Crocodile Clips
On-Screen Worksheets

Kinematics

ki0001.ckt	**Position-Time Graphs**	Examines how the linear motion of a cart can be analyzed with a position-time graph. What do motion at constant velocity and accelerated motion look like in the position-time graph? What is average and instantaneous velocity?
ki0002.ckt	**Velocity-Time Graphs**	Examines how the linear motion of a cart can be analyzed with a velocity-time graph. Contains questions on the relationship between instantaneous and average velocity. Shows that the area under the velocity-time graphs corresponds to the displacement.
ki0003.ckt	**Acceleration**	Explores motion at constant velocity and uniformly accelerated motion and how they are identified in velocity-time and acceleration-time graphs.

Dynamics

dy0001.ckt	**Newton's First Law**	Examines the law of inertia with a cart.
dy0002.ckt	**Newton's Second Law I**	Verify Newton's second law by measuring the acceleration of a uniformly accelerated cart.
dy0003.ckt	**Newton's Second Law II**	Compare the motion of 2 carts with different forces acting on them.
dy0004.ckt	**Acceleration due to gravity**	Uniform acceleration due to gravity; Balancing forces.

Vibrations and Waves

vi0001.ckt	**Hooke's Law I**	Verify Hooke's law by measuring the compression of coil springs under different forces.
vi0002.ckt	**Hooke's Law II**	Application of Hooke's law in different situations.
vi0003.ckt	**Simple Harmonic Motion I**	Explains the terms equilibrium position and restoring force. In which direction does the restoring force act? A harmonic oscillator displays sinusoidal motion. For a harmonic oscillator, the restoring force must be proportional to displacement.
vi0004.ckt	**Simple Harmonic Motion II**	Explains the terms amplitude, period and frequency of oscillation. Frequency is independent of amplitude for simple harmonic oscillators. Amplitude of oscillation stays constant if there is no energy-loss mechanism (friction).
vi0005.ckt	**Simple Harmonic Motion III**	Compare the motion of two different oscillators.

Sound

so0001.ckt	**Beating Soundwaves**	How does the beat frequency depend on the frequencies of the sources. What does beating look like? What does it sound like?

Easy Electric Circuits

el0001.ckt	**Electric Circuits (pictorial)**	Pictorial worksheet introducing easy lamp-switch-battery circuits.

el0002.ckt	**Electric Circuits I**	Introduces the concept of an electric circuit. Current flows only if there is a closed loop from the load to the battery. Switches can be used to control current flow.
el0003.ckt	**Electric Circuits II**	Elaborates on the role of switches and how they control current flow
el0004.ckt	**Series Circuits**	Easy introduction to series circuits by comparing the brightness of lamps in different configurations.
el0005.ckt	**Parallel Circuits**	Easy introduction to parallel circuits by comparing the brightness of lamps in different configurations.
el0006.ckt	**Diodes**	Examines circuits in which diodes are used to constrict current flow to one direction.
el0007.ckt	**Internal Resistance (conceptual)**	Conceptual introduction to internal resistance. Brightness of lamps decreases as more lamps are connected in parallel. Comparison to a circuit with ideal battery.

DC Circuits

dc0001.ckt	**Ohm's Law**	Rearrange, apply and verify Ohm's law for different circuits with lamps and LED.
dc0002.ckt	**Current in Simple Circuits**	Examines currents in series and parallel circuits: Current through a branch is inversely proportional to the branch's resistance.
dc0003.ckt	**Voltage in Simple Circuits**	Examines voltage in series and parallel circuits. Brightness of lamp relates to the voltage across it (Ohm's law). Voltages around a loop add up to source's voltage (Kirchhoff II).
dc0004.ckt	**Resistors in Series**	Find equivalent resistance of resistors in series.
dc0005.ckt	**Resistors in Parallel**	Find equivalent resistance of resistors in parallel.
dc0006.ckt	**Resistance Networks**	Find equivalent resistance of simple series/parallel networks by step-wise simplification.
dc0007.ckt	**Kirchhoff's First Law**	Conservation of charge applied to junctions in simple series/parallel circuits.
dc0008.ckt	**Kirchhoff's Second Law**	Conservation of energy applied to circuit loops in simple series/parallel circuits.
dc0009.ckt	**Potential Difference**	Examines the concept of potential difference. How does voltage relate to potential difference? What is negative voltage?
dc0010.ckt	**Voltage Divider**	Voltage divider circuits, where the voltage divider is used to make a smaller voltage out of a larger one.
dc0011.ckt	**Wheatstone Bridge**	Determine an unknown resistance by balancing a Wheatstone Bridge circuit.
dc0012.ckt	**Combination of Cells**	How do the emfs of series and parallel cells add up?
dc0013.ckt	**Internal Resistance**	Calculate the internal resistance of a battery by measuring open-circuit voltage and current when an external resistance is connected.
dc0014.ckt	**Light-Emitting Diodes**	Why does an LED need to be protected with a series resistor? How does one calculate the value for the series resistor?

Capacitance and Inductance

ca0001.ckt	**Capacitance**	Variations on Q = C V
ca0002.ckt	**Capacitors in Parallel**	Find the equivalent capacitance of capacitors in parallel.
ca0003.ckt	**Capacitors in Series**	Find the equivalent capacitance of capacitors in series.
ca0004.ckt	**Charging / Discharging Capacitors**	How does the charge on a capacitor vary with time while charging/discharging? What is the CR time-constant?

AC Circuits

ac0001.ckt	**Alternating Current**	What is AC? Period, frequency, peak value, RMS value.
ac0002.ckt	**Power in AC Circuits**	Power in resistive AC circuits. Peak and RMS values.
ac0003.ckt	**Rectification**	Shows the role taken by the different components of a rectification circuit. Why are 4 diodes better than 2? How can a capacitor be used to even out the produced voltage?
ac0004.ckt	**Transformers**	Turns-ratio equal emf-ratio.

Transistors and Amplifiers

tr0001.ckt	**Transistors**	Transistors as current amplifiers. Base current needs to be limited with resistor. Transistor switch.
tr0002.ckt	**Current Mirror I**	How does a current mirror work?
tr0003.ckt	**Current Mirror II**	Current mirrors with more than 1 output current. How does transistor's beta influence compliance? How can an additional transistor be used to increase the reference's stiffness.
tr0004.ckt	**Operational Amplifier**	Introduction to op-amps. Simple inverting amplifier with feedback resistor.

Logic

lo0001.ckt	**Logic Gates**	Introduces AND, OR and XOR gates, as well as simple combinations of them.
lo0002.ckt	**Logic Networks**	Truth tables of networks. How does one derive an algebraic expression for a logic network? Simple identities.
lo0003.ckt	**Logic Identities**	Elementary 1 and 2-variable theorems, such as X.X=X. Why are they useful? Show the equivalence of networks by using the theorems.
lo0004.ckt	**Sequential Logic**	Introduces simple sequential logic circuits to obtain a memory-effect: Burglar alarm, flip-flop.

Advanced Topics

at0001.ckt	**Amplitude Modulation I**	Interactive example of amplitude modulation and demodulation with envelope detector.
at0002.ckt	**Amplitude Modulation II**	Shows the difference between adding 2 signals (not = AM) and multiplying signals (= AM). How to generate AM using a diode as a mixer.

Textbook Sections Relevant to Worksheets

Textbooks referenced

D.C. Giancoli: Physics, *5th ed., Prentice Hall, 1998*
P.W. Zitzewitz: Merrill Physics, *GlenCoe, 1995*
P.G. Hewitt: Conceptual Physics, *8th ed., Addison Wesley, 1998*
F.E. Trinklein: Modern Physics, *Teacher's Edition, Holt, 1992*
P. Buban et al.: Understanding Electricity and Electronics Technology, *6th ed. GlenCoe, 1992*
R. Muncaster: A-Level Physics, *4th ed., Stanley Thornes, 1993*
K. Johnson et al.: Spotlight Science 9, *Stanley Thornes, 1995*

Worksheets

Kinematics

ki0001.ckt
Position-Time Graphs
Giancoli, page 21ff, 38ff
Zitzewitz, page 48
Hewitt, page 23ff, 693ff
Trinklein, page 40ff
Muncaster, page 25

ki0002.ckt
Velocity-Time Graphs
Giancoli, page 21ff, 38ff
Zitzewitz, page 54
Hewitt, page 23ff, 693ff
Trinklein, page 40ff
Muncaster, page 26

ki0003.ckt
Acceleration
Giancoli, page 24ff, 26ff
Zitzewitz, page 63ff
Hewitt, page 26ff
Trinklein, page 40ff
Muncaster, page 19

Dynamics

dy0001.ckt
Newton's First Law
Giancoli, page 78ff
Zitzewitz, page 89
Hewitt, page 56
Trinklein, page 56
Muncaster, page 11

dy0002.ckt
Newton's Second Law I
Giancoli, page 80ff
Zitzewitz, page 90ff
Hewitt, page 60ff
Trinklein, page 58
Muncaster, page 11

dy0003.ckt
Newton's Second Law II
Giancoli, page 80ff
Zitzewitz, page 90ff
Hewitt, page 60ff
Trinklein, page 58
Muncaster, page 11

Vibrations and Waves

vi0001.ckt
Hooke's Law I
Giancoli, page 156, 309ff
Zitzewitz, page 147
Hewitt, page 202
Trinklein, page 149
Muncaster, page 181

vi0002.ckt
Hooke's Law II
Giancoli, page 156, 309ff
Zitzewitz, page 147
Hewitt, page 202
Trinklein, page 149
Muncaster, page 181

vi0003.ckt
Simple Harmonic Motion I
Giancoli, page 309ff
Zitzewitz, page 147-148
Hewitt, page 325
Trinklein, page 109
Muncaster, page 92

vi0004.ckt
Simple Harmonic Motion II
Giancoli, page 309ff
Zitzewitz, page 147-148
Hewitt, page 325
Trinklein, page 109
Muncaster, page 92

vi0005.ckt
Simple Harmonic Motion III
Giancoli, page 309ff
Zitzewitz, page 147-148
Hewitt, page 325
Trinklein, page 109
Muncaster, page 92

Sound

so0001.ckt
Beating Soundwaves
Giancoli, page 362ff
Zitzewitz, page 320-321
Hewitt, page 353
Trinklein, page 275
Muncaster, page 481

Simple Electric Circuits

el0001.ckt
Electric Circuits (pictorial)
Giancoli, page 530ff
Zitzewitz, page 447ff
Hewitt, page 398ff, 408ff
Trinklein, page 414ff
Buban, page 7ff
Johnson, page 150ff

el0002.ckt
Electric Circuits I
Giancoli, page 530ff
Zitzewitz, page 447ff
Hewitt, page 398ff, 408ff
Trinklein, page 414ff
Buban, page 7ff
Johnson, page 150ff

el0003.ckt
Electric Circuits II
Giancoli, page 530ff
Zitzewitz, page 447ff
Hewitt, page 398ff, 408ff
Trinklein, page 414ff
Buban, page 7ff
Johnson, page 150ff

el0004.ckt
Series Circuits
Giancoli, page 530ff, 555ff
Zitzewitz, page 447ff, 469ff
Hewitt, page 408
Trinklein, page 424
Buban, page 9ff
Johnson, page 150

el0005.ckt
Parallel Circuits
Giancoli, page 530ff, 555ff
Zitzewitz, page 447ff, 469ff
Hewitt, page 410
Trinklein, page 424
Buban, page 9ff
Johnson, page 152

el0006.ckt
Diodes
Giancoli, page 907ff
Zitzewitz, page 605ff
Hewitt, page 405
Buban, page 172
Johnson, page 150ff

el0007.ckt
Internal Resistance (conceptual)
Giancoli, page 562ff
Trinklein, page 426

DC Circuits

dc0001.ckt
Ohm's Law
Giancoli, page 532ff
Zitzewitz, page 452ff
Hewitt, page 401
Trinklein, page 424
Buban, page 60ff
Muncaster, page 535

dc0002.ckt
Current in Simple Circuits
Giancoli, page 555ff
Zitzewitz, page 469ff
Hewitt, page 408ff
Trinklein, page 414ff
Buban, page 42ff

dc0003.ckt
Voltage in Simple Circuits
Giancoli, page 555ff
Zitzewitz, page 469ff
Hewitt, page 408ff
Trinklein, page 414ff
Buban, page 42ff

dc0004.ckt
Resistors in Series
Giancoli, page 555ff
Zitzewitz, page 470ff
Hewitt, page 408
Trinklein, page 427
Buban, page 69ff
Muncaster, page 540

dc0005.ckt
Resistors in Parallel
Giancoli, page 555ff
Zitzewitz, page 475ff
Hewitt, page 410
Trinklein, page 429
Buban, page 77ff
Muncaster, page 540

dc0006.ckt
Resistance Networks
Giancoli, page 555ff
Zitzewitz, page 482ff
Trinklein, page 431
Buban, page 86ff
Muncaster, page 541

dc0007.ckt
Kirchhoff's First Law
Giancoli, page 564ff
Trinklein, page 430
Buban, page 84
Muncaster, page 549

dc0008.ckt
Kirchhoff's Second Law
Giancoli, page 564ff
Trinklein, page 429
Buban, page 84
Muncaster, page 549

dc0009.ckt
Potential Difference
Giancoli, page 503, 555ff, 565

dc0010.ckt
Voltage Divider
Giancoli, page 555ff
Buban, page 74
Muncaster, page 561

dc0011.ckt
Wheatstone Bridge
Giancoli, page 555ff, 585
Trinklein, page 439
Muncaster, page 556

dc0012.ckt
Combination of Cells
Giancoli, page 568
Trinklein, page 420
Buban, page 75, 84
Muncaster, page 549

dc0013.ckt
Internal Resistance
Giancoli, page 562ff
Trinklein, page 426
Muncaster, page 546

dc0014.ckt
Light-Emitting Diodes
Giancoli, page 909
Zitzewitz, page 607
Buban, page 189
Muncaster, page 869

Capacitance and Inductance

ca0001.ckt
Capacitance
Giancoli, page 513ff, 568ff
Zitzewitz, page 441
Hewitt, page 390
Trinklein, page 399
Buban, page 103ff
Muncaster, page 589

ca0002.ckt
Capacitors in Parallel
Giancoli, page 568ff
Trinklein, page 405
Buban, page 107
Muncaster, page 594

ca0003.ckt
Capacitors in Series
Giancoli, page 568ff
Trinklein, page 405
Buban, page 107
Muncaster, page 595

ca0004.ckt
Charging / Discharging Capacitors
Giancoli, page 570ff
Zitzewitz, page 458
Trinklein, page 535
Buban, page 108
Muncaster, page 601

AC Circuits

ac0001.ckt
Alternating Current
Giancoli, page 541ff, 642ff
Zitzewitz, page 520
Hewitt, page 404
Trinklein, page 525ff
Muncaster, page 674

ac0002.ckt
Power in AC Circuits
Giancoli, page 541ff, 642ff
Zitzewitz, page 520
Trinklein, page 525ff
Muncaster, page 685

ac0003.ckt
Rectification
Giancoli, page 908
Zitzewitz, page 607
Hewitt, page 405
Buban, page 171-175
Muncaster, page 695

ac0004.ckt
Transformers
Giancoli, page 633ff
Zitzewitz, page 526
Hewitt, page 444
Trinklein, page 520
Buban, page 131
Muncaster, page 665

Transistors and Amplifiers

tr0001.ckt
Transistors
Giancoli, page 909ff
Zitzewitz, page 609
Hewitt, page 378
Trinklein, page 565
Buban, page 176ff
Muncaster, page 853

tr0002.ckt
Current Mirror I

tr0003.ckt
Current Mirror II

tr0004.ckt
Operational Amplifier
Buban, page 191
Muncaster, page 859

Logic

lo0001.ckt
Logic Gates
Buban, page 415ff
Muncaster, page 854

lo0002.ckt
Logic Networks
Buban, page 415ff
Muncaster, page 854

lo0003.ckt
Logic Identities
Buban, page 415ff
Muncaster, page 854

lo0004.ckt
Sequential Logic
Buban, page 415ff
Muncaster, page 856

Advanced Topics

at0001.ckt
Amplitude Modulation I
Giancoli, page 676ff
Hewitt, page 354
Buban, page 184, 366ff
Muncaster, page 871

at0002.ckt
Amplitude Modulation II
Giancoli, page 676ff
Hewitt, page 354
Buban, page 366ff
Muncaster, page 871