | 1-01-39(검전기) | 1-01-40(검전기) |
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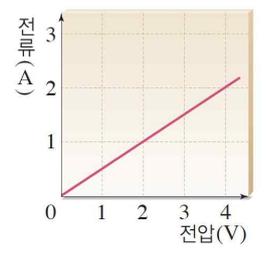
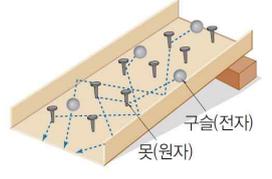
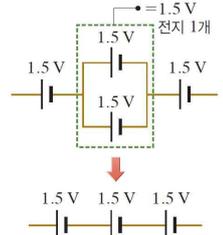
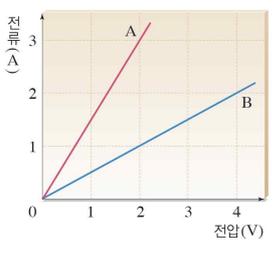
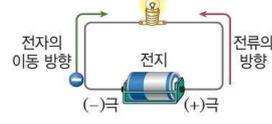
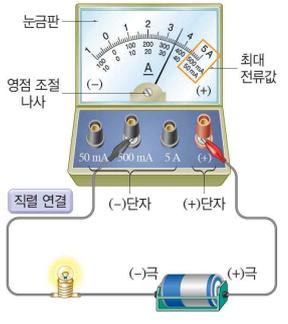
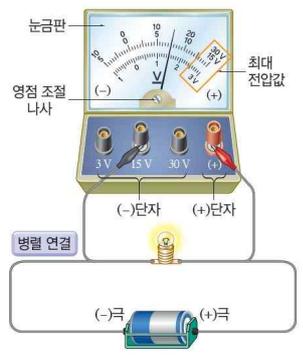
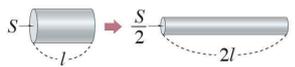
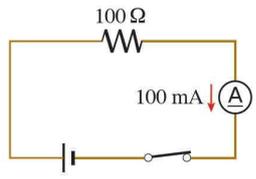
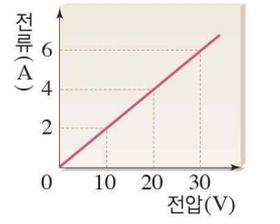
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|-------------------------|-------------------------|--------------------------|-----------------------|
| 1-01-41(원자의 구조와 전기의 발생) | 1-01-42(전기력-척력) | 1-01-43(전기력-인력) | 1-01-44(전기력) |
| | | | |
| 1-01-45(정전기 유도 과정) | 1-01-46(은박 구의 대전1) | 1-01-47(은박 구의 대전2) | 1-01-48(두 고무풍선의 대전) |
| | | | |
| 1-01-49(두 금속 막대의 대전) | 1-01-50(두 금속 막대의 대전 상태) | 1-01-51(알루미늄 캔에서 정전기 유도) | 1-01-52(고무풍선과 고양이 마찰) |
| | | | |

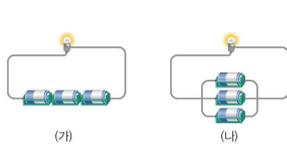
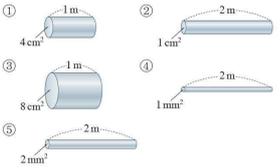
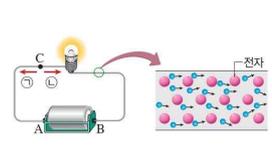
02. 전류, 전압, 전기 저항

| | | | |
|--------------------|--------------------|-----------------|-----------------|
| 1-02-01(전류와 전자 이동) | 1-02-02(전류와 전자 이동) | 1-02-03(전류계) | 1-02-04(전류계) |
| | | | |
| 1-02-05(전기 기호) | 1-02-06(전하량 보존) | 1-02-07(전하량 보존) | 1-02-08(전압의 비유) |
| | | | |

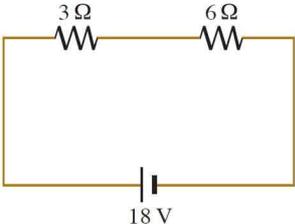
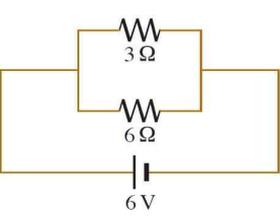
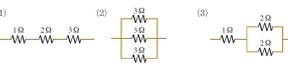
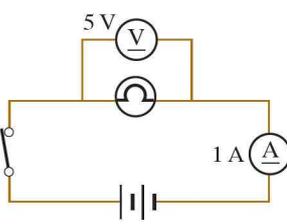
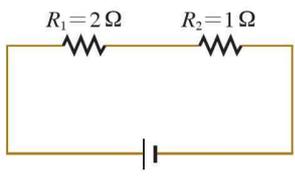
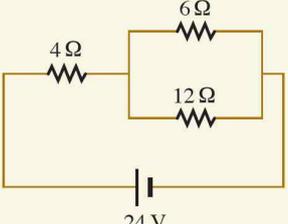
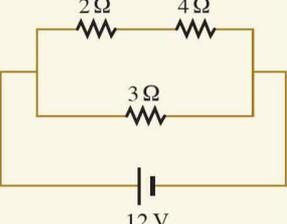
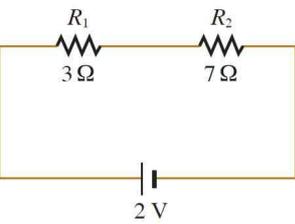
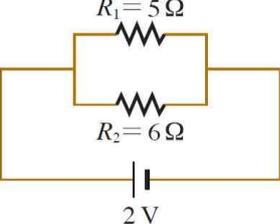
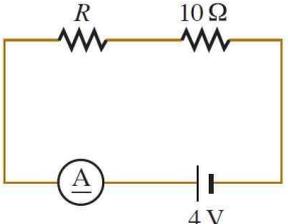
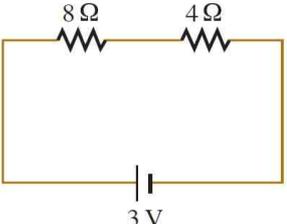
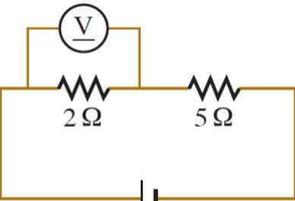
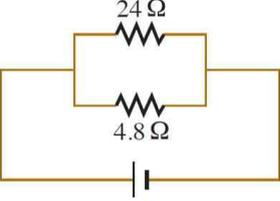
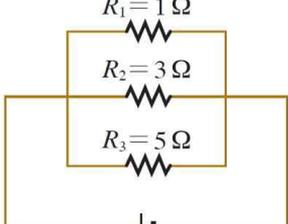
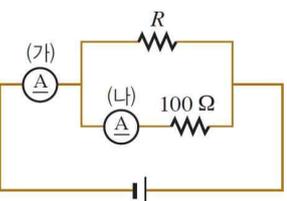
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|---|---|--|---|
| 1-02-09(전지의 연결) | 1-02-10(도선의 저항) | 1-02-11(전기 회로도) | 1-02-12(전기 회로와 전류계) |
|  |  |  |  |
| 1-02-13(전압-전류 그래프) | 1-02-14(전압-전류 그래프) | 1-02-15(전류와 전자 이동) | 1-02-16(전류와 전자 이동) |
|  |  |  |  |
| 1-02-17(전류계) | 1-02-18(전기 기호) | 1-02-19(전하량 보존) | 1-02-20(전하량 보존) |
|  | <p>① 저항  ② 전지 </p> <p>③ 전구  ④ 전류계 </p> <p>⑤ 전압계 </p> |  |  |
| 1-02-21(전압의 비유) | 1-02-22(전류계, 전압계 연결) | 1-02-23(전지의 연결) | 1-02-24(도선의 저항) |
|  |  |  |  |
| 1-02-25(전류계와 전압계) | 1-02-26(전압-전류 그래프) | 1-02-27(전압-전류 그래프) | 1-02-28(전자의 이동) |
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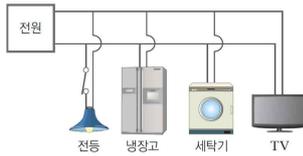
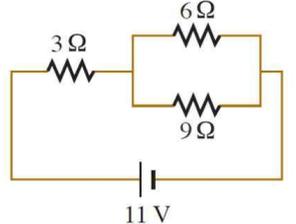
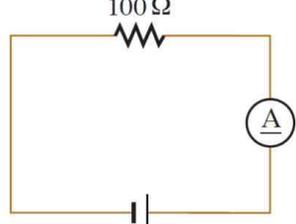
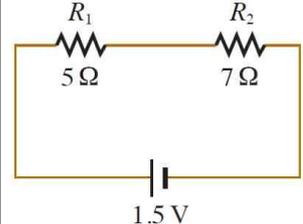
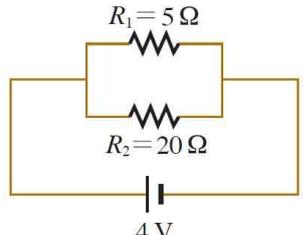
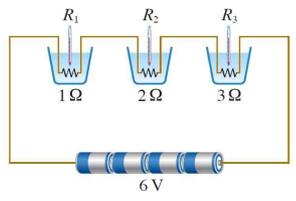
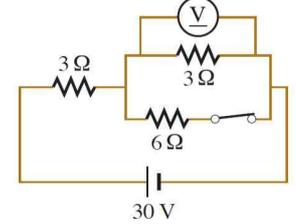
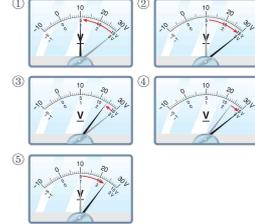
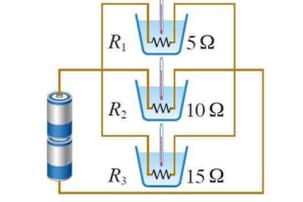
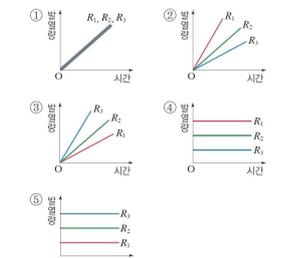
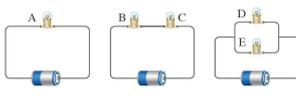
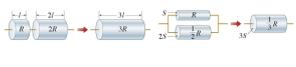
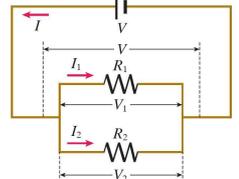
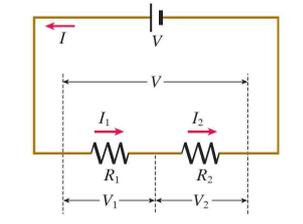
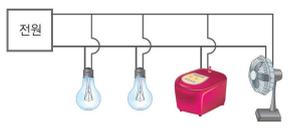
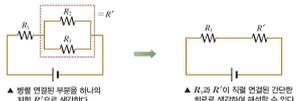
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|----------------------|---------------------|--------------------|------------------|
| 1-02-29(전류계, 전압계 연결) | 1-02-30(전류계와 전압계) | 1-02-31(전하량 보존) | 1-02-32(도선의 저항) |
| | | | |
| 1-02-33(전압-전류 그래프) | 1-02-34(전류의 방향) | 1-02-35(전류와 전자 이동) | 1-02-36(전류의 세기) |
| | | | |
| 1-02-37(전류계의 연결) | 1-02-38(전류계) | 1-02-39(전기 기호) | 1-02-40(전기 회로도) |
| | | | |
| 1-02-41(전하량 보존 법칙) | 1-02-42(전류와 전압의 비유) | 1-02-43(전압계의 연결) | 1-02-44(전압계의 눈금) |
| | | | |
| 1-02-45(전기 회로도) | 1-02-46(전지의 직렬 연결) | 1-02-47(전지의 병렬 연결) | 1-02-48(전기 저항) |
| | | | |

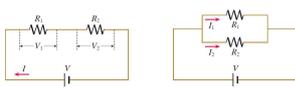
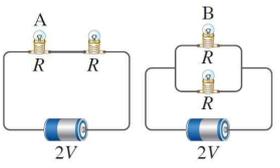
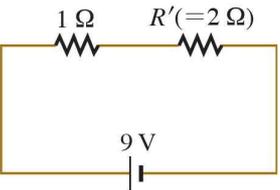
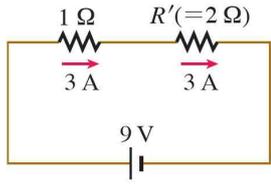
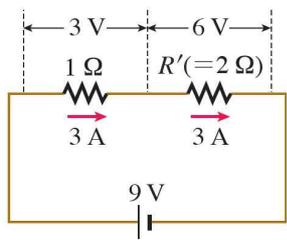
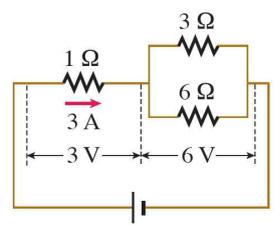
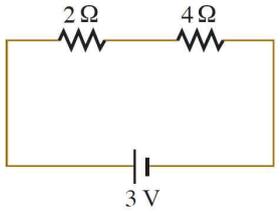
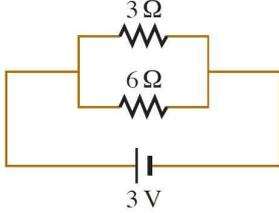
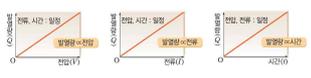
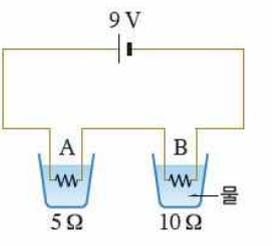
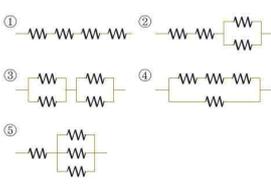
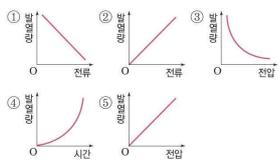
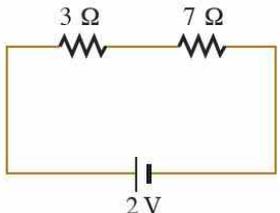
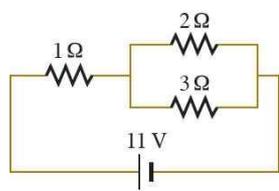
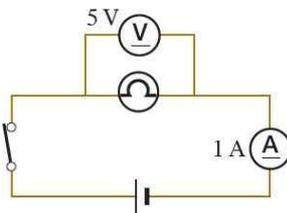
| | | | |
|---|---|--|--|
| 1-02-49(옴의 법칙) | 1-02-50(전압-전류 그래프) | 1-02-51(전기 저항의 비유) | 1-02-52(전체 전압) |
|  |  |  |  <p>∴ 전체 전압 = 1.5 V × 3 = 4.5 V</p> |
| 1-02-53(전압-전류 그래프) | 1-02-54(전류의 방향) | 1-02-55(전류계의 연결) | 1-02-56(전류계의 눈금 읽기) |
|  |  |  |  |
| 1-02-57(전압계의 연결) | 1-02-58(전압계의 눈금 읽기) | 1-02-59(길이와 전기 저항) | 1-02-60(단면적과 전기 저항) |
|  |  |  |  |
| 1-02-61(균일하게 늘일 때 전기 저항) | 1-02-62(전기 회로도) | 1-02-63(그래프의 기울기로 저항 구하기) | 1-02-64(전압계 눈금판) |
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| | | | |
|---|---|--|---|
| 1-02-65(전지의 직렬 병렬 연결) | 1-02-66(도선의 길이와 단면적) | 1-02-67(도선 속 전자의 운동) | 1-02-68(전류계와 전압계) |
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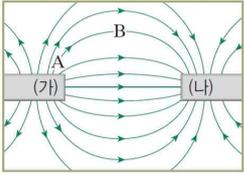
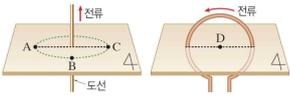
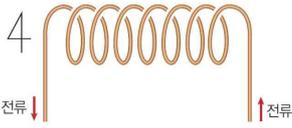
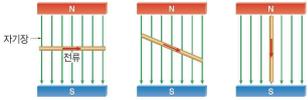
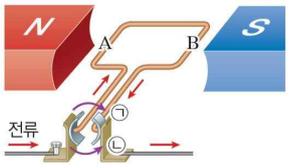
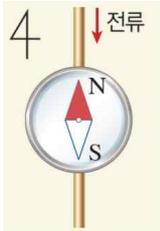
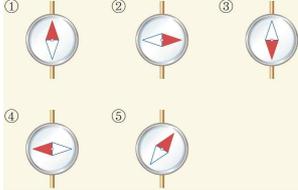
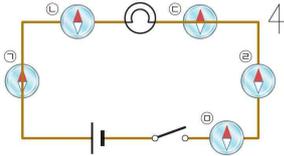
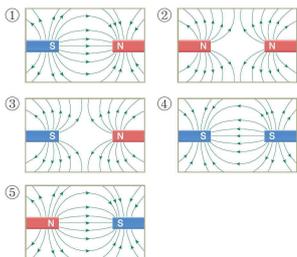
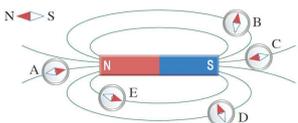
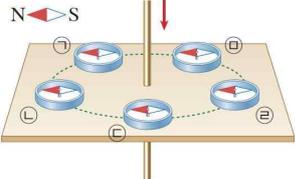
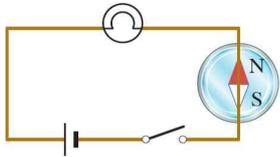
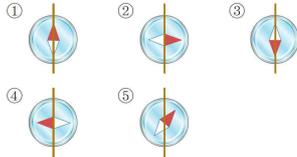
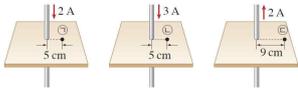
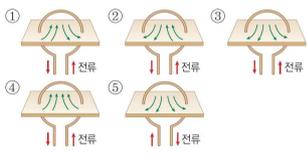
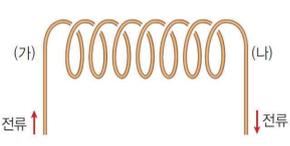
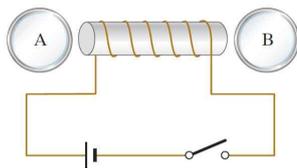
03. 저항의 연결과 전기 에너지

| | | | |
|---|---|--|---|
| 1-03-01(직렬 연결) | 1-03-02(병렬 연결) | 1-03-03(혼합 연결) | 1-03-04(전기 회로도) |
|  |  |  |  |
| 1-03-05(직렬 연결) | 1-03-06(LED 전구) | 1-03-07(혼합 연결) | 1-03-08(혼합 연결) |
|  |  |  |  |
| 1-03-09(직렬 연결) | 1-03-10(병렬 연결) | 1-03-11(직렬 연결) | 1-03-12(직렬 연결) |
|  |  |  |  |
| 1-03-13(직렬 연결) | 1-03-14(병렬 연결) | 1-03-15(병렬 연결) | 1-03-16(병렬 연결) |
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| | | | |
|--|--|--|--|
| <p>1-03-17(가정에서 연결)</p>  <p>전원 전등 냉장고 세탁기 TV</p> | <p>1-03-18(혼합 연결)</p>  <p>11 V</p> | <p>1-03-19(전기 회로도)</p>  <p>100 Ω</p> | <p>1-03-20(직렬 연결)</p>  <p>1.5 V</p> |
| <p>1-03-21(병렬 연결)</p>  <p>4 V</p> | <p>1-03-22(열량계 직렬 연결)</p>  <p>6 V</p> | <p>1-03-23(혼합 연결)</p>  <p>30 V</p> | <p>1-03-24(전압계)</p>  |
| <p>1-03-25(열량계 병렬 연결)</p>  | <p>1-03-26(시간-발열량 그래프)</p>  | <p>1-03-27(전구의 밝기)</p>  | <p>1-03-28(TV)</p>  |
| <p>1-03-29(TV)</p>  | <p>1-03-30(TV)</p>  | <p>1-03-31(저항의 연결)</p>  | <p>1-03-32(병렬 연결)</p>  |
| <p>1-03-33(직렬 연결)</p>  | <p>1-03-34(가정에서 연결)</p>  <p>전원</p> | <p>1-03-35(저항의 혼합 연결)</p>  <p>▲ 병렬 저항들 부분을 하나의 저항 R'으로 생각한다. ▲ R'은 R'이 직렬 연결된 것만큼 필요로 생각하여 계산할 수 있다.</p> | <p>1-03-36(병렬 연결의 장점)</p>  |

| | | | |
|--|---|--|---|
| <p>1-03-37(전기 에너지와 전류, 전압)</p>  | <p>1-03-38(전력과 전구의 밝기)</p>  | <p>1-03-39(혼합 연결1)</p>  | <p>1-03-40(혼합 연결2)</p>  |
| <p>1-03-41(혼합 연결3)</p>  | <p>1-03-42(혼합 연결4)</p>  | <p>1-03-43(직렬 연결)</p>  | <p>1-03-44(병렬 연결)</p>  |
| <p>1-03-45(발열량 그래프)</p>  | <p>1-03-46(소비 전력 표시)</p>  | <p>1-03-47(열량계 직렬 연결)</p>  | <p>1-03-48(저항의 연결)</p>  |
| <p>1-03-49(발열량 측정 실험 장치)</p>  | <p>1-03-50(발열량 실험 결과 그래프)</p>  | <p>1-03-51(저항의 직렬 연결과 전력)</p>  | <p>1-03-52(저항의 혼합 연결)</p>  |
| <p>1-03-53(전기 회로도와 전기 에너지)</p>  | | | |

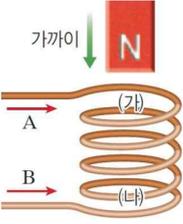
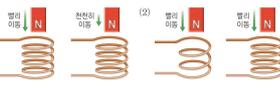
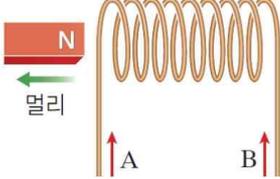
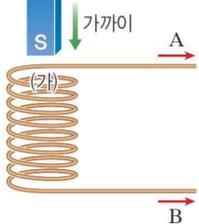
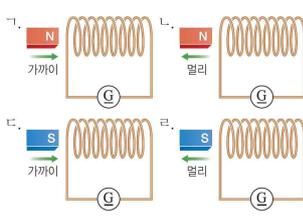
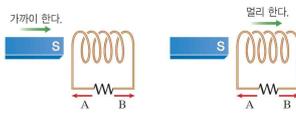
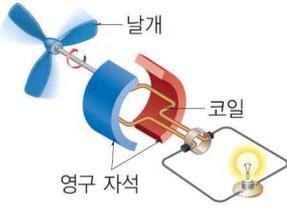
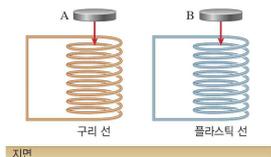
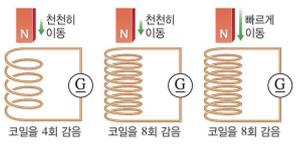
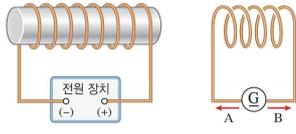
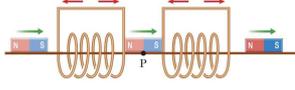
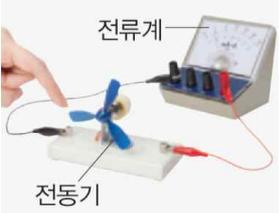
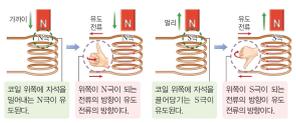
04. 전류에 의한 자기장

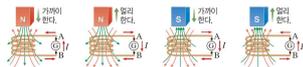
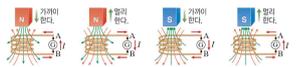
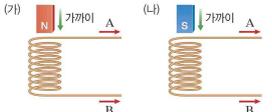
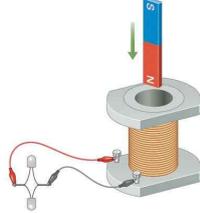
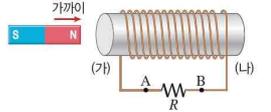
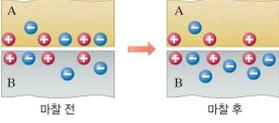
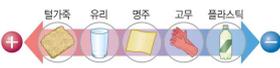
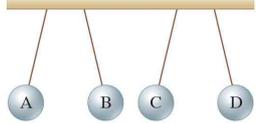
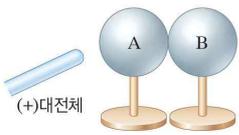
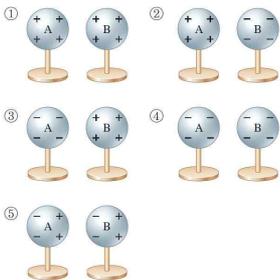
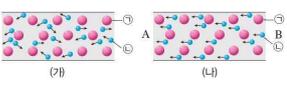
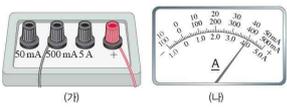
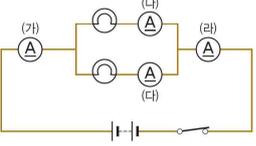
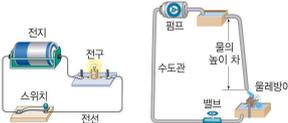
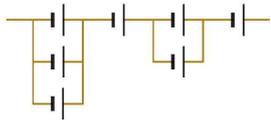
| | | | |
|---|---|--|---|
| <p>1-04-01(자기력선)</p> | <p>1-04-02(직선, 원형 도선)</p> | <p>1-04-03(코일에 의한 자기장)</p> | <p>1-04-04(자기장 속 도선)</p> |
|  |  |  |  |
| <p>1-04-05(도선의 각도와 힘)</p> | <p>1-04-06(전동기의 구조)</p> | <p>1-04-07(직선 도선과 나침반)</p> | <p>1-04-08(직선 도선과 나침반)</p> |
|  |  |  |  |
| <p>1-04-09(직선 도선과 나침반)</p> | <p>1-04-10(자기장 속에서 전류가 받는 힘 실험)</p> | <p>1-04-11(자기력선)</p> | <p>1-04-12(자기력선)</p> |
|  |  |  |  |
| <p>1-04-13(직선 도선과 나침반)</p> | <p>1-04-14(직선 도선과 나침반)</p> | <p>1-04-15(직선 도선과 나침반)</p> | <p>1-04-16(직선 도선)</p> |
|  |  |  |  |
| <p>1-04-17(원형 도선)</p> | <p>1-04-18(코일에 의한 자기장)</p> | <p>1-04-19(전자석)</p> | <p>1-04-20(빈 나침반)</p> |
|  |  |  |  |

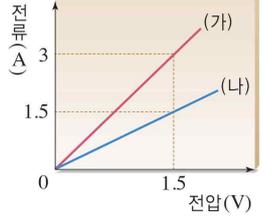
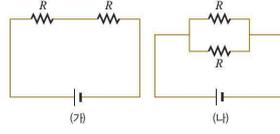
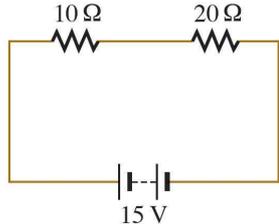
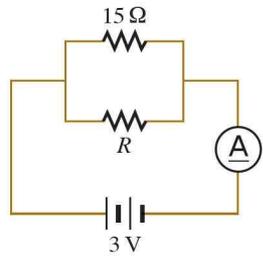
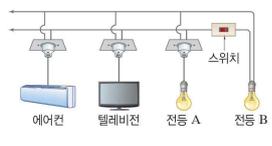
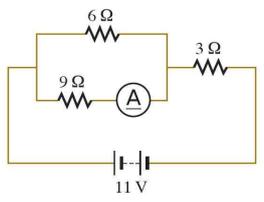
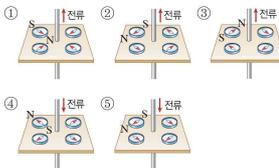
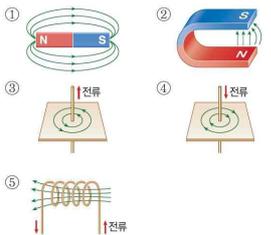
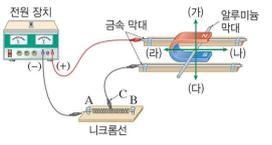
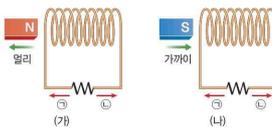
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|-------------------------------|-------------------------------------|-------------------------------------|-----------------------------------|
| <p>1-04-21(도선 그네)</p> | <p>1-04-22(자기장 속에서 전류가 받는 힘 실험)</p> | <p>1-04-23(자기장 속에서 전류가 받는 힘 실험)</p> | <p>1-04-24(전동기의 구조)</p> |
| <p>1-04-25(직선 도선)</p> | <p>1-04-26(원형 도선)</p> | <p>1-04-27(전자석)</p> | <p>1-04-28(전자석)</p> |
| <p>1-04-29(전류계의 구조)</p> | <p>1-04-30(직선 도선)</p> | <p>1-04-31(자기력선)</p> | <p>1-04-32(직선 도선 주위의 자기장)</p> |
| <p>1-04-33(원형 도선 주위의 자기장)</p> | <p>1-04-34(코일 주위의 자기장)</p> | <p>1-04-35(지구 자기)</p> | <p>1-04-36(원형 도선에 의한 자기장의 모양)</p> |
| <p>1-04-37(자기장)</p> | <p>1-04-38(전자석)</p> | <p>1-04-39(자기장에서 전류가 받는 힘)</p> | <p>1-04-40(자기장)</p> |

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| 1-04-41(전동기) | 1-04-42(전류계의 구조) | 1-04-43(스피커의 구조) | 1-04-44(직선 도선과 나침반) |
| | | | |
| 1-04-45(직선 도선과 나침반) | 1-04-46(막대자석 주위의 자기력선) | 1-04-47(직선 도선 주위의 자기장) | 1-04-48(원형 도선 주위의 자기장) |
| | | | |
| 1-04-49(코일 주위의 자기장) | 1-04-50(막대자석 주위의 나침반) | 1-04-51(코일 주위의 나침반) | 1-04-52(전동기의 회전 원리) |
| | | | |
| 1-04-53(전자석의 극) | 1-04-54(직선 도선 위 나침반) | 1-04-55(코일 주위의 나침반) | 1-04-56(전동기의 구조) |
| | | | |
| 1-04-57(도선 그네 실험 장치) | | | |
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05. 전자기 유도

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|---|---|---|--|
| <p>1-05-01(전자기 유도)</p>  | <p>1-05-02(전자기 유도)</p>  | <p>1-05-03(전자기 유도)</p>  | <p>1-05-04(전자기 유도)</p>  |
| <p>1-05-05(전자기 유도)</p>  | <p>1-05-06(전자기 유도 실험)</p>  | <p>1-05-07(전자기 유도)</p>  | <p>1-05-08(발전기 구조)</p>  |
| <p>1-05-09(자석의 낙하)</p>  | <p>1-05-10(전자기 유도)</p>  | <p>1-05-11(전자석과 유도 전류)</p>  | <p>1-05-12(레일과 유도 전류)</p>  |
| <p>1-05-13(전동기와 발전기)</p>  | <p>1-05-14(유도 전류)</p>  | <p>1-05-15(전동기와 발전기)</p>  | <p>1-05-16(유도 전류의 방향)</p>  |
| <p>1-05-17(유도 전류의 방향)</p>  | <p>1-05-18(유도 전류의 방향)</p>  | <p>1-05-19(유도 전류의 방향)</p>  | <p>1-05-20(유도 전류의 방향 찾는 법)</p>  |

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| <p>1-05-21(자석의 움직임과 유도 전류의 방향)</p>  | <p>1-05-22(전동기)</p>  | <p>1-05-23(발전기)</p>  | <p>1-05-24(유도 전류가 흐르는 경우)</p>  |
| <p>1-05-25(유도 전류가 흐르지 않는 경우)</p>  | <p>1-05-26(유도 전류의 방향)</p>  | <p>1-05-27(유도 전류의 발생-발광 다이오드)</p>  | <p>1-05-28(전자기 유도)</p>  |
| <p>1-05-29(마찰 전기)</p>  | <p>1-05-30(대전열)</p>  | <p>1-05-31(전기력)</p>  | <p>1-05-32(금속 막대의 정전기 유도)</p>  |
| <p>1-05-33(금속 구의 정전기 유도)</p>  | <p>1-05-34(금속 구의 대전 상태)</p>  | <p>1-05-35(검전기의 대전)</p>  | <p>1-05-36(도선 속 전자의 운동)</p>  |
| <p>1-05-37(전류계의 눈금 읽기)</p>  | <p>1-05-38(전하량 보존)</p>  | <p>1-05-39(전기 회로와 물의 흐름)</p>  | <p>1-05-40(전지의 혼합 연결)</p>  |

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|--|---|---|---|
| <p>1-05-41(도선의 전기 저항의 비)</p>  | <p>1-05-42(두 니크롬선의 전압-전류 그래프)</p>  | <p>1-05-43(저항의 직렬 병렬 연결)</p>  | <p>1-05-44(저항의 직렬 연결)</p>  |
| <p>1-05-45(저항의 병렬 연결)</p>  | <p>1-05-46(가정의 전기 기구 연결)</p>  | <p>1-05-47(저항의 혼합 연결)</p>  | <p>1-05-48(직선 도선 주위의 나침반)</p>  |
| <p>1-05-49(자기력선)</p>  | <p>1-05-50(자기장에서 도선이 받는 힘)</p>  | <p>1-05-51(유도 전류 방향)</p>  | |