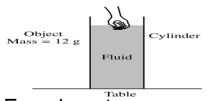
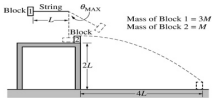
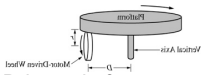
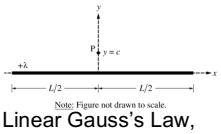
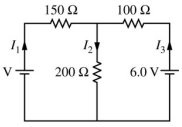
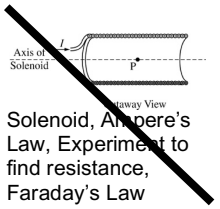
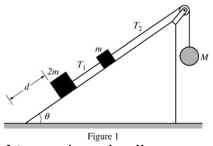
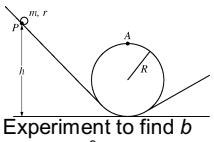
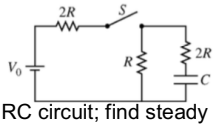
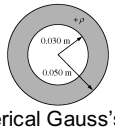
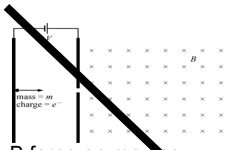
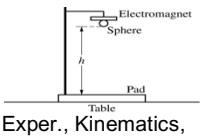
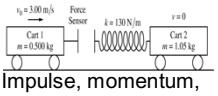
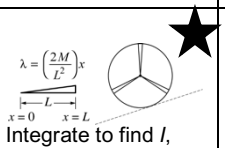
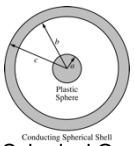
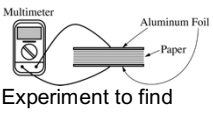
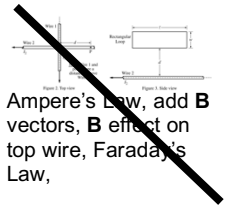
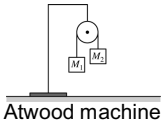
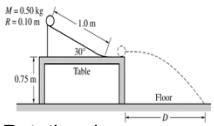
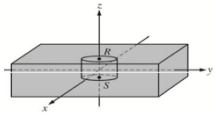
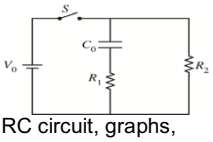
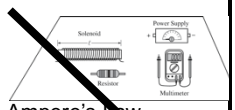
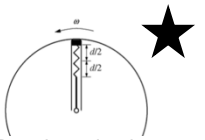
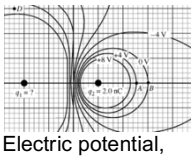
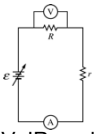
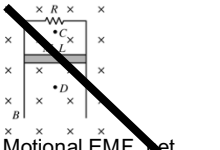
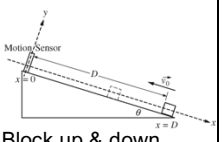
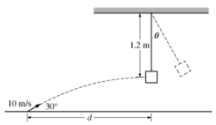
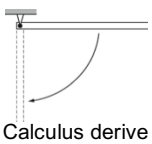
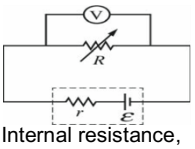
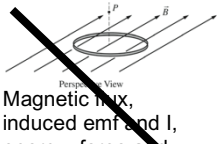
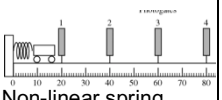
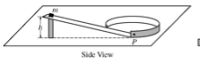
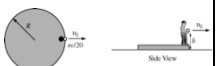
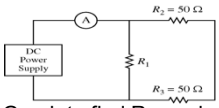
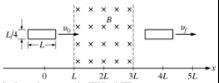
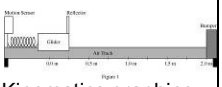
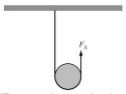
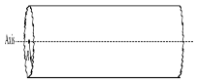
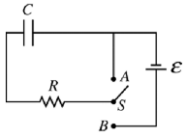
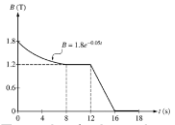
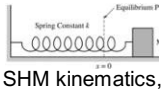
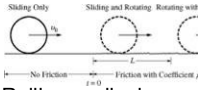
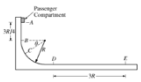
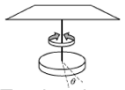
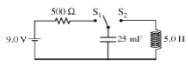
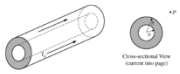
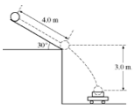
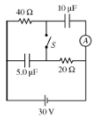
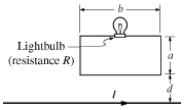
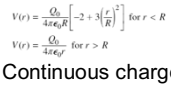
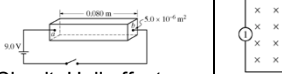
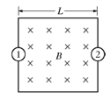
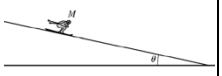
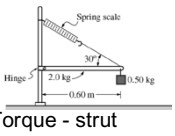
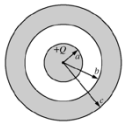
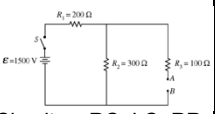
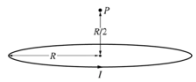
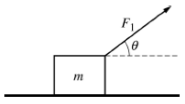
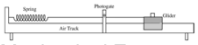
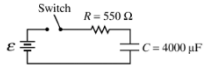
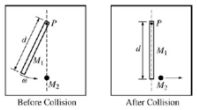
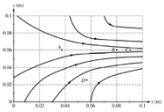
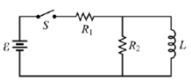
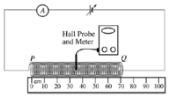
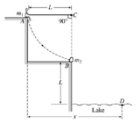
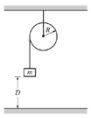
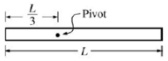
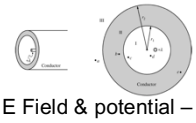
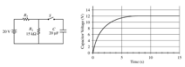
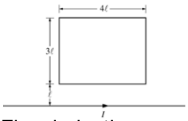
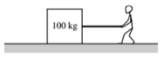
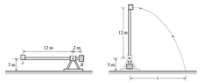
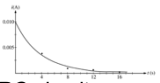
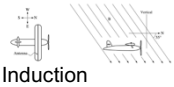
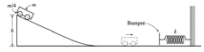
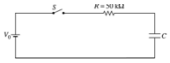
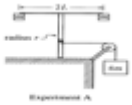
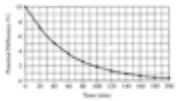
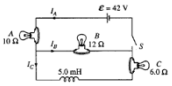
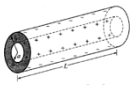
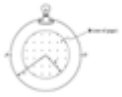
AP Physics C Free-Response Index--from M. Lietz and G. Friedlander
*BB=Black Box problems for Word 2007-8 in single-year files—use multiple-year files
See end of document for index to Practice Exam Problems 2008, 2013-18

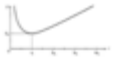
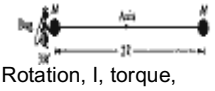
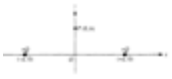
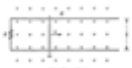
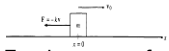
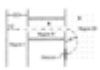
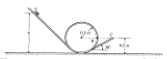
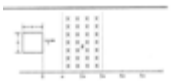
Mechanics Exam: Topics on the exam **Units 1-5: Kinematics, Newton's Laws of Motion, Work, Power, Energy, Systems of particles & Linear Momentum, Rotation** || *Topics NOT on the exam Units 6 & 7: Oscillation and Gravitation*

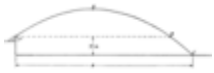
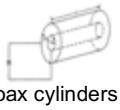
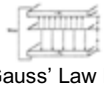
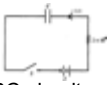
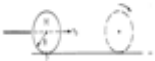
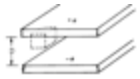
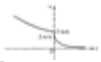
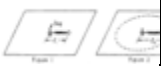
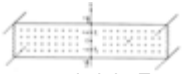
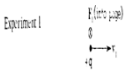
E & M Exam: Topics on the exam **Units 1-3: Electrostatics, Conductors, Capacitors, Dielectrics, Electric Circuits ||** *Topics NOT on the exam Units 4-5: Magnetic Fields, Electromagnetism*

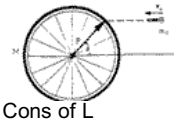
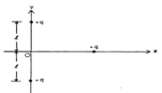
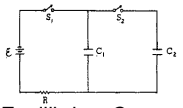
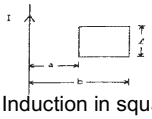
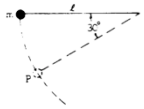
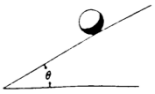
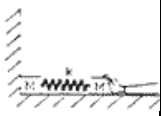
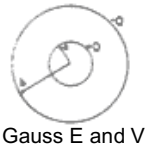
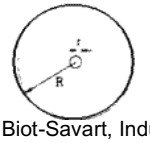
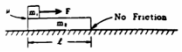
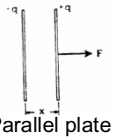
	M1	M2	M3	E1	E2	E3
2019 -1-	 Experiment $v = A(1 - e^{-Bt})$ Find *y(t), F(t)*	 Reversed Ballistic pendulum. Verical circle energy, force; projectie motion	 Driven platform rotation, inelastic rotational collision, experiment, error being off-axis	 Linear Gauss's Law, integrating Coulomb's Law	 Two Battery Circuit; write Kirchoff's Laws, RC & L/R final state	 Solenoid, Ampere's Law, Experiment to find resistance, Faraday's Law
2019 -2-	 Atwood on incline, NSL, energy, friction	Vertical rocket launch with $a=K-Lt^2$. Impulse, energy, *v-t* graph of whole flight	 Experiment to find *b* in $I=bMR^2$. Not lose contact at top of loop. Graph *h vs. b*	 RC circuit; find steady state, write diff.eq., sketch current in *R* after switch is opened	 Spherical Gauss's Law, non-uniform distribution; E, V, speed of proton	 B force on moving charge, mass/charge ratio experiment
2018	 Exper., Kinematics, exp. error	 Impulse, momentum, energy, $v_{c.o.m.}$	 Integrate to find *I*, rotational impulse, F.B.D. on ramp, energy	 Spherical Gauss's Law. *E* and *V*	 Experiment to find κ, RC Circuit, exp. error	 Ampere's Law, add **B** vectors, **B** effect on top wire, Faraday's Law,
2017	 Atwood machine (reg. and modified) experiment, graphing	 Energy conversions, $F=\beta v^2$ diff. eq., graphs	 Rotational energy, projectile, c.f. cyliner and sphere	 Gauss's Law on charged slab, add plates top & bottom, potential	 RC circuit, graphs, half-life, energy	 Ampere's Law experiment, experimental errors and difficulties
2016	 Dynamics, friction, experiment, graphing,	 Momentum, nonlinear spring, energy, net force	 Rotation, circular motion, spring, Angular momentum, vector acceleration	 Electric potential, Electric field, and effects	 V=IR, resistivity, non-ideal meters	 Motional EMF, net field, v_T, power, diff.eq. for speed as a function of time
2015	 Block up & down ramp, kinematics, graphs, friction	 Projectile, momentum, energy, pendulum motion	 Calculus derive I of rod, energy, graph, experiment	 Parallel plate capacitor, Gauss' Law, non-uniform dielectric, potential, energy	 Internal resistance, graphing, finding emf and *r*, maximum I, voltmeters	 Magnetic flux, induced emf and I, energy, force and torque

	M1	M2	M3	E1	E2	E3
2014	 Non-linear spring energy, graphing, experiment	 Energy, Circular motion F, a, v	 Projectile, momentum, kinematics, angular momentum	 Graph to find R_{eq} and R_1, RC circuit	 Motional EMF, current, diff.eq. for speed as a function of time	Charge density of atom, Gauss' Law, graph of E versus r
2013	 Kinematics graphing Spring energy, SHM, experiment	 Drag force F_D=kv	 Rotational dynamics, energy	 Gauss's Law Cylinder E, V	 RC circuit, graph,	 Faraday's Law in Loop
2012	 SHM kinematics, w/o and w friction	Design experiment of potential to kinetic energy. Experimental discrepancies.	 Rolling w slipping	 Field, Potential, charge	 Experiment: resistivity, RC circuit	Motional EMF
2011	 Impulse-momentum	 Freefall ride.	 Torsional pendulum, experiment	Gauss' Law – spheres and shells	 RC – LC circuits	 Ampere's Law
2010	 Coffee filter lab	 Rotation	 Mechanics	 Field and Potential	 RC circuit	 EM induction
2009	Potential energy function and graphs	 Physical pendulum, experiment	 Modified Atwood's machine	 Continuous charge distribution	 Circuit, Hall effect	 Faraday's Law - circuits
2008	 Inclined plane F=kv	 Torque - strut	 Hooke's Law – Force and Energy, experiment	 Gauss' Law	 Circuits – RC, LC, RR	 Biot-Savart Law
2007	 Linear dynamics	Orbital mechanics Mars Surveyor	 Mechanical Energy Conservation; spring, experiment	 RC circuit	Gauss' Law	Faraday's Law
2006* BB	Linear dynamics	Non-linear spring, data analysis, GRAPH, energy conservation	Rot'l kinematics, projectile	Electrostatics – field and potential	RC circuit	Spring, B force on a current loop, induction

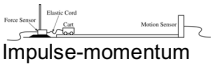
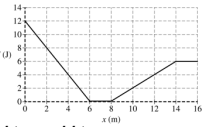
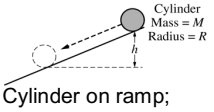
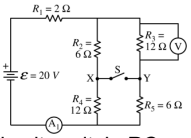
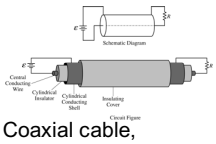
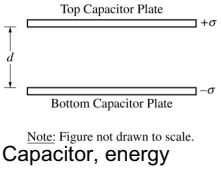
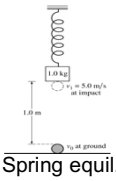
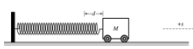
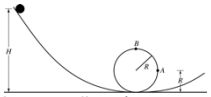
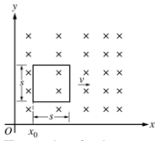
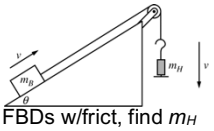
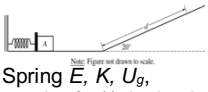
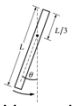
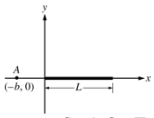
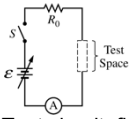
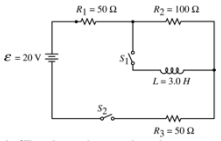
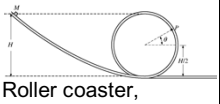
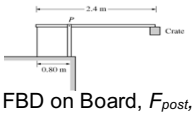
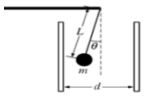
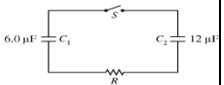
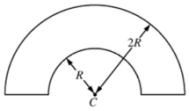
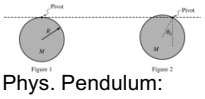
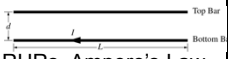
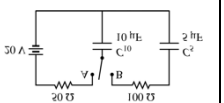
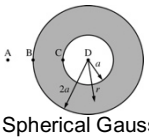
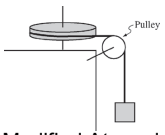
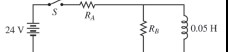
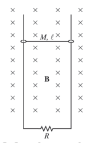
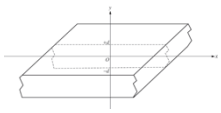
	M1	M2	M3	E1	E2	E3
2005* BB	Motion w/ air resistance, GRAPH	Moons of Saturn: Data analysis, GRAPH	 Rotational dynamics	 Field diagram & potential	 LR circuit	 Hall probe, solenoid, experiment, GRAPH
2004* BB	 Energy, inelastic collision, projectile	 Rot'l dynamics, experiment	 Physical pendulum	 E Field & potential – Gauss' Law	 RC Circuit	 Flux, induction
2003* BB	 Work, energy & power	 Spring, SHM, inelastic collision	 Catapult, projectiles, experiment	 E Field – Gauss' Law	 RC circuit	 Induction
2002* BB	$v = \frac{8}{1+5t}$ Collision and calculus kinematics	 Energy: grav., rot., spring	$U(x) = \frac{4.0}{2.0+x}$, Graphical U vs x, F=-dU/dx, exper.	 E field, potential, F, energy	 RC circuit, experiment	 Flux and Induction, energy dissipated
2001	 mass and force sensor - imp-momentum, acc	Gravity, satellite motion.	 angular motion, rot inertia	 fields, potential, thunder	 res of capacitors, dielect.	 mag field of wire, forces.
2000	Lab, pendulum, find g, elevator, experiment.	Ball falling thru resistive medium, $F = -bv^2$, energy	 F=ma, angular motion	 LR - RC circuits	 fields and potential	 Gauss and Ampere
1999	 Lab - ballistic pendulum, experiment	 Hole through earth - SHM	 Rotational Eq, Energy	 Spherical Capacitor	 Induction	 E field, potential, static ch
1998	 lab data for air track collision.	 inelastic coll, linear and ang mom. C of M motion.	 two body motion, friction, force diagrams	 Coulomb, F=qE, forces.	 Circuit, RC, LR	Motional Emf, bar sliding down incline, term vel.
1997	non-linear spring, lab question	inelastic momentum - calculus treatment	sphere on incline, acceleration, energy	graphical analysis of circuit - experimental battery	electric fields and forces – flux	B field of long wire, flux, motional emf.
1996	Lab question – vibrations - Gravitation	forklift - eqns of motion, friction	Mom of inertia of rod, hoop. Rota	Concentric spheres - E field, V	RC Circuit	Faraday's law, Solenoid

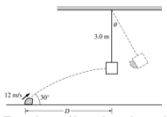
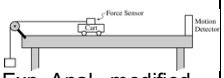
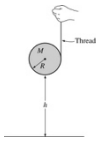
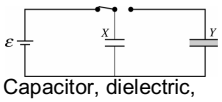
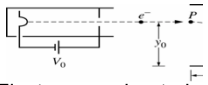
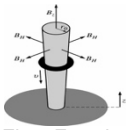
	M1	M2	M3	E1	E2	E3
1995	 Impulse, momentum, projectile.	 Potential energy function	grav, orbits, ang momentum, moment of Inertia.	 Nonconductor field and potential	 Capacitors, RC Circuit	 Air track - Motional Emf, Lenz' Law
1994	 Cons of En and mom, spring	 rolling w/o slipping, cons of energy on an incline.	 orbits, cons of energy and ang mom.	 E field, potential - ring and part of ring.	 Motional Emf, energy conservation	 Coaxial cable, Amperes law for B field.
1993	 En in a spring, friction, cons of en.	 resistive medium, equations of motion.	 torque, angular acceleration.	 non conductor - Gauss' law. conductor, Ampere's law	 Faraday's law, magnetic forces, induced I.	 Mass Spectrometer.
1992	 Energy, cons of mom, inelastic	 Rotation, I, torque, energy	 Orbits, cons of En and ang mom.	Charge dist in a sphere, find total charge, field with Gauss' Law.	 RC circuit	 B field of wire, flux through loop, Faraday's law
1991	 Ballistic pend - cons of En and Mom - Vertical Circle	 Rotation, torque	 Spring, cons of mom and en, elastic collision	 field and potential of point charges	 LR circuit	 Faraday's law, resisting medium
1990	 F = -kv, eqns of motion.	 motion on incline, box and sphere. energy.	 vertical spring, oscillation, energy	 conc spheres, Gauss' Law, fields	 Mass spectrometer	 Falling through B field, induction, term velocity.
1989	 Energy cons, critical speed, vert circle	 several bodies, heavy pulley, acc	 vert spring, SHM.	 Two charges, E and potential	 Motional Emf, induced current	RC circuit.
1988	car on banked curve	springs in parallel, work = area in F vs d	Angular motion, torque, acceleration	conc shells, Gauss' law, potential, Capacit.	Circuit, with C. Energy dissipated.	Solenoid, Amp law, flux induced Emf.
1987	Centrip forces on a swing	Potential Energy function. F = -dU/dr	Cons of linear and ang momentum	Charge dist thru a sphere, Gauss' law, potential	Flux, Faraday's law, induced I, energy dissipated	LR Circuit.
1986	platform acc upward. Power	sphere on incline, I, acceleration.	- $F = -kx^3$. Non linear spring, SHM	Equipotentials and fields, work	Circuit, add C, add L.	Long wire B, flux thru nearby loop, induced I

	M1	M2	M3	E1	E2	E3
1985	 Projectile, cons of momentum	 spring on an incline, energy cons	 Atwoods mach, eqns of motion.	 coax cylinders, Gauss' law, cylindrical capacitor	 Circuits, RC	 Faraday's law, induced Emf, E.
1984	 Centripetal motion, force diagram	 Orbits, mom cons, energy.	falling through a resisting medium, F = -kmv	 E and B forces on moving charge.	 Gauss' Law betw parallel plates.	 motional Emf bar decelerates. Power
1983	 proj motion in a plane	 rotation, acceleration	 skier on snowball	 conc shells, Gauss' Law, potential	 RC circuit	 Superimposed B fields from wires.
1982	 spring on incline, En cons	one dimensional motion of car with friction, slowing.	 torque, I, rotation equations	 point charge, field, potential, flux	 B for long wire, flux thru loop nearby	 R-L circuit
1981	 Incline, trans eq, friction	 Energy on a swing	 Cons of linear and ang momentum.	 Gauss' Law, spherical capac., dielectrics	 Elec and B field of a ring of charge	 Faradays Law, induced Emf, I, power
1980	 spring, SHM	 Momentum & En Conservation	 Rotation w/o slipping, eqns of motion	 E and V for thin, bent rod.	 Gauss' Law E between plates, Capacitance	 Faraday's Law, induced Emf and E
1979	 Projectile, en cons, mom cons.	 Ferry, cons of momentum, impulse	 torque, ang mom, SHM w spring during rotation	 conc shells, Gauss' law, E vs r, V vs r	 non-cond slab, E field, cond slab, B field.	 B fields and forces on particles. hand rules.
1978	circular, work	linear and ang mom	torque, ang mom, SHM w spring	E,B forces on elect, V and vector v	Faraday's, Lenz's Law, energy	Gauss E&V, C, U_c,
1977	F = -kv, work	Rotation, "walk the dog" yo-yo trick	Binary stars M, 2M	E and V for on axis of ring	Gauss's law on resistor	B force, torque
1976	circ motion, , friction, tangential a, kinematics	rotation,	energy, momentum	Gauss E and V	Induced emf	Mass spectrometer

	M1	M2	M3	E1	E2	E3
1975	falling through a resisting medium F = -kv Graph drawing	 Cons of L	 Calculus, force, work done lifting chain	 Coulomb U,F, Work	 Equilibrium Capac.	 Induction in square due to dI/dt in wire
1974	 circ motion, energy, force, tangential a	 rotation, change μ	 energy, momentum, SHM	 Gauss E and V	 Parallel plate capacitor, E, Q, C, copper insert	 Biot-Savart, Induced emf
1973	 Two block system w/ friction	Work-energy theorem	 Angular mechanics	 Parallel plate capacitor	Magnetic effects	 Motional emf

The following are from the "Practice Exams"—the questions themselves are only available on the Audit site.*
They should not be shared electronically (whether email, direct file transfer, or through a website), even to other physics teachers, and
Even in printed form, should not leave your classroom.
* = The 2012 exam has been released from these restrictions, not that it matters for the FR.

	M1	M2	M3	E1	E2	E3
2018	 Impulse-momentum graphs, integration, SPE, experiment, linearize graph	 *U* to *v*, *U* to *a*, *U* to *F(x)*	 Cylinder on ramp; find *L(h),* Yo-Yo on ramp: find *a*, F_f, *KE*	 Circuit, switch, RC	 Coaxial cable, Ampere's Law, Experiment *B vs* $\mathcal{E}$, error & intercept	 Capacitor, energy given σ, metal slab: new E, new C, plot V vs x to find σ and *d*
2017	 Spring equil., energy, inelastic collision, period	 SHM equations, graphs, K and U, total energy, two springs, period, added mass	 Loop, rolls w/o slipping, FBD, energy, circle, min *h*, sphere vs loop, projectile	$V(x) = \alpha x^2 + \beta x - \gamma$ Find work on e^-, derive *E(x)*, sketch *a(x), KE(x);* add an *E(x)* then determine ΔV	Design and draw RC circuit with switch, solve with numerical values: *q, V,* dissipated energy, write diff.eq., and solve for τ.	 Faraday's Law w changing *B*, moving square, find **F** needed to keep *v* constant
2016	 FBDs w/frict, find m_H for const. *v*, find $\vec{\mathbf{a}}$ if string is cut, find d_{max}	 Spring *E, K, U*$_g$, graph of *v(t)*, inelastic collision, impulse	 Use calc. to show *I,* diff.eq. for $\theta(t)$, use diff.eq. to find *T*, exper. w graph of *T(L)* to find *g*	 $\lambda=\alpha x$, find *Q, E*$_A$, *F* on proton, graph *a(x), v(x),* show $E_\infty \approx$ as for point charge	 Test circuit: find R_0 by graph, *RC* sketch *I(t)*, given τ, find U, insert dielectric, compare *Q(t)* w. old	 *L/R* circuit, calculate *I(t), U(t),* write diff.eq. for *I(t)*, find *I(t)*
2015	Sports car exper test: graph *v(t)*, find dist. from graph, given $v(t)=-.3t^2+7t$, find *a(t), x(t),* find dist. from *t*=2 to 8s	 Roller coaster, energy, FBD, find where leaves loop, replace block by sphere	 FBD on Board, F_{post}, F_{wire}, find *I* of board-crate system, rot. dynamics, *a* of left end	 sphere between plates: FBD, find *Q*, experimental design, analysis, difficulties	 Find Q_0 on C_1, diff. eq. for $q_2(t)$, calculate *Q*'s at equilibrium, energy dissipated, $t_{1/2}$ for larger *R*	 Find dE_y then find total *E;* Biot-Savart to find **B**
2014	Exper. design to find $\mu_{\square}$, work done by friction on incline, effect of increased *m*	Satellite cicular orbit find *v*, E_{tot}, work done in boost to double *R*	 Phys. Pendulum: Disk on pivot, *I,* ω_{max}, diff. eq. for $\theta(t)$, small angle approx. period, double *R*	 RHRs, Ampere's Law, *F=ILB*, experiment I^2 vs. M_{added} to find μ_0	 *RC* circuit, *Q* on capacitor, *I* in 100 Ω resistor, energy dissipated	 Spherical Gauss with non-uniform shell. Find *Q, E, V*
2013	Fall with air resistance **F**= -*b*A**v**, v_T, time for $v_T/3$, graphs	Collision; elastic?, KE-->Spring U, *k*, what if $F=-bx^3$	 Modified Atwood w/rotation, graph anal. (kin.), *I, L,* disk to hoop	 L/R circuit, experiment to find *R* values, error due to $R_{internal}$	 Motional emf, Power, F_B, v_T, write diff. eq. for *v*, add R	 Gauss's Law on non-uniform slab, find ΔV inside
2012	Same as Operational	Same as Operational	Same as Operational	Same as Operational	Same as Operational	Same as Operational

	M1	M2	M3	E1	E2	E3
2008	 Projectile, inelastic collision, energy, period	 Exp. Anal., modified Atwood, kinematics, work two ways,	 Rotation without and with slipping	 Capacitor, dielectric, removing dielectric, RC derivation	 Electron accelerated by V_0 and **E**, kinematics, *e* accelerated by **B**	 Flux, Faraday's Law, power, F_B due to x- and y- **B** fields