Which Equation?

SweetLion Prep

Name _____ Date _____

Each question needs one equation. Find it and write it on the matching line of your C/P Equation Sheet (section 03, question C goes on line 03 C). You do not have to solve the problem, but if you can, do it. Hold off on the answer key until every line has something on it.

01 Kinematics

A A car starts from rest and accelerates at 3 m/s^2 for 4 s. How fast is it moving?

B A ball is dropped from rest. How far does it fall in 2 s?

C A cyclist moving at 10 m/s brakes to a stop over 25 m. What is her acceleration? (No time is given.)

D A runner speeds up evenly from 2 m/s to 6 m/s over 5 s. How far does she travel? (No acceleration is given.)

E A projectile is launched at 20 m/s, 30° above the horizontal. What is its horizontal velocity?

02 Forces and Equilibrium

A A net force of 12 N acts on a 3 kg block. What is its acceleration?

B What is the weight of a 70 kg patient on Earth?

C Two satellites move twice as far apart. How does the gravitational force between them change?

D A crate rests on the floor with $\mu_s = 0.5$. What is the largest horizontal push it can resist without sliding?

E Once the crate slides, $\mu_k = 0.3$. What friction force opposes its motion?

F A box sits on a frictionless ramp tilted 30°. What force component pulls it down the ramp?

G A 1 kg ball swings in a horizontal circle of radius 0.5 m at 2 m/s. What net inward force is needed?

H A 20 N force is applied perpendicular to a wrench, 0.3 m from the bolt. What is the torque?

I A spring with k = 200 N/m is compressed 0.1 m. What restoring force does it exert?

03 Work, Energy, Power, Momentum

A A person pulls a sled 10 m with a 50 N force angled 60° above the ground. How much work is done?

B What is the kinetic energy of a 2 kg cart moving at 3 m/s?

C How much potential energy does a 5 kg box gain when lifted onto a 2 m shelf?

D How much energy is stored in a spring (k = 400 N/m) stretched 0.05 m?

E Friction does −30 J of work on a sliding puck. What is the change in its kinetic energy?

F A motor lifts a 100 kg load 10 m in 20 s. What is its power output?

G What is the momentum of a 0.15 kg baseball moving at 40 m/s?

H A bat touches a ball for 0.01 s and changes its momentum by 12 kg·m/s. What average force acts on the ball?

I A lever lets a 100 N effort lift a 400 N load. What is its mechanical advantage?

J A pulley system takes in 500 J of work and delivers 400 J. What is its efficiency?

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04 Fluids

A A 50 g object has a volume of 20 cm^3. What is its density?

B An oil has a density of 800 kg/m^3. What is its specific gravity?

C A 600 N person stands on 0.04 m^2 of shoe sole. What pressure does she put on the floor?

D What is the absolute pressure 10 m below the surface of a lake?

E A 0.002 m^3 block is fully submerged in water. What upward force does the water exert?

F Blood flows into a narrowing with half the cross-sectional area. How does its speed change?

G Air moves faster over the top of a wing. How does the pressure there compare to below the wing?

H A hydraulic lift has pistons of 0.01 m^2 and 0.5 m^2. What input force lifts a 10,000 N car?

I An arteriole's radius drops by half. By what factor does flow change at the same pressure gradient?

05 Electrostatics and Magnetism

A Two +2 µC charges sit 0.3 m apart. What force acts between them?

B What is the electric field strength 0.1 m from a +5 nC point charge?

C A +1 µC and a −1 µC charge are 0.2 m apart. How much potential energy does the pair have?

D What is the electric potential 0.5 m from a +3 µC charge?

E An electron moves through a potential difference of 100 V. How much work is done on it?

F Parallel plates 2 mm apart have a uniform 5,000 V/m field between them. What is the voltage across them?

G A proton moves at 10^6 m/s perpendicular to a 0.5 T field. What magnetic force acts on it?

H A 2 m wire carrying 3 A runs perpendicular to a 0.1 T field. What force acts on the wire?

I What is the magnetic field 0.02 m from a long straight wire carrying 10 A?

06 Circuits

A 12 C of charge passes a point in 4 s. What is the current?

B A 9 V battery drives current through a 3 Ω resistor. What current flows?

C A wire is stretched to twice its length with the same cross section. What happens to its resistance?

D A 120 V lamp draws 0.5 A. How much power does it use?

E A 4 Ω and a 6 Ω resistor are connected end to end. What is the equivalent resistance?

F Two 10 Ω resistors are each connected directly across the same battery. What is the equivalent resistance?

G A capacitor holds 6 µC at 3 V. What is its capacitance?

H A dielectric with $\kappa = 3$ is slid between the plates of a capacitor. What happens to its capacitance?

I How much energy is stored in a 10 µF defibrillator capacitor charged to 100 V?

J Two 4 µF capacitors are connected in series. What is the equivalent capacitance?

K Two 4 µF capacitors are connected in parallel. What is the equivalent capacitance?

07 Waves and Sound

A A 340 Hz sound wave travels at 340 m/s. What is its wavelength?

B A wave completes 50 cycles every second. How long does one cycle take?

C A guitar string's tension is quadrupled. How does the wave speed on it change?

D A sound's intensity increases by a factor of 100. By how many decibels does its level rise?

E What is the wavelength of the fundamental on a 0.6 m string fixed at both ends?

F What is the wavelength of the fundamental in a 0.25 m tube closed at one end?

G A 500 Hz siren approaches a standing listener at 30 m/s. What frequency does the listener hear?

H Tuning forks at 440 Hz and 444 Hz sound together. How many times per second does the loudness pulse?

I A speaker radiates 10 W evenly in all directions. What is the intensity 2 m away?

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08 Light and Optics

A What is the frequency of 600 nm light?

B What is the energy of a photon with a frequency of 5×10^{14} Hz?

C Light travels at 2.25×10^{8} m/s in water. What is water's index of refraction?

D Light passes from air into glass (n = 1.5) at 30° from the normal. What is the angle of refraction?

E Above what angle is light totally internally reflected when going from glass (n = 1.5) into air?

F An object sits 30 cm from a converging lens with f = 10 cm. Where does the image form?

G The image in the last question forms 15 cm from the lens. How big is it relative to the object, and is it upright?

H A concave mirror has a radius of curvature of 40 cm. What is its focal length?

I A corrective lens has a focal length of +0.5 m. What is its power?

J A +2 D lens and a +3 D lens are placed in contact. What is their combined power?

09 Atomic and Nuclear

A 5 eV photons strike a metal with a 3 eV work function. What is the maximum kinetic energy of the ejected electrons?

B A tracer has a half-life of 6 hours. What fraction remains after 24 hours?

C A nucleus has a mass defect of 0.03 u. How much binding energy does that represent?

D What is the energy of hydrogen's electron in the n = 2 level?

10 Thermodynamics and Gases

A A gas absorbs 500 J of heat and does 200 J of work on its surroundings. What is its change in internal energy?

B How much heat raises 2 kg of water from 20 °C to 30 °C?

C How much heat is needed to melt 0.5 kg of ice that is already at 0 °C?

D A 10 m steel rail warms by 30 °C. How much longer does it get?

E How many moles of gas occupy 22.4 L at 273 K and 1 atm?

F A balloon at 1 atm and 300 K is moved to 0.5 atm and 150 K. What happens to its volume?

G Air is 21% oxygen. What is the partial pressure of O_2 at a total pressure of 760 mmHg?

H How much faster does He (4 g/mol) effuse than CH_4 (16 g/mol)?

I A gas's absolute temperature doubles. What happens to the average kinetic energy of its molecules?

J A gas expands from 2 L to 5 L against a constant 1 atm. How much work does it do?

11 Kinetics, Equilibrium, Thermochemistry

A Doubling [A] quadruples the rate, and changing [B] does nothing. Write the rate law.

B A catalyst lowers the activation energy. What happens to the rate constant?

C Write the equilibrium expression for $N_2 + 3H_2 \rightleftharpoons 2NH_3$.

D A reaction has $\Delta H = +40$ kJ/mol and $\Delta S = +100$ J/(mol·K). Above what temperature is it spontaneous?

E A reaction has $K = 1$. What is its $\Delta G°$?

F A reaction with $\Delta G° > 0$ is run with almost no product present. Can it still proceed forward?

G Using standard heats of formation, find ΔH for the combustion of methane.

H Using average bond enthalpies, estimate ΔH for $H_2 + Cl_2 \rightarrow 2HCl$.

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12 Solutions, Acids and Bases

A 0.5 mol of NaCl is dissolved to make 250 mL of solution. What is the molarity?

B How much 6 M HCl do you need to make 1 L of 0.3 M HCl?

C What is the pH of a solution with $[H^+] = 1 \times 10^{-3}$ M?

D What is $[OH^-]$ in a solution at pH 4?

E A buffer has equal amounts of acetic acid (pK_a 4.76) and acetate. What is its pH?

F K_a of HF is 7×10^{-4}. What is K_b of F^-?

G Compared with 1 m glucose, how much more does 1 m $CaCl_2$ raise water's boiling point?

H Salt is spread on an icy road. How do you predict how far the freezing point drops?

I What is the osmotic pressure of 0.1 M NaCl at 300 K?

J A nonvolatile solute makes up 10% of the moles in a solution. How does its vapor pressure compare to the pure solvent's?

K A protein sample's absorbance doubles in the same cuvette. What happened to its concentration?

13 Electrochemistry

A Cu^{2+}/Cu is +0.34 V and Zn^{2+}/Zn is −0.76 V. What is E° for a galvanic cell built from them?

B A cell with E° = +1.10 V transfers 2 electrons. What is ΔG°?

C As a battery runs, Q rises. How does its voltage change?

D How long must 2 A run to plate out 1 mol of copper from Cu^{2+}?

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