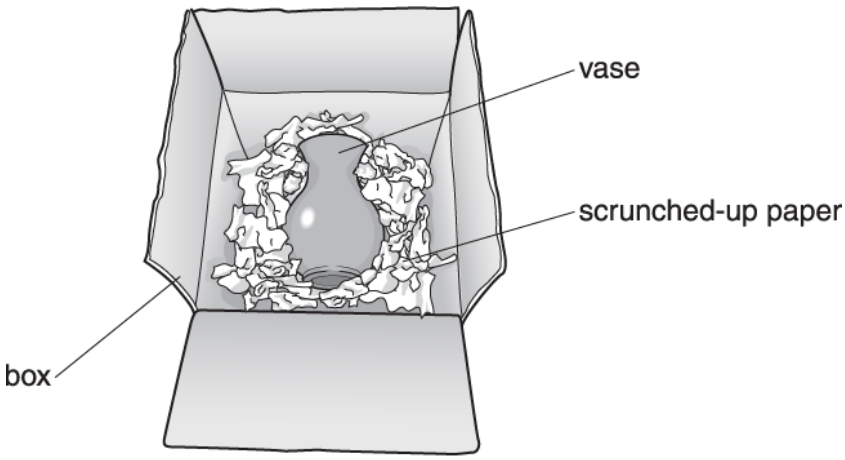
1. Tina wants to mail a box to a friend.

The box contains a fragile glass vase.

The mail company advises that a fragile item should be wrapped in scrunched-up newspaper to prevent it breaking if the box is dropped.



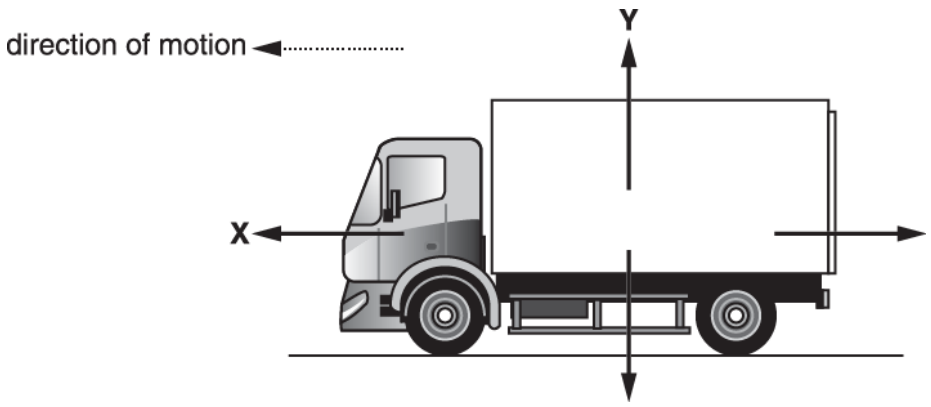
Explain to Tina how the scrunched-up paper protects the vase if the box is dropped.

Use ideas about forces in your answer.

The quality of written communication will be assessed in your answer.

[6]

2. The diagram shows the four forces acting on a lorry as it moves at constant speed along a straight, horizontal road.



(i) What are the names of the forces labelled **X** and **Y** on the diagram?

Draw one straight line from each **force** to its correct **name**.

Force	Name
	counter force
X	driving force
Y	reaction
	weight

[2]

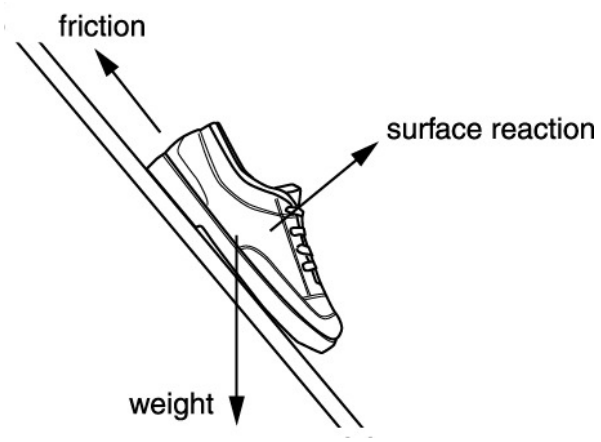
(ii) The lorry is moving at constant speed.

Explain how this is shown by the two horizontal arrows on the diagram.

---

[2]

3. The forces on a shoe as it rests on a ramp are shown in the diagram.



Complete the sentences about this situation.

Choose words from the list.

balanced	Earth	large	mass
ramp	small	vertical	weight

Each force comes from an interaction between two objects.

The friction on the shoe is caused by the interaction between the shoe and the _____.

The weight of the shoe is caused by the interaction between the shoe and the _____.

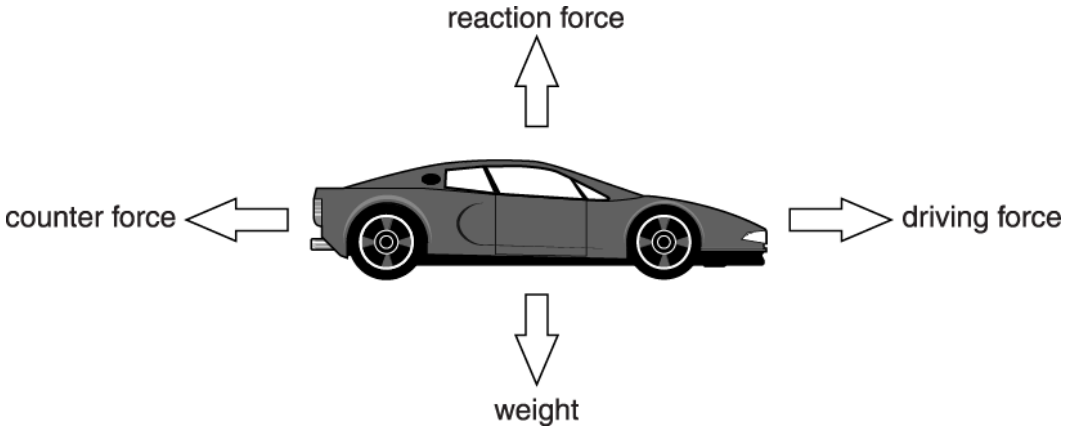
If the shoe is stationary, then the forces must be _____.

[3]

4. Racing car teams track the progress of cars to analyse their performance.

One team was testing how well a car accelerated at the start of a race.

Some of the forces on the car are shown below.



(i) Draw a line from each **force** to the correct **description** of the force.

force	description
counter force	push of the engine
driving force	force due to friction and air resistance
reaction force	pull of gravity on the car
weight	force from the ground on the car

[2]

(ii) The team had force sensors on the car.

At one moment, the sensors measured the following forces:

counter force	driving force
11 500 N	18 000 N

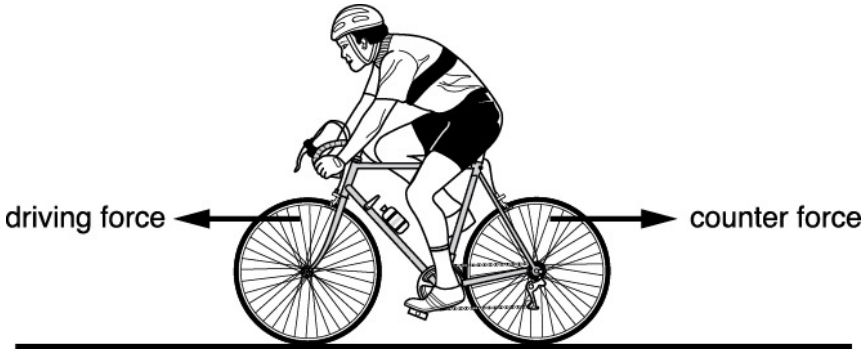
Explain how this data shows that the car is speeding up.

---

[2]

5. Alex rides along a straight horizontal road.

There are two horizontal forces acting on him and his bike, as shown in the diagram.



(i) What is the counter force due to?

---

[1]

(ii) How does the driving force compare with the counter force when he is travelling at **constant speed**?

Put a tick (✓) in the box next to the correct answer.

The driving force is **slightly bigger** than the counter force. ☐

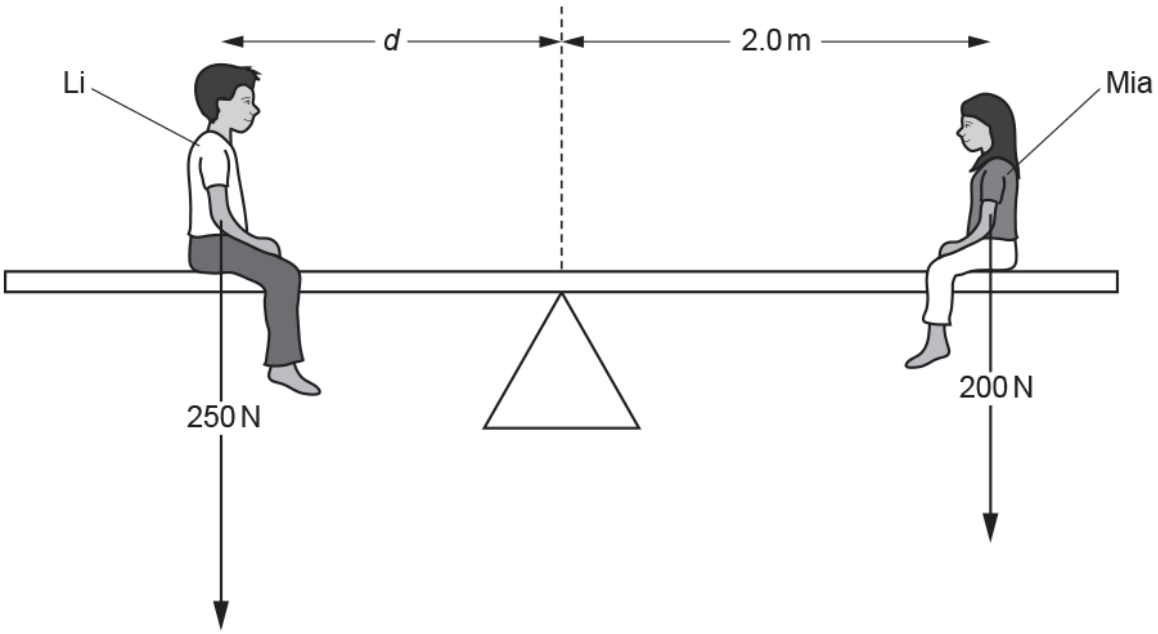
The driving force is **much bigger** than the counter force. ☐

The driving force is **smaller** than the counter force. ☐

The driving force is **the same as** the counter force. ☐

[1]

6(a). The figure shows Li and Mia balanced on a see-saw.



Mia weighs 200 N.

Calculate the moment of Mia's weight about the centre of the see-saw.

Moment = ... N m **[3]**

(b). Li weighs 250 N.

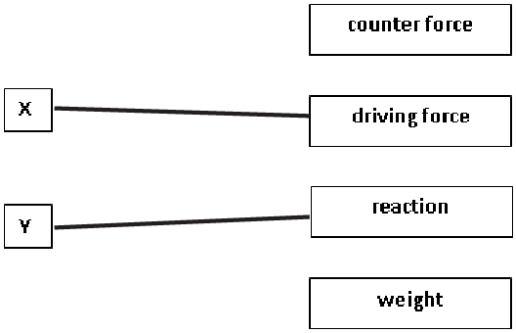
To balance Mia as shown in the diagram, he needs to sit at a distance *d* from the centre of the see-saw.

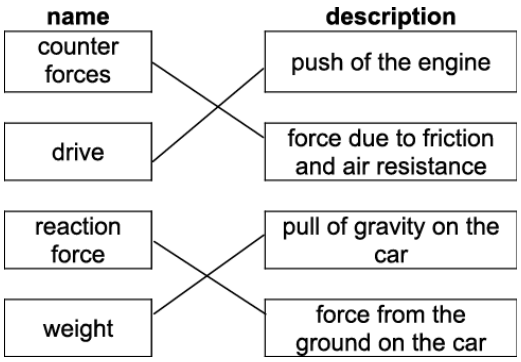
Calculate the distance *d*.

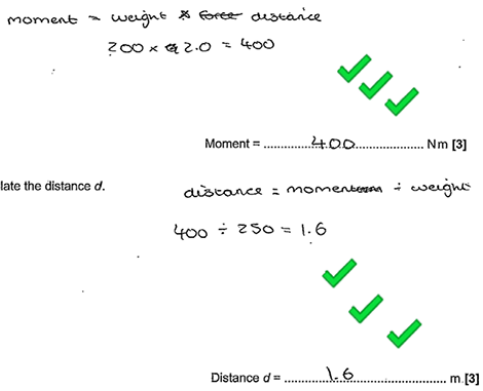
Distance *d* = ... m **[3]**

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1			[Level 3] More than one relevant statement made **AND** explanation given. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Both relevant statements made **OR** an explanation given. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] One relevant statement made. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to D/C Indicative scientific points may include: Statements: • Scrunched up newspaper compresses / works like a crumple zone (or other example) • To reduce / absorb the force / shock / energy Explanation: • Time taken to stop increases Distance to stop becomes longer • Slower momentum change due to deceleration • Loss of kinetic energy • Use of change of momentum=resultant force x time • Use of work done = force x distance Use the L1, L2, L3 annotations in RM ASSESSOR; do not use ticks. Examiner's Comments The candidates found this question difficult. Hardly any candidates discussed the increased time for momentum change leading to a smaller force and hence very few candidates gained 5 or 6 marks. Many candidates did understand the concept of cushioning and there were frequent references to other examples of the same ideas e.g. crumple zones or crash helmets. Candidates should be encouraged to apply their knowledge to more novel contexts to prepare them for this type of question.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
2		i		2	One mark for each correct line **Examiner's Comments** Candidates universally used the correct number of lines in this question, and X was almost always correctly connected to the driving force. Y was often connected to the counter force as an incorrect answer.
		ii	equal / same (length / magnitude) (1); opposite direction (1)	2	**accept** one forward and one backwards **accept** “balance” for one mark **reject** right and left **Examiner's Comments** Many candidates correctly explained that the forces or arrows were “the same” but fewer candidates could explain that they were in opposite directions.
			Total	**4**	
3			ramp (1) Earth (1) balanced (1)	3	**reject** equal **Examiner's Comments** This was generally answered well.
			Total	**3**	

Question			Answer/Indicative content	Marks	Guidance
4		i		2	4 lines correct for 2 marks 3 or 2 lines correct for 1 mark **Examiner's Comments** Both parts (i) and (ii) were answered well by most candidates. At least two pairs of boxes were linked correctly by the majority of candidates in part (i) thus gaining at least 1 mark.
		ii	forces are unbalanced / different (1) identification of force which is greater (1)	2	driving force greater than counter force gets both marks **Examiner's Comments** In part (ii), though the majority of candidates compared the forces given in the data to gain the marks, a few failed to do so, using expressions such as 'the driving force is increasing' and therefore got no credit.
			Total	4	
5		i	air resistance / friction	1	**allow** rolling friction **allow** moving against / through the air **allow** wind as moving air **Examiner's Comments** Most candidates scored at least half of the marks in this question about a bike ride. About half the candidates could correctly name the counter force on the bicycle and knew that it had to be exactly the same as the driving force.
		ii	The driving force is **the same as** the counter force. √	1	**Examiner's Comments** Most candidates scored at least half of the marks in this question about a bike ride. As expected, weak candidates wanted the driving force to be slightly larger than the counter force for a constant speed.
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
6	a		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 400 (N m) award 3 marks Recall: moment = force × distance ✓ 200 (N) × 2(.0) (m) ✓ 400 (N m) ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	
	b		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 1.6 (m) award 3 marks Moment of Max's weight (about pivot) = 400 (N m) ✓ 250 (N) × d = 400 (N m) ⇒ d = 400 (N m) ÷ 250 (N) ✓ = 1.6 (m) ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	**ECF** incorrect answer to (a) or term for moment. **ALLOW** ratio method eg, 250 ÷ 200 = 2 ÷ d <u>Examiner's Comments</u> The concept of moments seemed to puzzle many candidates. Only a few candidates were able to recall the equation to use. In part (a) the most common error was to divide the weight by the distance from the centre. Many candidates did not try to use the moment calculated in part (a), in order to find the distance, *d* in part (b). Candidates who correctly used their value calculated in part (a) in part (b) could be credited with both marks in part (b). Exemplar 1  This response shows clearly laid out calculations.

Question			Answer/Indicative content	Marks	Guidance
					In part (a), the equation is written out, and then it is clear which numbers have been substituted into the equation. The final answer is written on the answer line. Here the units are included on the answer line, and candidates who cannot recall the equation may be able to use the units as a clue. The units for moment are given as Nm, which means that a force or weight in Newton should be multiplied by a distance in metre. In part (b) the candidate has correctly re-arranged the equation to calculate the distance from the centre, and then substituted the value for moment calculated in part (a) and Li's weight to find the distance of 1.6 m.
			Total	6	