Force and Motion II

Resultant force

One force with the same effect as all the forces together.

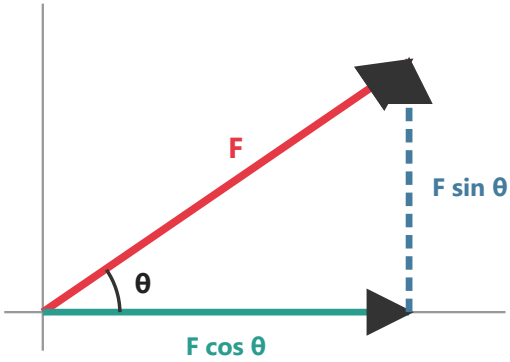
Resolution

Split one force into two parts at right angles: F cos θ and F sin θ.

Inclined plane

Weight along the slope = mg sin θ; into the slope = mg cos θ.

Resolving a force



Two forces at 90°: $R = \sqrt{(F_1^2 + F_2^2)}$
Equilibrium: resultant force = 0
(forces form a closed triangle)
Spring (Hooke's law): F = kx
Series springs: extension adds up
Parallel springs: load shared, less extension

Equilibrium

Resultant = 0: at rest or constant velocity. Hanging picture, lifts.

Elasticity

Stretches and returns when the force is removed. Hooke's law until the elastic limit.

Elastic energy

Energy stored = area under F–x graph = ½Fx = ½kx².

FORMULA / KEY TERMS

- $R = \sqrt{(F_1^2 + F_2^2)}$ for forces at 90°
- $F_x = F \cos \theta$ · $F_y = F \sin \theta$
- $F = kx$ (Hooke's law)
- $E_p = \frac{1}{2}kx^2$

COMMON MISTAKE

❌ "On a slope the weight acting along it is mg cos θ."

✅ Along the slope = mg sin θ; perpendicular to it = mg cos θ (θ = slope angle).

QUICK CHECK (worked answers at the back, page 16)

1. Forces of 3 N and 4 N act at right angles. Find the resultant.
2. A spring with k = 200 N m^{-1} stretches 0.05 m. Find the force and energy stored.
3. A 10 kg box rests on a smooth 30° slope. Find the force pulling it down the slope. (g = 9.81 m s^{-2})

Pressure

Liquid pressure

Increases with depth and density. Dams are thicker at the bottom.

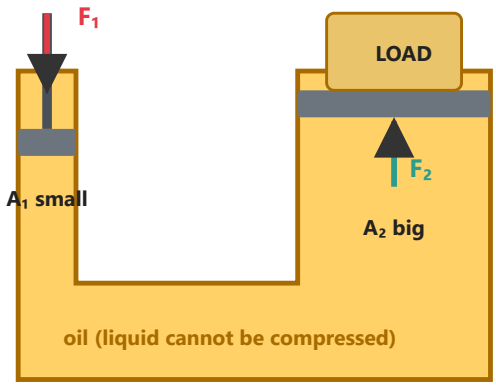
Atmospheric pressure

Weight of air: about 100 kPa at sea level; falls with altitude.

Gas pressure

Gas molecules hit the walls; measured with a Bourdon gauge or manometer.

Hydraulic jack (Pascal's principle)



Pressure is passed EQUALLY through the liquid:
$F_1/A_1 = F_2/A_2$ → small force, big lift
Archimedes: buoyant force = weight of fluid displaced → floats when buoyant force = weight
Bernoulli: fast-moving fluid → LOW pressure → lift on an aerofoil

Archimedes

Ships float because they displace a weight of water equal to their own weight.

Bernoulli

Air over the curved top of a wing moves faster → lower pressure → lift.

Pascal at work

Hydraulic brakes and jacks multiply force using a liquid.

FORMULA / KEY TERMS

- $P = F/A$ (Pa = N m^{-2})
- $P = h\rho g$ · total $P = P_{atm} + h\rho g$
- $F_1/A_1 = F_2/A_2$
- Buoyant force $F_B = \rho Vg$

COMMON MISTAKE

❌ "Liquid pressure depends on the shape of the container."

✅ It depends only on depth h, density ρ and g, not on shape or area.

QUICK CHECK (worked answers at the back, page 17)

1. Find the water pressure at a depth of 10 m. (ρ = 1000 kg m^{-3}, g = 9.81 m s^{-2})
2. A force of 50 N acts on a small piston of area 0.01 m^2. Find the force on a big piston of 0.5 m^2.
3. Explain why a ship floats.

Electricity

Current

Rate of flow of charge: I = Q/t (ampere).

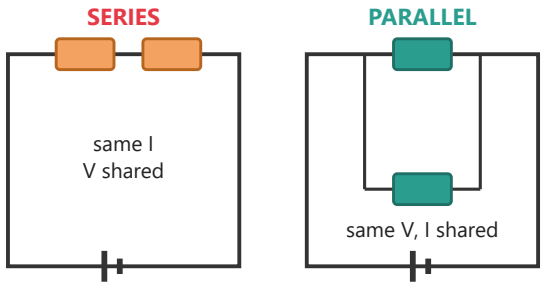
Potential difference

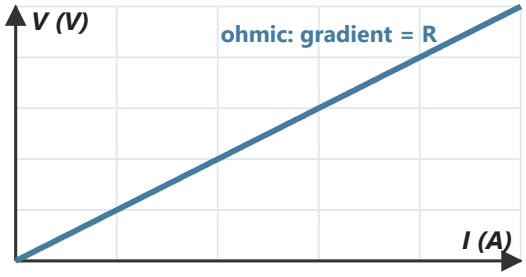
Work done per unit charge: V = W/Q (volt).

Resistance factors

Longer, thinner, hotter wire and higher resistivity → more resistance.

Series vs parallel





Ammeter in SERIES, voltmeter in PARALLEL
Fuse rating just above normal current

e.m.f. and r

E = V + Ir. Lost volts across internal resistance r.

Energy cost

Energy (kWh) = power (kW) × time (h); multiply by the price per kWh.

Save energy

LED lamps, 5-star appliances, switch off at the wall.

FORMULA / KEY TERMS

- Q = It · V = IR · R = ρl/A
- Series R = R_1 + R_2 · Parallel 1/R = 1/R_1 + 1/R_2
- E = V + Ir
- P = VI = I^2R = V^2/R · E = Pt

COMMON MISTAKE

❌ "Adding more resistors in parallel increases the total resistance."

✅ It DECREASES: more paths for current, so total R is less than the smallest resistor.

QUICK CHECK (worked answers at the back, page 17)

1. 2 Ω and 3 Ω resistors are in series with a 12 V supply. Find the current.
2. Find the effective resistance of 6 Ω and 3 Ω in parallel.
3. A 2 kW heater is used for 3 hours. Electricity costs 22 sen per kWh. Find the cost.

Electromagnetism

Right-hand grip

Thumb = current; fingers curl the way the magnetic field goes.

Fleming's left hand

Motor rule: First finger Field, seCond finger Current, thuMb Motion.

Induction

Changing magnetic flux through a coil induces an e.m.f. (Faraday).

	DC motor	Generator	Transformer
Changes	electrical → kinetic	kinetic → electrical	a.c. voltage up or down
Rule	Fleming's LEFT hand	Fleming's RIGHT hand	Faraday's law
Key part	commutator	slip rings (a.c.) commutator (d.c.)	soft iron core
Make it stronger	more turns, bigger current, stronger magnet	faster turning, more turns, stronger magnet	turns ratio Ns : Np

Lenz's law

Induced current opposes the change that made it.

Fleming's right hand

Generator rule: thumb motion, first finger field, second finger induced current.

Power lines

Step up to very high voltage → small current → less I^2R heat loss.

FORMULA / KEY TERMS

- $V_s/V_p = N_s/N_p$
- Ideal transformer: $V_pI_p = V_sI_s$
- Efficiency = $P_{out}/P_{in} \times 100\%$
- Power loss in cables = I^2R

COMMON MISTAKE

❌ "A transformer works with a d.c. battery."

✅ It needs a CHANGING current (a.c.) to make changing flux; steady d.c. induces nothing.

QUICK CHECK (worked answers at the back, page 17)

1. A transformer changes 240 V to 12 V. The primary coil has 1000 turns. Find the secondary turns.
2. State two ways to make a d.c. motor turn faster.
3. A magnet is pushed into a coil. Use Lenz's law to state the pole at that end of the coil.

Worked Answers (2/2)

Form 5 Chapter 2: Pressure

1. P = hρg = 10 × 1000 × 9.81 = 98 100 Pa (98.1 kPa) above atmospheric.
2. F_2 = 50 × 0.5 ÷ 0.01 = 2500 N.
3. The hull displaces water whose weight equals the ship's weight, so the buoyant force balances the weight.

Form 5 Chapter 3: Electricity

1. R = 5 Ω. I = 12 ÷ 5 = 2.4 A.
2. 1/R = 1/6 + 1/3 = 1/2 → R = 2 Ω.
3. E = 2 × 3 = 6 kWh. Cost = 6 × 22 = 132 sen = RM1.32.

Form 5 Chapter 4: Electromagnetism

1. N_s = 1000 × 12 ÷ 240 = 50 turns.
2. Any two: larger current; more turns on the coil; stronger magnet.
3. The same pole as the approaching magnet pole (N facing N) so it repels and opposes the motion.

Form 5 Chapter 5: Electronics

1. E = eV = $1.6 \times 10^{-19} \times 2000 = 3.2 \times 10^{-16}$ J.
2. $\beta = 2 \times 10^{-3} \div 20 \times 10^{-6} = 100$. I_E = 2 mA + 0.02 mA = 2.02 mA.
3. It stores charge and releases it when the output falls, smoothing the d.c. output.

Form 5 Chapter 6: Nuclear Physics

1. 15 ÷ 5 = 3 half-lives: 80 → 40 → 20 → 10 g.
2. $E = mc^2 = 0.001 \times (3 \times 10^8)^2 = 9 \times 10^{13}$ J.
3. A = 238 − 4 = 234, Z = 92 − 2 = 90 (thorium-234).

Form 5 Chapter 7: Quantum Physics

1. $E = 6.63 \times 10^{-34} \times 5 \times 10^{14} = 3.3 \times 10^{-19}$ J.
2. $W = hf_0 = 6.63 \times 10^{-34} \times 5.0 \times 10^{14} = 3.3 \times 10^{-19}$ J.
3. Each UV photon has energy (hf) above the work function; red photons have less energy than the work function, so no electron is freed however many arrive.

Key Terms: English – Bahasa Melayu (2/2)

Form 5. Use the English words in your DLP answers; the BM words help when you read BM books or past papers.

English	Bahasa Melayu
resultant force	daya paduan
resolution of forces	leraian daya
equilibrium	keseimbangan
elasticity	kekenyalan
spring constant	pemalar spring
elastic limit	had kenyal
pressure	tekanan
atmospheric pressure	tekanan atmosfera
buoyant force	daya apungan
density	ketumpatan
current	arus
potential difference	beza keupayaan
resistance	rintangan
resistivity	kerintangan
electromotive force	daya gerak elektrik
internal resistance	rintangan dalam
series circuit	litar bersiri
parallel circuit	litar selari
power	kuasa
magnetic field	medan magnet
electromagnet	elektromagnet
electromagnetic induction	aruhan elektromagnet
induced current	arus aruhan
magnetic flux	fluks magnet
transformer	transformer
step-up	injak naik
step-down	injak turun
generator	penjana
commutator	komutator
thermionic emission	pancaran termion
semiconductor	semikonduktor
diode	diod
rectification	rektifikasi
capacitor	kapasitor
transistor	transistor
radioactive decay	reputan radioaktif
half-life	separuh hayat
nuclear fission	pembelahan nukleus
nuclear fusion	pelakuran nukleus
mass defect	cacat jisim
chain reaction	tindak balas berantai
photon	foton
quantum	kuantum
photoelectric effect	kesan fotoelektrik
work function	fungsi kerja
threshold frequency	frekuensi ambang
black body	jasad hitam

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