

EDEXCEL A LEVEL PHYSICS · TOPIC 2 · 6-MARK PROSE

“With reference to Newton’s laws, explain...”

These 5- and 6-mark questions come up again and again, and the mark scheme wants the same six points every time. Learn the chain once, then fill in the objects from the question.

1. How to spot one

THE TRIGGER WORDS

“With reference to Newton’s laws of motion, explain...”

...followed by a **scenario** and a **picture**: a rocket, a balloon car, a passenger holding a pole, ice whizzing across water. **Object A pushes on object B**, and **object A accelerates**. That’s your cue for the Newton chain.

2. The Newton chain: six links, six marks

THE NEWTON CHAIN 3 → 2

Third law first, then the second law

Say it until it sticks: **A on B · B on A · equal & opposite · resultant · accelerates · so...**

1 A on B

Object A exerts a force on object B. Name them from the question.

2 B on A **N3**

By Newton’s third law, B exerts a force on A.

3 Equal & opposite

Same size, opposite direction. Say which way it pushes A.

4 Resultant

This is the resultant (unbalanced) force on A.

5 Accelerates **N2**

By Newton’s second law, A accelerates: it changes speed, direction or momentum.

6 So...

Link it back to the question: which way, how fast, and why.

The 0-mark trap. Writing out Newton's laws word for word scores **nothing**. The mark scheme says so. Every link must be about **A and B in this question**: "the gas exerts a force on the ice", never just "every action has an equal and opposite reaction".

Six links for five marks? Good. The mark scheme usually has one more point than the marks available, so the extra link is your safety net if an examiner doesn't accept one of the others.

3. Before you write: mark up the question

Ring three things in the question. They're the only parts of your answer that change from question to question.

RING A

The object that accelerates

The thing the question asks about: the ice, the car, the passenger.

RING B

The object it interacts with

The gas, the air, the pole. A pushes B, so B pushes A back.

UNDERLINE

What object A does ($F = ma$)

- starts moving
- speeds up
- turns
- keeps going at a steady speed

Either it accelerates, or its acceleration is zero.

If the question says A...	Resultant force on A	So your link 5 says
changes speed (starts moving, speeds up, slows down)	Not zero, along the line of motion	A accelerates (or decelerates): its velocity and momentum change
changes direction (turns, spins, curves)	Not zero, at an angle to the motion	A accelerates even at a steady speed, because its velocity changes direction
moves at constant velocity (or stays still)	Zero: the forces are balanced	By Newton's first law, A does not accelerate

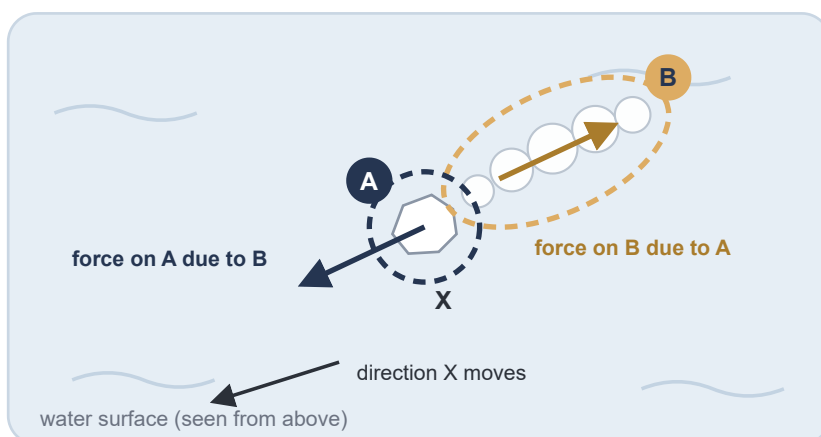
4. Worked example: ice on water

Solid carbon dioxide on water

Edexcel A Level Physics past paper · 5 marks

Solid carbon dioxide ^A changes state directly from solid to gas. This process is called sublimation. Solid carbon dioxide, when placed on water, will move rapidly across the surface due to jets of ejected gas ^B.

The diagram below shows the direction of movement for a large piece of solid carbon dioxide placed on water.



Redrawn from the exam photo, with the two forces added. They are the same size and point opposite ways, and each one acts on a different object.

(a) When placed **at rest** on water, piece X **begins to move rapidly** in the direction shown.

With reference to **Newton's laws of motion** explain the motion of piece X.

(5)

NEWTON'S LAWS

Explain Newton's **third** law, then Newton's **second** law. Run the chain.

A AND B

A = the solid carbon dioxide (piece X). B = the gas it pushes out.

WHAT A DOES ($F = MA$)

- "at rest"
- "begins to move rapidly"
- it **changes speed**, so there's a resultant force and it accelerates

STEP 1 Run the chain in note form

- 1 ice on gas
- 2 N3: gas on ice
- 3 equal & opposite (pushes X the way shown)
- 4 resultant force (little friction)
- 5 N2: accelerates from rest
- 6 $F = ma$: small mass $\rightarrow$ large acceleration

STEP 2 Write it in full sentences

- 1 The **solid carbon dioxide exerts a force on the gas**, pushing the jet of gas out backwards. ✓ 1 mark
- 2 By **Newton's third law**, the **gas exerts a force on the solid** carbon dioxide. ✓ 1 mark
- 3 This force is **equal in size and opposite in direction** to the force on the gas, so it pushes piece X in the direction shown. ✓ 1 mark
- 4 There is very little friction from the water, so this is a **resultant (unbalanced) force** on piece X. ✓ 1 mark
- 5 By **Newton's second law**, a resultant force causes an acceleration, so **piece X accelerates** from rest: its velocity increases in the direction shown. ✓ 1 mark
- 6 Using **$F = ma$** : as the piece of ice has a **small mass**, there is a **large acceleration** for the same resultant force, so it moves rapidly. ✓ 1 mark

Six marking points, five marks available: full marks with one to spare.

▼ **Check it against the mark scheme**

Mark scheme says	Link
Solid (CO ₂) exerts a force on the gas (CO ₂)	1 A on B (1)
N3 means (gas exerts) a force on the solid/X	2 B on A (1)
Force is in opposite direction on the solid/gas	3 Equal & opp. (1)
There is a resultant/unbalanced force (on the solid)	4 Resultant (1)
N2/1 means the (solid) accelerates (accept changes velocity/speed)	5 Accelerates (1)
Rapid because mass/friction is small	6 So... (1)

Max 5. No mark for a statement of Newton's laws. Quality of written communication is assessed, so write it in order: the chain does that for you.

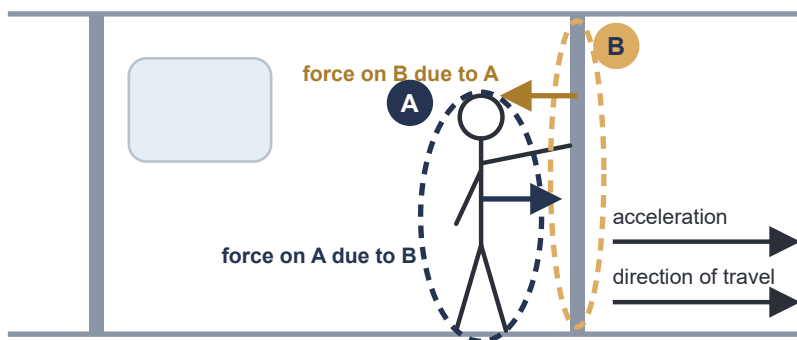
5. Your turn: practise the chain

Same chain, different objects. Mark up the question first (ring A, ring B, underline what A does), write your answer, then open the answer to see the mark-up, the chain and the mark scheme.

Practice 1 · Holding on in an accelerating train

Edexcel A Level Physics past paper · 5 marks

(b) As the train leaves the next station **the passenger** ^A holds on to **a vertical support** ^B as **the train accelerates**. This prevents the passenger **falling backwards**.



The passenger pulls the pole backwards; the pole pulls the passenger forwards.

NEWTON'S LAWS

Third law, then second law.
Run the chain.

A AND B

A = the passenger. B = the vertical support (pole).

WHAT A DOES ($F = MA$)

- "the train accelerates"
- the passenger must **speed up with the train**, so there's a resultant force and they accelerate

With reference to **Newton's laws of motion**, explain why holding on to a vertical support prevents the passenger falling backwards. (5)

STEP 1 Run the chain in note form

- 1 passenger pulls pole backwards
- 2 N3: pole on passenger
- 3 equal & opposite (forwards)
- 4 resultant force
- 5 N2: accelerates forwards
- 6 same acceleration as the train

STEP 2 Write it in full sentences

- 1 The **passenger exerts a force on the support**, pulling it backwards. ✓ 1 mark

- 2 By **Newton's third law**, the **support exerts a force on the passenger**. ✓ 1 mark
-
- 3 This force is **equal in size and opposite in direction**, so it pulls the passenger forwards, the same way as the train accelerates. goes with 2
-
- 4 This forward force is the **resultant (unbalanced) force** on the passenger. ✓ 1 mark
-
- 5 By **Newton's second law**, a resultant force causes an acceleration, so **the passenger accelerates forwards**. ✓ 1 mark
-
- 6 The passenger accelerates at the **same rate as the train**, so they move with the train and do not fall backwards. ✓ 1 mark

▼ Check it against the mark scheme

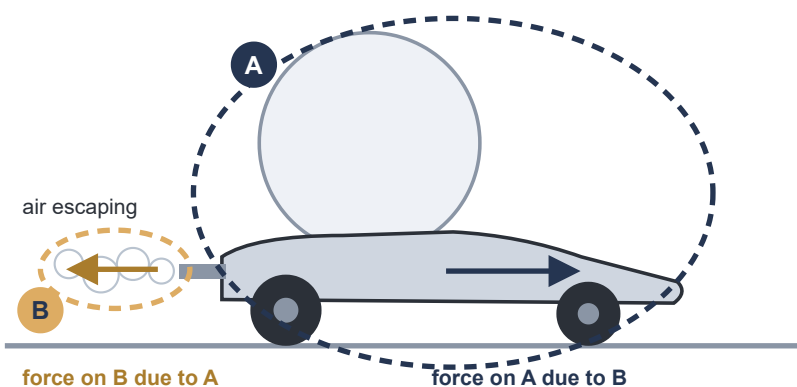
Mark scheme says	Link
Man pulls (backward) on the support	1 A on B (1)
Due to N3 the support exerts an (opposite) force on the man	2–3 B on A (1)
This force is a resultant/unbalanced/net force on man	4 Resultant (1)
Due to N1/N2 the man will accelerate	5 Accelerates (1)
With the same acceleration/speed/velocity as the train	6 So... (1)

5 marks. Here “equal and opposite” shares a mark with the third law, so link 6 is the one you can't skip: say **same acceleration as the train**.

Practice 2 · The balloon car

Edexcel A Level Physics past paper · 3 marks

The diagram shows a toy car **A** driven by air **B** from a deflating balloon.



The car pushes the air backwards; the air pushes the car forwards.

When the air in the inflated balloon is released, the car **starts to move forwards**.

(a) Use **Newton's first and third laws** of motion to explain why the air coming out of the balloon causes this. (3)

NEWTON'S LAWS

They ask for the **first** and **third** laws. Run the chain, and use the first law at link 5.

A AND B

A = the car (with its balloon). B = the air pushed out.

WHAT A DOES ($F = MA$)

- "starts to move forwards"
- it **changes speed** from rest, so there's a resultant force and it accelerates

STEP 1 Run the chain in note form

- 1 car pushes air backwards
- 2 N3: air on car
- 3 equal & opposite (forwards)
- 4 resultant force (bigger than friction)
- 5 N1: can't stay at rest, accelerates
- 6 starts moving forwards

STEP 2 Write it in full sentences

- 1 The **balloon exerts a force on the air**, pushing it out backwards. ✓ mark 1
- 2 By **Newton's third law**, the **air exerts a force on the balloon and car**. ✓ mark 1
- 3 This force is **equal in size and opposite in direction**, so it pushes the car forwards. ✓ mark 1

- 4 The forward force is bigger than the friction and drag, so there is a **resultant (unbalanced) force** on the car. ✓ mark 2
-
- 5 By **Newton's first law**, the car can only stay at rest if there is no resultant force, so **the car accelerates**. ✓ mark 2
-
- 6 So the car **starts to move forwards**, in the opposite direction to the air coming out. ✓ mark 3

Only 3 marks, but the chain still works: links 1–3 earn mark 1, links 4–5 earn mark 2, and naming both laws in context earns mark 3.

▼ Check it against the mark scheme

Mark scheme says	Link	
Uses N3: force (backward) on air by balloon/car, (so/=) force (forward) on balloon/car by air	1–3	(1)
Uses N1: resultant force / forces unbalanced / force on balloon > drag, (so) there is an acceleration / moves from rest / starts moving	4–5	(1)
Identifies the use of N1 or N3 (by name or description) correctly, linking it to the context	2 and 5	(1)

6. Spot the difference: who gets pushed, and who keeps going

Some questions have two groups. The people a seat **pushes on** get the chain: third law, then second law, so they slow down. The person **nothing pushes on** gets Newton's first law: the resultant force is zero, so they **keep going**. The clue: a vehicle slows down suddenly and someone carries on moving.

PUSHED OR NOT? 3 → 2, then 1

Who gets a force, and who doesn't?

1 Pushed **N3**

They push on their seat; the seat pushes them back, equal and opposite.

2 Slow down **N2**

That's a resultant force on them, so they decelerate with the vehicle.

3 Keeps going **N1**

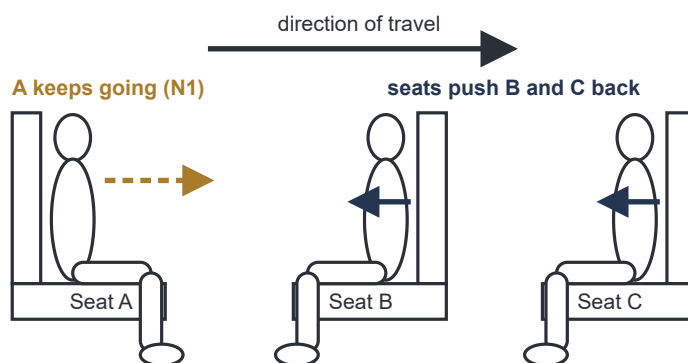
No horizontal force on them: resultant force zero, so they carry on at the same speed. Never "thrown forwards".

4 So...

Who hits whom, and so which seat is safest.

Practice 3 · Which seat is safest?

Edexcel A Level Physics past paper · 4 marks



The diagram shows three passengers sitting on a train that is travelling at a high speed in the direction shown. Seat belts are not used on trains.

With reference to **one of Newton's laws** of motion, explain why seat C is the safest seat for a passenger to be sitting in

NEWTON'S LAWS

Two groups. B and C get pushed by their seats: **third** law, then **second** law. A gets no horizontal force: **first** law.

WHO GETS A FORCE?

B and C: their seat backs are in front of them. A: nothing in front of them.

WHAT HAPPENS ($F = MA$)

- "rapid deceleration"
- B and C decelerate with the train; resultant force on A is zero, so A keeps going

the event of a **rapid deceleration**. You may assume that the seats all remain fixed firmly to the floor and do not break. (4)

STEP 1 Run the check in note form

- 1 B and C push chair to the right
- 2 N3: seats push B and C to the left
- 3 resultant force: B and C decelerate
- 4 no horizontal force on A
- 5 resultant force zero (N1)
- 6 A continues at same speed
- 7 A hits B
- 8 nobody hits C

STEP 2 Write it in full sentences

- 1 When the train decelerates, passengers **B and C push on the backs of their seats**, to the right. goes with 2
- 2 By **Newton's third law**, **seats B and C push the passengers** to the left, with an equal and opposite force. ✓ 1 mark
- 3 This is a **resultant force on B and C**, so by Newton's second law they **decelerate** (slow down) with the train and **stay in their seats**. ✓ 1 mark
- 4 **No horizontal force acts on passenger A**: their seat back is behind them, not in front. goes with 5
- 5 The **resultant force on A is zero**, so by **Newton's first law** A's velocity does not change. ✓ 1 mark
- 6 So **A continues to move forwards at the same speed** while the train slows down. ✓ 1 mark
- 7 Passenger **A hits passenger B**. ✓ 1 mark
- 8 **Nobody hits C**, so seat C is the safest. answers the question

Five marking points, four marks available. Don't write that A is "thrown forwards": nothing throws them, they just keep going. The mark scheme refuses that mark.

▼ Check it against the mark scheme

Mark scheme says	Link	
(B and) C will stay in their seats	3	(1)
Resultant force acts / chair exerts force on (B and) C, or (B and) C will decelerate	1–3	(1)
Passenger A continues to move (at the same speed). Not if A is "thrown/thrust/pushed" forward	6	(1)
Identifies movement of passenger A as Newton's first law, in the context of the question	4–5	(1)
A will collide with B	7	(1)
Max 4. Just quoting N1 doesn't score: it has to be about passenger A.		