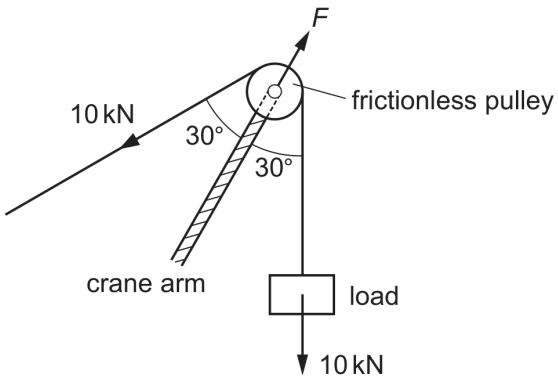
Unit 4: Forces, density and pressure:

Subunit 4.1: Turning effects of forces:

Topical Question No: 1

2 A crane has an arm to which is attached a frictionless pulley. A cable passes over the pulley and supports a load of 10 kN as shown.



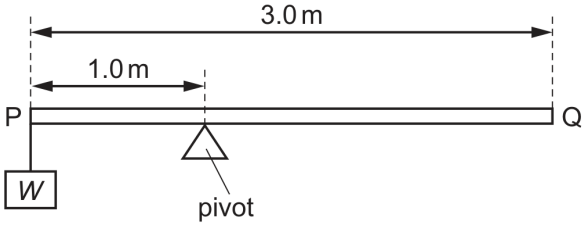
The crane arm exerts a force *F* on the pulley.

What is the value of *F*?

A 5.0 kN **B** 8.7 kN **C** 10 kN **D** 17 kN

Topical Question No: 2

12 The diagram shows a uniform beam PQ. The length of the beam is 3.0 m and its weight is 50 N. The beam is supported on a pivot 1.0 m from end P. A load of weight *W* is hung from end P and the beam is in equilibrium.



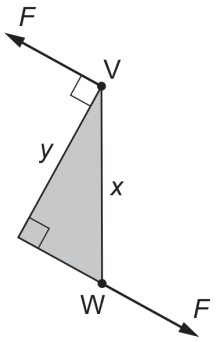
What is the value of *W*?

A 25 N **B** 50 N **C** 75 N **D** 100 N

Topical Question No: 3

13 Two forces, each of magnitude *F*, act at points V and W on an object.

The two forces form a couple. The shape of the object is a right-angled triangle with sides of lengths *x* and *y*, as shown.

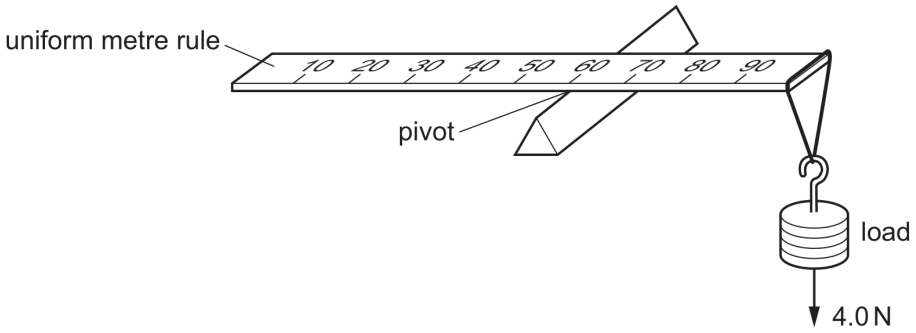


Which expression gives the torque exerted by the couple?

A *Fx** **B** *Fy** **C** 2*Fx** **D** 2*Fy*

Topical Question No: 4

12 A uniform metre rule of weight 2.0 N is pivoted at the 60 cm mark. A 4.0 N load is suspended from one end, causing the rule to rotate about the pivot.

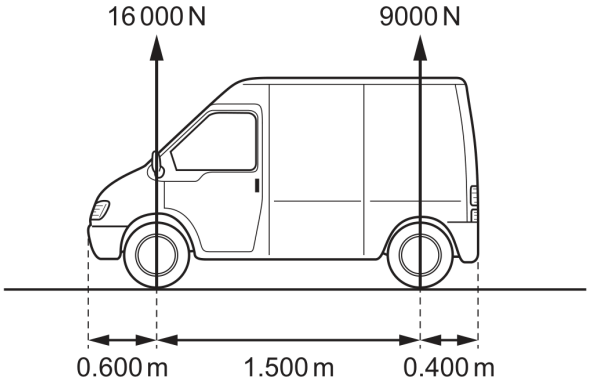


At the instant when the rule is horizontal, what is the resultant moment about the pivot?

A 0.0 N m **B** 1.4 N m **C** 1.6 N m **D** 1.8 N m

Topical Question No: 5

13 The vertical forces that the ground exerts on a stationary van are shown.



The van is 2.50 m long with the wheels at a distance of 0.600 m from the front of the van and 0.400 m from the rear of the van.

What is the horizontal distance of the van's centre of gravity from the front of the van?

A 0.540 m **B** 0.960 m **C** 1.14 m **D** 1.36 m

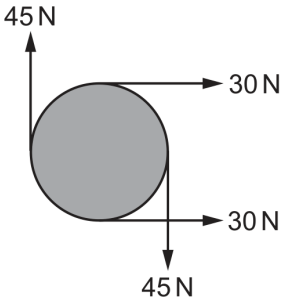
Topical Question No: 6

2 Which row shows a quantity and an **incorrect** unit?

	quantity	unit
A	efficiency	no unit
B	moment of force	$N\,m^{-1}$
C	momentum	N s
D	work done	J

Topical Question No: 7

11 The diagram shows four forces applied to a circular object.

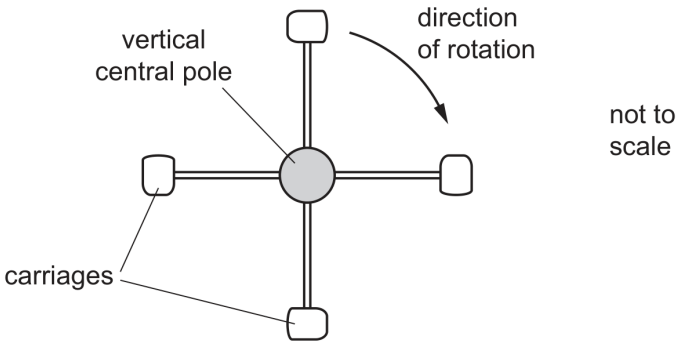


Which row describes the resultant force and resultant torque on the object?

	resultant force	resultant torque
A	non-zero	non-zero
B	non-zero	zero
C	zero	non-zero
D	zero	zero

Topical Question No: 8

12 A fairground ride consists of four carriages connected to a central vertical pole, as shown in the following view from above.



A motor rotates the central pole about its axis. This results in the four carriages each moving along a circular path.

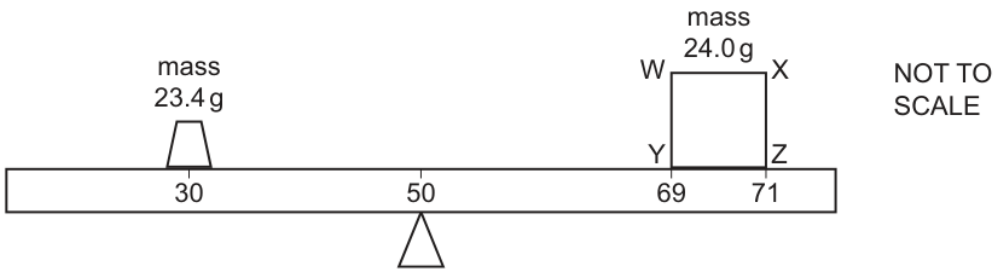
The distance from the middle of each carriage to the centre of the pole is 3.20 m. When they are moving, each carriage experiences an air resistance force of 85.0 N. Assume that there are no other significant resistive forces.

Which torque does the motor need to apply to the pole to keep the system rotating at constant maximum speed?

A 5.44 N m **B** 272 N m **C** 544 N m **D** 1090 N m

Topical Question No: 9

12 A cube WXZY has sides of length 2.0 cm and mass 24.0 g. The cube rests on a metre rule of negligible mass. The geometrical centre of the cube is vertically above the 70.0 cm mark on the scale of the rule.



The cube has a non-uniform density so that its centre of gravity is **not** at its geometrical centre. The centre of gravity of the cube is in the plane of the diagram.

The rule rests on a pivot at the 50.0 cm mark. A mass of 23.4 g is placed vertically above the 30.0 cm mark. The rule is horizontal and in equilibrium.

What can be determined about the position of the centre of gravity of the cube?

A It must be somewhere along a horizontal line that is 0.5 cm from line WX.

B It must be somewhere along a horizontal line that is 0.5 cm from line YZ.

C It must be somewhere along a vertical line that is 0.5 cm from line WY.

D It must be somewhere along a vertical line that is 0.5 cm from line XZ.

Topical Question No: 10

15 What is the centre of gravity of an object?

A the geometrical centre of the object

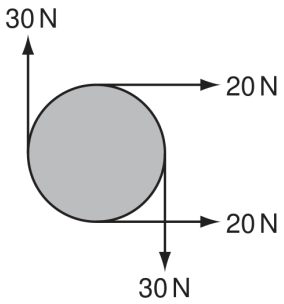
B the point at which the weight of the object may be considered to act

C the point on the object about which there is a zero net torque

D the point where gravity acts on the object

Topical Question No: 11

12 The diagram shows four forces applied to a circular object.



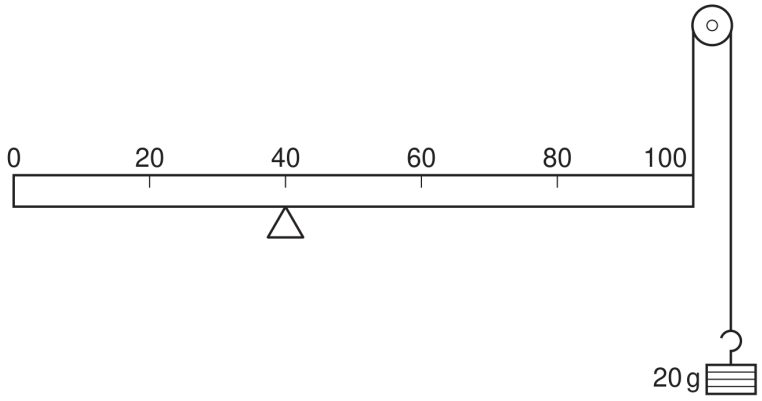
Which row describes the resultant force and resultant torque on the object?

	resultant force	resultant torque
A	zero	zero
B	zero	non-zero
C	non-zero	zero
D	non-zero	non-zero

Space for working

Topical Question No: 12

13 A uniform metre rule of mass 100 g is supported by a pivot at the 40 cm mark and a string at the 100 cm mark. The string passes round a frictionless pulley and carries a mass of 20 g as shown in the diagram.



At which mark on the rule must a 50 g mass be suspended so that the rule balances?

A 4 cm **B** 36 cm **C** 44 cm **D** 64 cm

Topical Question No: 13

11 Two forces form a couple.

Which statement describes the two forces?

A They are in the same direction.

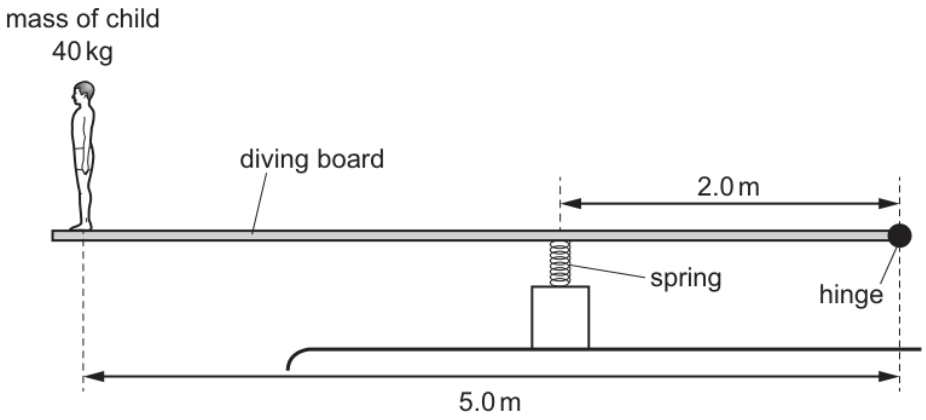
B They are perpendicular to each other.

C They have the same magnitude.

D They pass through the same point.

Topical Question No: 14

13 A diving board of length 5.0 m is hinged at one end and supported 2.0 m from this end by a spring of spring constant 10 kN m^{-1}. A child of mass 40 kg stands at the far end of the board.



What is the extra compression of the spring caused by the child standing on the end of the board?

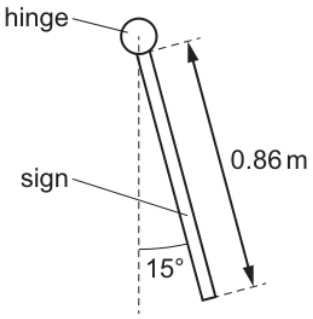
A 1.0 cm **B** 1.6 cm **C** 9.8 cm **D** 16 cm

Topical Question No: 15

15 A square shop sign of uniform density has mass 2.4 kg and sides of length 0.86 m.

The sign is supported by a hinge along its top edge.

There is friction in the hinge so that the sign hangs from it in equilibrium at an angle of 15° to the vertical, as shown.

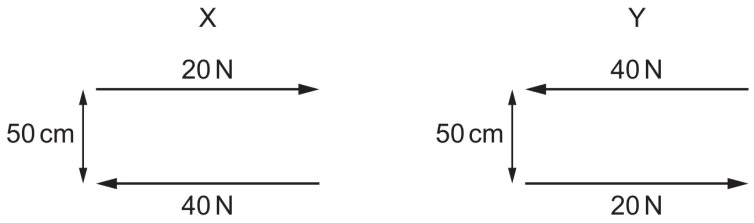


What is the moment about the hinge of the weight of the sign?

A 2.6 N m **B** 4.0 N m **C** 5.2 N m **D** 9.8 N m

Topical Question No: 16

11 The diagram shows two pairs X and Y of parallel forces.



Which statement is correct?

A X is equivalent to a clockwise torque of 10 N m and a force of 20 N to the left.

B X is equivalent to a clockwise torque of 20 N m only.

C Y is equivalent to an anticlockwise torque of 30 N m and a force of 20 N to the left.

D Y is equivalent to an anticlockwise torque of 30 N m only.

Topical Question No: 17

12 What is **not** a necessary requirement of the forces in a couple?

A They act in opposite directions.

B They act along different lines.

C They have the same magnitude.

D They produce a resultant force.

Answer Key

1. N/A
2. N/A
3. N/A
4. N/A
5. N/A
6. N/A
7. N/A
8. N/A
9. C
10. B
11. N/A
12. N/A
13. C
14. C
15. A
16. N/A
17. D