O Level Combined Physics Structured

Moments Test 1.0

Q1

Fig. 3.1 shows a typical barrier found in a carpark. It consists of a 600 N counterweight attached to an arm of weight 200 N. Both are pivoted at P and are held in the horizontal position by a rope tied to the ground.

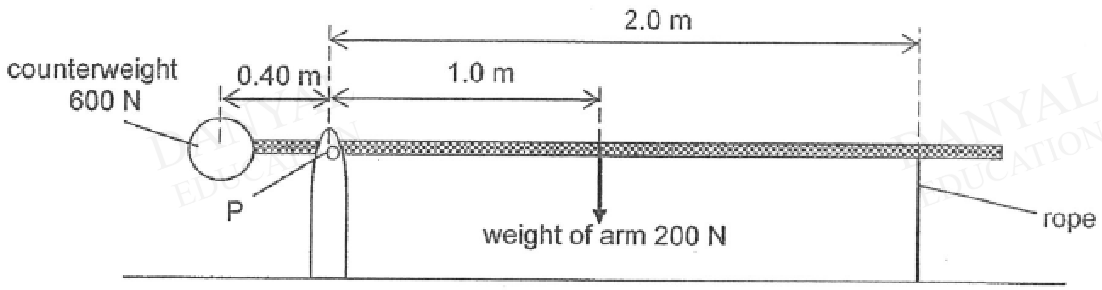

Fig. 3.1

(a) Define *centre of gravity*.

....

....[1]

(b) The centre of gravity of the arm is 1.0 m from P and the rope is 2.0 m from P.

When the arm is horizontal as shown above, calculate

(i) the moment of the counterweight about P,

moment = ...[1]

(ii) the tension in the rope.

tension = ...[2]

(c) Suggest one way to reduce the tension in the rope while keeping the arm horizontal.

....

....[1]

Q2

3. **Fig. 3.1** and **Fig. 3.2** show two ways in which a retort stand can be balanced.

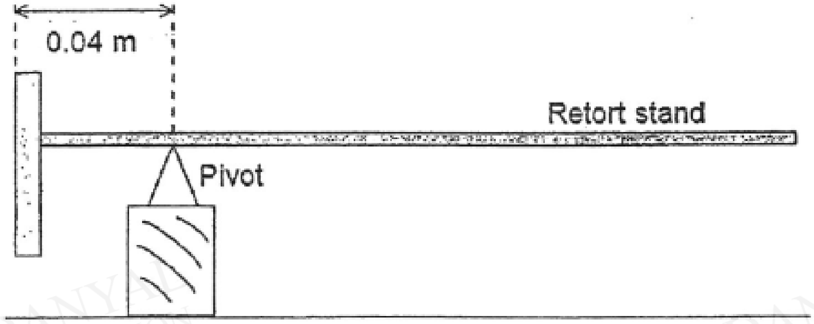

Fig. 3.1

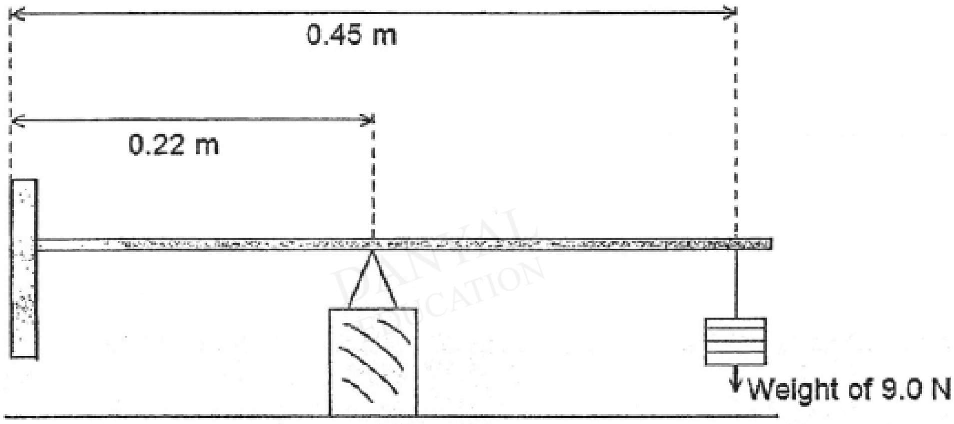

Fig. 3.2

(a) On **Fig. 3.1**, indicate with the symbol "X", the centre of gravity of the retort stand. [1]

(b) Calculate the weight of the retort stand.

weight = ... N [3]

Q3

(b) Fig 4.4 shows the side view of the same pole. A wet bed sheet with a mass of 2.0 kg is hung over the pole. The pole and bed sheet is hung out to dry and are at rest.

The centre of gravities of the rod and sheet is shown in Fig 4.4.

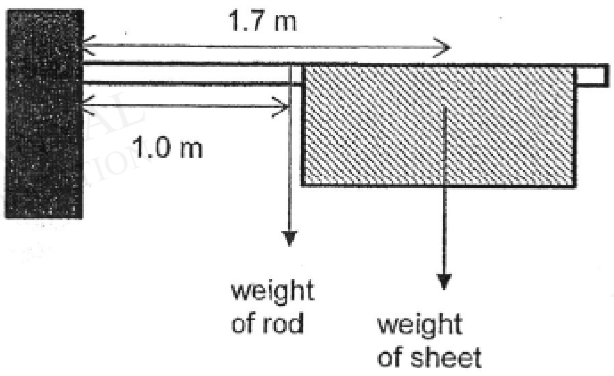

Fig 4.4

Calculate the sum of the moments about the hinge due to the weight of the rod and the sheet.

sum of moments = ... Nm [2]

(c) An upward force U acts on the hinge. Calculate U and explain using Newton's First Law how you obtained your answer.

U = ... N

Explanation: ....

....

.... [2]

Q4

Fig. 4.1 shows the rest position and Fig. 4.2, the displaced position of a weighted toy. **G** is its centre of gravity. The toy weighs 5.0 N.

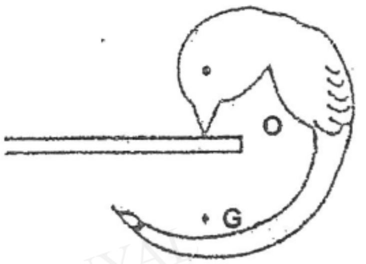

Fig. 4.1

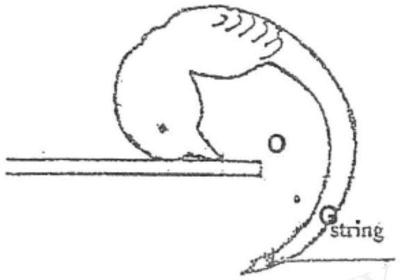

Fig. 4.2

(a) Explain why **G** has to be vertically below the pivot **O** for the toy to remain at rest position as shown in Fig. 4.1.

....

....

....

....

....[2]

(b) Fig. 4.2 shows the toy in its slightly displaced position using a string.

State and explain what happens to the toy when the string is cut.

....

....

....

....

....[2]

Q5

Fig. 11.1 shows a person P crossing a uniform bridge supported at AB. The length of the bridge is 6.0 m and its weight is 2 000 N. The person is 4.0 m away from B.

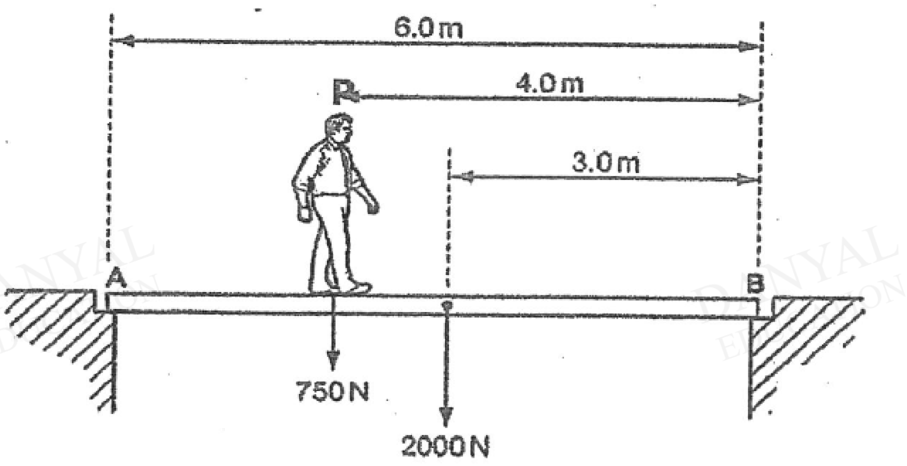

Fig. 11.1 (not to scale)

By taking moments about B, calculate

(a) the moment of the weight of the bridge.

moment = ... [2]

(b) the moment of the weight of the person.

moment = ... [2]

(c) On Fig. 11.1, draw clearly the reaction forces acting on the bridge by the supports at A and at B. Label the forces $\mathbf{F_A}$ and $\mathbf{F_B}$ respectively. [2]

(d) Hence, calculate

(i) $\mathbf{F_A}$, the force exerted by the support on the bridge at **A**.

force = ... [2]

(ii) $\mathbf{F_B}$, the force exerted by the support on the bridge at **B**.

force = ... [2]

DANYAL EDUCATION

Answers

Moments Test 1.0

Q1

(a)	The point where the whole weight of the object seems to act.	B1
(b)(i)	Moment = 600 x 0.4 = 240 Nm	A1
(ii)	Taking moments about P,	
	sum of anti-clockwise moment = sum of clockwise moment	
	240 = 200 x 1.0 + T x 2.0	C1
	T = 20 N	A1
(c)	**Any one of the following answers.**	B1

- Use a lighter counterweight
- Move counterweight closer to pivot
- Use a heavier arm
- Place the rope further away from P.

DANYAL EDUCATION

Q2

3. **Fig. 3.1** and **Fig. 3.2** show two ways in which a retort stand can be balanced.

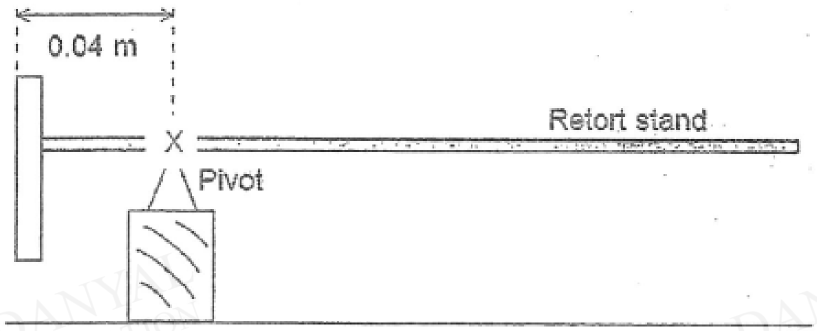

Fig. 3.1

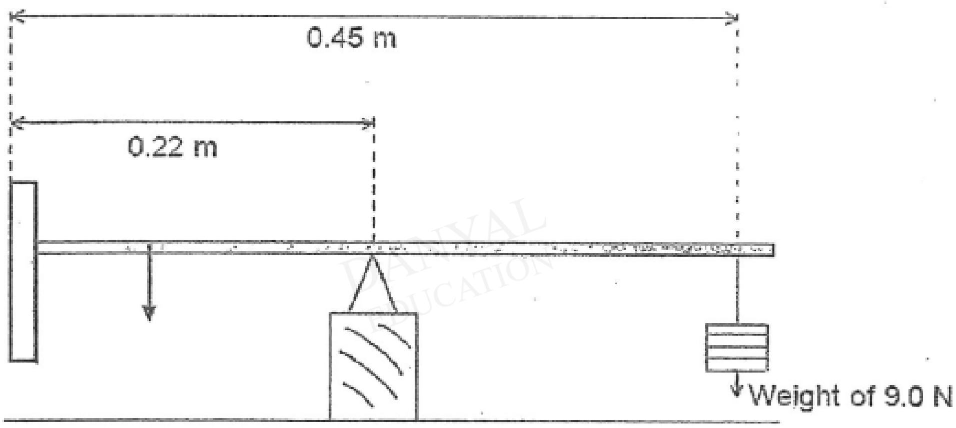

Fig. 3.2

(a) On **Fig. 3.1**, indicate with the symbol "X", the centre of gravity of the retort stand. [1]
Only X is required for 1 mark

(b) Calculate the weight of the retort stand.
Taking moments about the pivot,
W x (0.22 – 0.04) = 9.0 x (0.45 – 0.22) [C1: W x (0.22 – 0.04)] [C1: 9.0 x (0.45 – 0.22)]
W x 0.18 = 9.0 x 0.23
W = <u>11.5 N</u> [A1: minus 1 mark for wrong or missing unit]

weight = ______________________ N [3]

Q3

b)	Moments $= m_{rod}g(d_{rod}) + m_{sheet}g\ (d_{sheet})$ = (0.879)(10)(1.0) + 2.0(10)(1.7) = 8.79 + 34 = 42.8 Nm	1 1
c)	$U = W_{rod} + W_{sheet}$ = 8.79 + 20 = 28.8 N Newton's 1st Law implies since the rod is at rest. that if Fnet is zero, hence $F_{up} = F_{down}$ and U = total weight of rod and sheet	1 1

Q4

a The toy which is at rest is in equilibrium and thus there is no (resultant) moment. When G is directly under the pivot O, the perpendicular distance from the pivot to the line of action of the force (or weight) is zero.

b When the string is cut, the toy starts to oscillates about O / moves to the left first and then to the right. This is due to the moment of the weight of the toy. The toy comes to rest eventually at the position shown in Fig 4.1.

Q5

a Moment of weight of the bridge about B = F x d
= 2 000 x 3.0
= 6 000 Nm

b Moment of weight of person about B = F x d
= 750 x 4.0
= 3 000 Nm

c F_A and F_B and arrows at correct positions

d In equilibrium, taking moments about B,
clockwise moments = anti-clockwise moments
$F_A \times 6.0 = 6\,000 + 3\,000$
$F_A = 9\,000/6.0$
= 1 500 N

e In equilibrium, sum of upward forces = sum of downward forces
$F_A + F_B = 2\,000 + 750$
$F_B = 2\,750 - 1\,500$
= 1 250 N