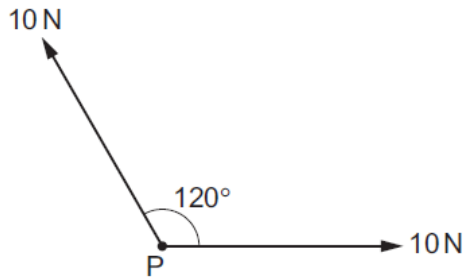
Forces – 2023 June AS Physics 9702

1. June/2023/Paper_ 9702/11/No.24

Two forces, each of 10 N, act at a point P, as shown. The angle between the directions of the forces is 120°.

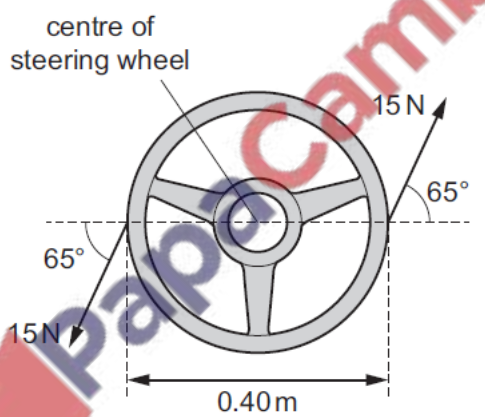


What is the magnitude of the resultant force?

A 5 N **B** 10 N **C** 17 N **D** 20 N

2. June/2023/Paper_ 9702/11/No.11

The driver of a car applies two parallel forces to a steering wheel, as shown.



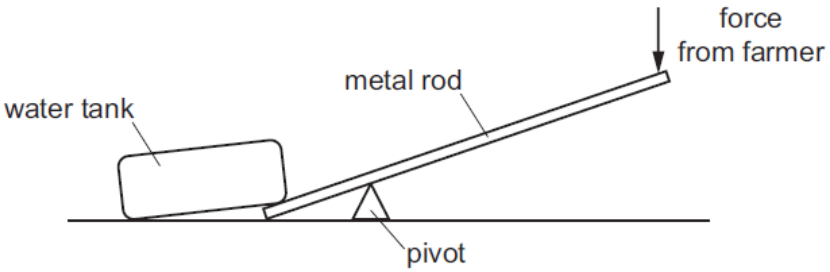
Each force has a magnitude of 15 N and acts in the direction shown. The steering wheel has a diameter of 0.40 m.

What is the torque exerted on the steering wheel?

A 1.3 N m **B** 2.5 N m **C** 2.7 N m **D** 5.4 N m

3. June/2023/Paper_ 9702/11/No.12

A farmer is trying to lift the corner of a large water tank. She uses a metal rod as a lever.



The vertical force from the farmer is constant and is always applied to the end of the rod.

Which change **must** increase the upward force on the water tank?

A using a longer rod and moving the pivot closer to the tank

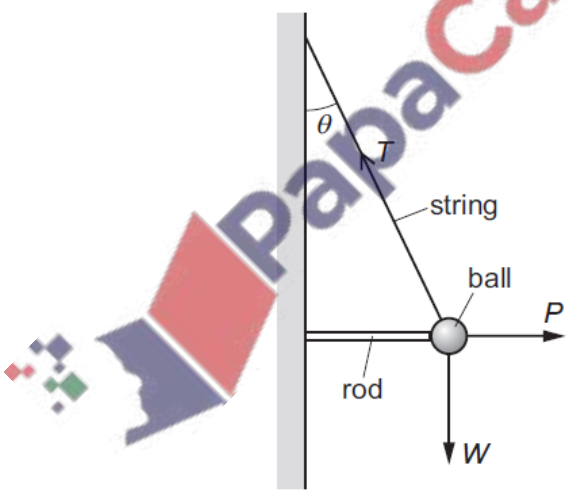
B using a longer rod and moving the pivot further away from the tank

C using a shorter rod and moving the pivot closer to the tank

D using a shorter rod and moving the pivot further away from the tank

4. June/2023/Paper_ 9702/11/No.13

The diagram shows a ball of weight W hanging in equilibrium from a string.



The string is at an angle θ to the vertical. The tension in the string is T. The ball is held away from the wall by a horizontal force P from a metal rod.

Which relationship between the magnitudes of T, P and W is correct?

A $P = T\cos\theta$ and $W = T\sin\theta$

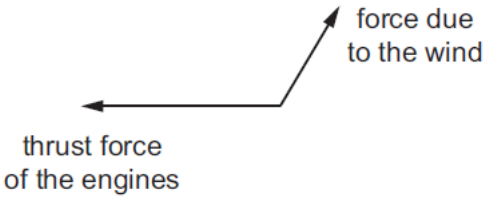
B $T = P + W$

C $T^2 = P^2 + W^2$

D $W = P\tan\theta$ and $W = T\cos\theta$

5. June/2023/Paper_ 9702/12/No.4

An aircraft travels along a horizontal path. Two of the forces that act horizontally on the aircraft are the thrust force of the engines and the force due to the wind. The vector diagram for these forces is shown.



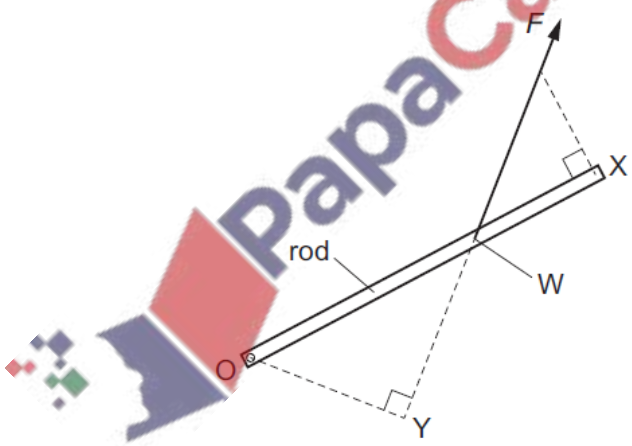
Which vector represents the resultant horizontal force acting on the aircraft due to these two forces?

A **B** **C** **D**

6. June/2023/Paper_ 9702/12/No.11

A rod is pivoted at point O.

A force *F* is applied to the rod at point W, as shown.



What is the moment of the force *F* about O?

A $F \times$ distance OX

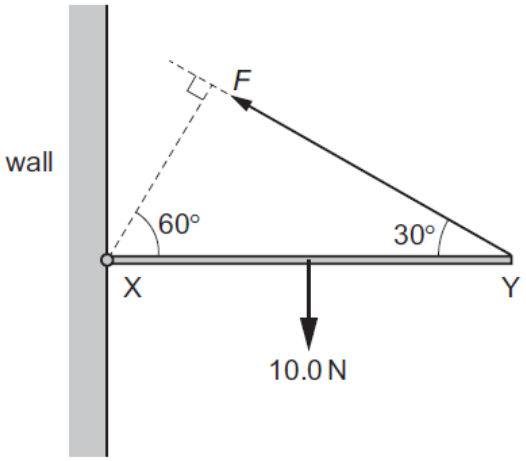
B $F \times$ distance OY

C $F \times$ distance WO

D $F \times$ distance WX

7. June/2023/Paper_ 9702/12/No.12

A uniform rod XY of weight 10.0 N is freely hinged to a wall at X. It is held horizontal by a force *F* acting from Y at an angle of 30° to the horizontal, as shown.

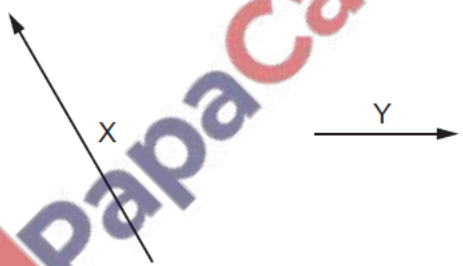


What is the value of *F*?

A 5.0 N **B** 8.7 N **C** 10 N **D** 20 N

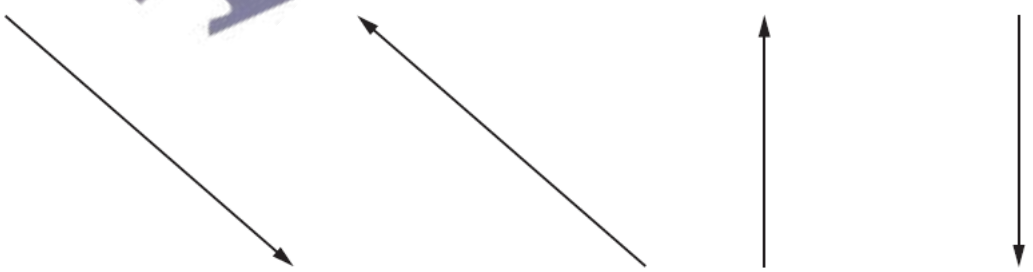
8. June/2023/Paper_ 9702/13/No.4

The diagram shows two vectors, X and Y, drawn to scale.



If X = Y – Z, which diagram represents the vector Z?

A **B** **C** **D**



9. June/2023/Paper_ 9702/13/No.11

What is **not** a requirement for two forces to act as a couple?

A The two forces act in opposite directions.

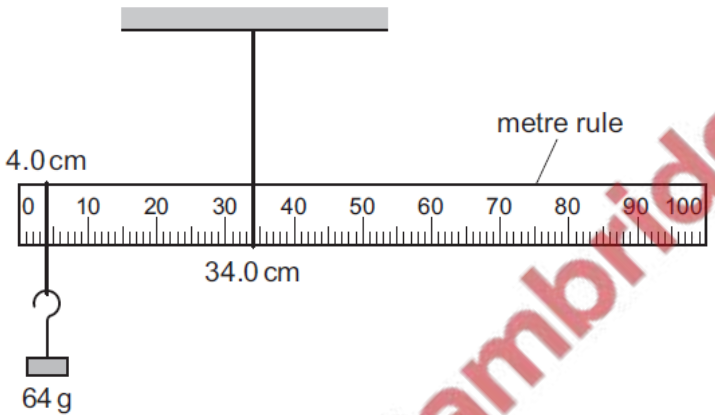
B The two forces act through the same point.

C The two forces combine to produce zero resultant force.

D The two forces have equal magnitude.

10. June/2023/Paper_ 9702/13/No.12

A uniform metre rule is pivoted at the 34.0 cm mark, as shown.



The rule balances when a 64 g mass is hung from the 4.0 cm mark.

What is the mass of the metre rule?

A 38 g **B** 44 g **C** 120 g **D** 136 g

11. June/2023/Paper_ 9702/13/No.5

Which equation, representing uniformly accelerated motion in a straight line, can be determined using **only** the definition of acceleration?

A $s = ut + \frac{1}{2}at^2$

B $s = \frac{1}{2}(u+v)t$

C $v = u + at$

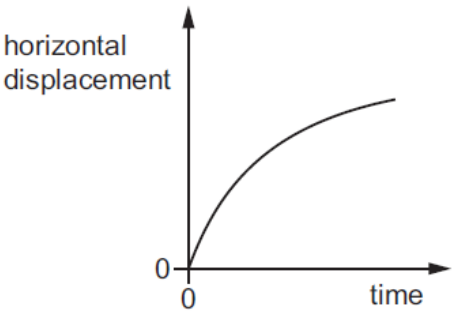
D $v^2 = u^2 + 2as$

12. June/2023/Paper_ 9702/13/No.6

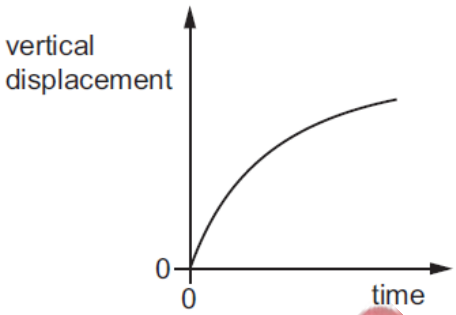
An object moves from rest with uniform velocity horizontally and uniform acceleration vertically.

Which graph showing the variation with time of the displacement of the object from its initial position is correct?

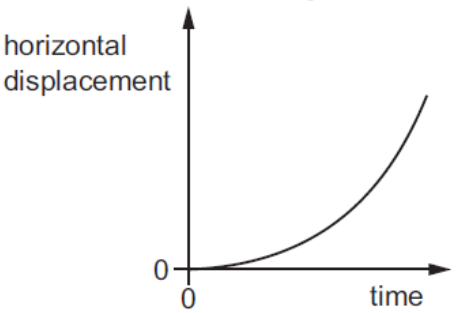
A



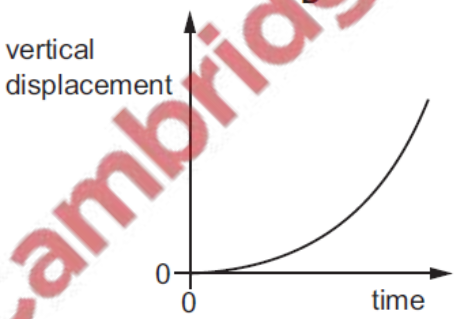
B



C



D



13. June/2023/Paper_ 9702/21/No.2(a, b)

A rigid uniform beam of weight W is connected to a fixed support by a hinge, as shown in Fig. 2.1.

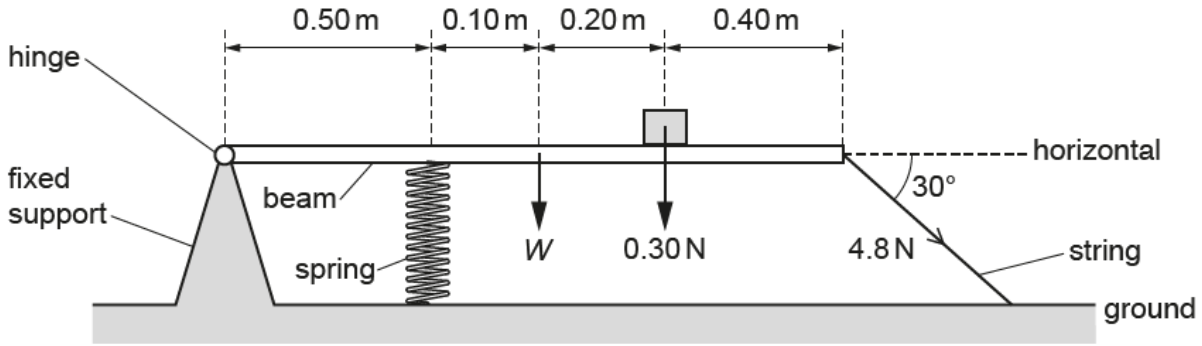


Fig. 2.1 (not to scale)

A compressed spring exerts a total force of 8.2 N vertically upwards on the horizontal beam. A block of weight 0.30 N rests on the beam. The right-hand end of the beam is connected to the ground by a string at an angle of 30° to the horizontal. The tension in the string is 4.8 N. The distances along the beam are shown in Fig. 2.1.

The beam is in equilibrium. Assume that the hinge is frictionless.

(a) (i) Show that the vertical component of the tension in the string is 2.4 N.

[1]

(ii) By taking moments about the hinge, determine the weight W of the beam.

W = ... N [3]

(iii) Calculate the horizontal component of the force exerted on the beam by the hinge.

force = ... N [1]

(b) The spring obeys Hooke's law and has an elastic potential energy of 0.32 J.

Calculate the compression of the spring.

compression = ... m [2]

14. June/2023/Paper_ 9702/22/No.2(a, b)

(a) State what is meant by the centre of gravity of an object.

.....

..... [1]

(b) Two blocks are on a horizontal beam that is pivoted at its centre of gravity, as shown in Fig. 2.1.

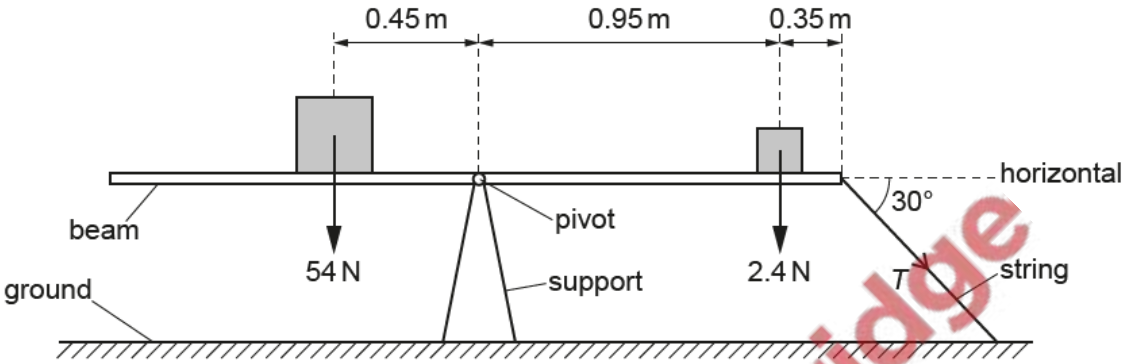


Fig. 2.1 (not to scale)

A large block of weight 54 N is a distance of 0.45 m from the pivot. A small block of weight 2.4 N is a distance of 0.95 m from the pivot and a distance of 0.35 m from the right-hand end of the beam.

The right-hand end of the beam is connected to the ground by a string that is at an angle of 30° to the horizontal. The beam is in equilibrium.

(i) By taking moments about the pivot, calculate the tension T in the string.

T = ... N [3]

(ii) The string is cut so that the beam is no longer in equilibrium.

Calculate the magnitude of the resultant moment about the pivot acting on the beam immediately after the string is cut.

resultant moment = ... N m [1]

15. March/2023/Paper_ 9702/12/No.7

Which expression defines force?

A (mass × change in speed) × time taken

B $\frac{\text{mass} \times \text{change in speed}}{\text{time taken}}$

C (change of momentum) × time taken

D $\frac{\text{change of momentum}}{\text{time taken}}$

16. March/2023/Paper_ 9702/12/No.8

A ship of mass 8.4×10^7 kg is approaching a harbour with speed $16.4\,\text{m}\,\text{s}^{-1}$. By using reverse thrust it can maintain a constant total stopping force of 920 000 N.

How long will it take to stop?

A 15 seconds

B 150 seconds

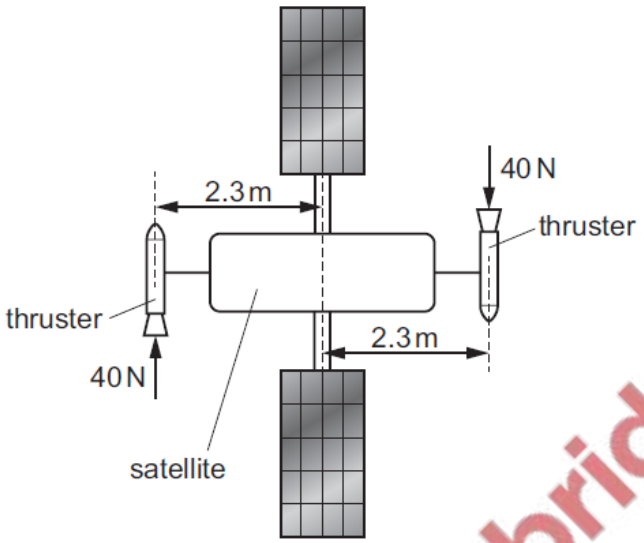
C 25 minutes

D 250 minutes

17. March/2023/Paper_ 9702/12/No.11

A satellite uses two thrusters to adjust its motion in space.

Each thruster exerts a force of 40 N on the satellite. The line of action of each force is a perpendicular distance of 2.3 m from the centre of gravity of the satellite. These two parallel forces act in opposite directions.



What are the magnitudes of the torque and the resultant force acting on the satellite due to the two thrust forces?

	torque / N m	resultant force / N
A	92	0
B	92	80
C	180	0
D	180	80

18. March/2023/Paper_ 9702/12/No.12

The diagrams show two ways of hanging the same picture.

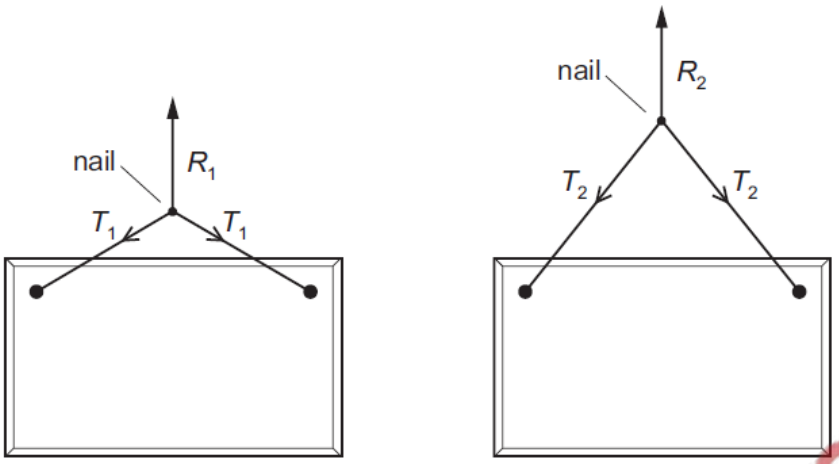


diagram 1 diagram 2

In both cases, a string is attached to the same points on the picture and looped symmetrically over a nail in a wall. The forces shown are those that act on the nail.

In diagram 1, the string loop is shorter than in diagram 2.

Which information about the magnitude of the forces is correct?

A $R_1 = R_2$ $T_1 = T_2$

B $R_1 = R_2$ $T_1 > T_2$

C $R_1 > R_2$ $T_1 < T_2$

D $R_1 < R_2$ $T_1 = T_2$

19. March/2023/Paper_ 9702/12/No.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

20. March/2023/Paper_ 9702/22/No.2(c)

A motor uses a wire to raise a block, as illustrated in Fig. 2.1.

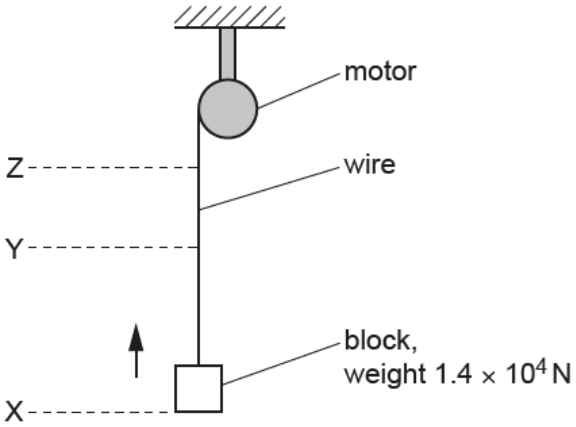


Fig. 2.1 (not to scale)

The base of the block takes a time of 0.49 s to move vertically upwards from level X to level Y at a constant speed of 0.64 m s^{-1}. During this time the wire has a strain of 0.0012. The wire is made of metal of Young modulus 2.2 × 10^{11} Pa and has a uniform cross-section.

The block has a weight of 1.4 × 10^4 N. Assume that the weight of the wire is negligible.

(c) The base of the block now has a uniform deceleration of magnitude 1.3 m s^{-2} from level Y until the base of the block stops at level Z.

Calculate the tension T in the wire as the base of the block moves from Y to Z.

T = ... N [3]

21. March/2023/Paper_ 9702/22/No.3

A uniform beam AB is attached by a hinge to a wall at end A, as shown in Fig. 3.1.

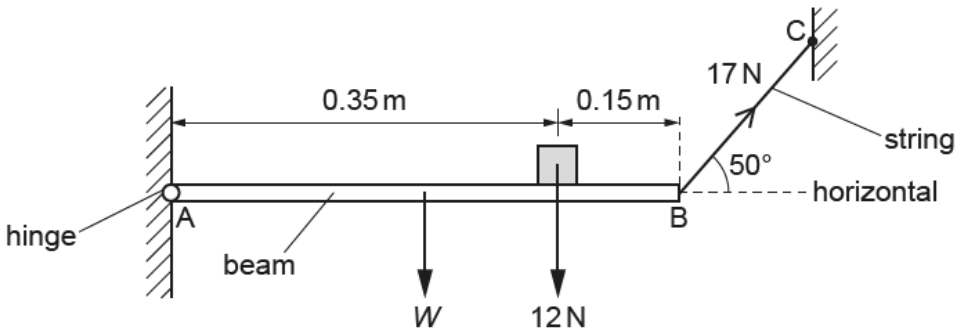


Fig. 3.1 (not to scale)

The beam has length 0.50 m and weight *W*. A block of weight 12 N rests on the beam at a distance of 0.15 m from end B.

The beam is held horizontal and in equilibrium by a string attached between end B and a fixed point C. The string has a tension of 17 N and is at an angle of 50° to the horizontal.

(a) State **two** conditions for an object to be in equilibrium.

1 .....

.....

2 .....

.....

[2]

(b) Show that the vertical component of the tension in the string is 13 N.

[1]

(c) By taking moments about end A, calculate the weight *W* of the beam.

W = ... N [2]

(d) Calculate the magnitude of the vertical component of the force exerted on the beam by the hinge.

force = ... N [1]

(e) The block is now moved closer to end A of the beam. Assume that the beam remains horizontal.

State whether this change will increase, decrease or have no effect on the horizontal component of the force exerted on the beam by the hinge.

..... [1]

[Total: 7]