Riding the Lift: Forces in Motion
Phone Sensor + Simulation Group Investigation | JC1 H2 Physics | Dynamics

Role	Member Name	Role	Member Name
Sensor Operator	______________________	Simulation Operator	______________________
Calculator	______________________	Recorder	______________________

A Quick Theory

N - mg = ma => N = m(g + a)

Lift motion	Acceleration a	Scale reads...
Accelerating upward / decelerating downward	a > 0 (upward)	More than actual weight
Constant velocity or stationary	a = 0	Actual weight
Decelerating upward / accelerating downward	a < 0 (downward)	Less than actual weight

B Equipment & Procedure

Phone Sensor Setup	Simulation Setup
- Open the browser-based accelerometer simulation. - Allow motion / orientation access if prompted. - Hold the phone firmly with the screen facing you. - Observe accX, accY, accZ and the simulation response. - If no sensor is detected, use the slider mode.	- Use the projected or shared simulation link / QR code. - Press Reset before each trial. - Use gentle tilts and small hand motions only. - Use the idealised lift acceleration sequence in Part D for calculations.

Safety
Use gentle phone movements only. Do not run, throw, swing, or shake the phone forcefully. Keep a firm grip and be considerate of classmates.

C Phone Sensor and Simulation Observation

Complete this table before doing the lift calculations. Your exact sensor values may differ because phone axes and browser handling vary.

Action	Observed accX / accY / accZ	Simulation response	Physics interpretation
Phone held still and upright			
Phone tilted gently to the right			
Phone tilted gently to the left			
Small gentle upward hand motion, then stop			
Small gentle downward hand motion, then stop			
Sensor unavailable: use slider mode			

D Elevator Motion Model

Use the standard model below unless your teacher gives a different acceleration profile. Take upward as positive and use g = 10 N kg^-1.

Phase	Acceleration a (m s^-2)	Velocity: increasing / constant / decreasing	Expected: N > W, N = W, or N < W
L1 -> L12: lift starts moving upward	+0.40		
L1 -> L12: constant speed upward	0		
L1 -> L12: decelerates at L12	-0.40		
Stationary at L12	0		
L12 -> L1: lift starts moving downward	-0.40		

Phase	Acceleration a (m s^-2)	Velocity: increasing / constant / decreasing	Expected: N > W, N = W, or N < W
L12 -> L1: constant speed downward	0		
L12 -> L1: decelerates at L1	+0.40		

E Normal Force and Scale Reading

Assume the student has mass m = 60 kg. Weight W = mg = 600 N.

Phase	a (m s^-2)	N = m(g + a) / N	Scale reading = N / 10 / kg	Matches Part D? Y / N
Stationary at L1	0			
Accelerating upward	+0.40			
Constant speed upward	0			
Decelerating at L12	-0.40			
Stationary at L12	0			
Accelerating downward	-0.40			
Constant speed downward	0			
Decelerating at L1	+0.40			

F Analysis & Discussion

Q1. Which quantity determines whether the scale reads more or less than your actual weight: velocity or acceleration? Explain using one phase from the table.

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Q2. During the upward journey, identify one phase where the lift is moving upward but acceleration is downward. What happens to N?

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Q3. Calculate the expected normal force for m = 60 kg and a = +0.40 m s^-2. Convert it to the kg reading shown by a scale.

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Q4. Calculate the expected normal force for m = 60 kg and a = -0.40 m s^-2. Convert it to the kg reading shown by a scale.

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Q5. Draw free body diagrams for these three cases: accelerating upward, constant velocity, and decelerating upward. Label N and W and show relative arrow lengths.

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Q6. Why does a person feel heavier when the lift accelerates upward even though the person's mass has not changed?

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Q7. If the lift were in free fall, what would the scale read? Use N = m(g + a) to justify your answer.

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Q8. Give one advantage and one limitation of using the browser phone sensor simulation instead of collecting real lift data.

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Q9. Give one advantage and one limitation of using an idealised simulation instead of a real lift experiment.

Q10. Group consensus: Which evidence helped you most - phone sensor observation, simulation model, or calculation? Give two reasons.

G Extension

Challenge 1 A 70 kg student is in a lift with acceleration +0.80 m s^-2. Calculate N and the scale reading in kg.	Challenge 2 A lift is moving downward but slowing down before the ground floor. State the direction of acceleration and draw the FBD.	Challenge 3 Explain why a real phone accelerometer may show a noisy signal even when the idealised simulation uses a clean acceleration value.

Formula Reference
Newton's 2nd Law: F_net = ma | Normal force: N = m(g + a) | Weight: W = mg | Upward taken as positive | g = 10 N kg^-1

Simulation link

Open the live elevator phone accelerometer simulation: https://iwant2study.org/lookangejss/02_newtonianmechanics_3dynamics/ai/ElevatorSim/elevator_phone_accelerometer_sim.html

This link is placed here so the handout, lesson plan, or answer key still points students and teachers back to the correct simulation when downloaded or shared.