

Cambridge International AS & A Level

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Mathematics

9709/42

Paper 4 Mechanics

October/November 2021

Question No (2)

- 2** A van of mass 3600 kg is towing a trailer of mass 1200 kg along a straight horizontal road using a light horizontal rope. There are resistance forces of 700 N on the van and 300 N on the trailer.

(a) The driving force exerted by the van is 2500 N.

Find the tension in the rope.

The driving force is now removed and the van driver applies a braking force which acts only on the van. The resistance forces remain unchanged.

(b) Find the least possible value of the braking force which will cause the rope to become slack.

Solution:

② let T be the tension in the rope.

consider the force acting on the van,

By Newton's 2nd law,

$$\text{Resultant force} = ma$$

$$DF - R - T = ma$$

$$2500 - 700 - T = 3600a$$

$$1800 - T = 3600a$$

$$T = 1800 - 3600a \rightarrow \textcircled{1}$$

consider the forces acting on the trailer

By Newton's 2nd law

$$T - R = ma$$

$$T - 300 = 1200a$$

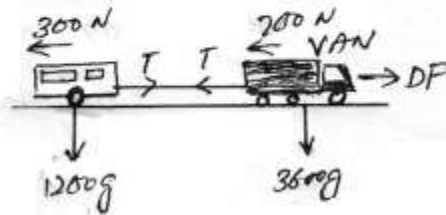
$$T = 1200a + 300 \rightarrow \textcircled{2}$$

solving equations ① and ②

$$1800 - 3600a = 1200a + 300$$

$$1800 - 300 = 1200a + 3600a$$

$$1500 = 4800a$$



$$a = \frac{1500}{4800}$$

$$a = 0.312 \text{ m/s}^2$$

substitute value of 'a' in to equation (2)

$$T = 1200(0.312) + 300$$

$$T = 675 \text{ N}$$

∴ Tension in the rope = 675 N

(b) let the braking force be F N
Tension in the rope, $T = 0$

consider the force acting on the van

By Newton 2nd law

$$-F - R = ma$$

$$-F - 700 = 3600a$$

(-F
back in
direction)

$$\Rightarrow F = -700 - 3600a \rightarrow (1)$$

consider the forces acting on the trailer

By Newton 2nd law

$$-R = ma$$

$$-300 = 1200a \Rightarrow a = -0.25 \text{ m/s}^2$$

substitute value of a in Equation (1)

$$F = -700 - 3600(-0.25)$$

$$= -700 + 900$$

$$F = 200 \text{ N}$$

