O Level Combined Physics Structured

Moments Test 2.0

Q1

(a) State the principle of moments.

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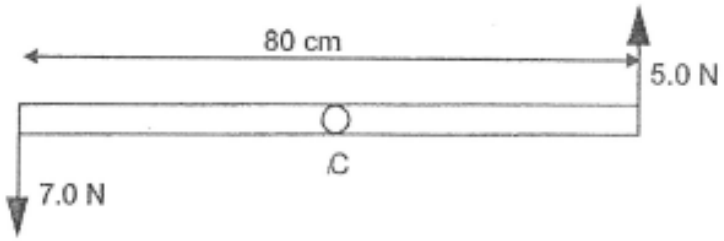
.....

..... [1]

(b) A uniform rod of length 80 cm is freely pivoted about its centre of gravity *C*. Forces of 7.0 N and 5.0 N act at the ends of the rod as shown in the diagram.

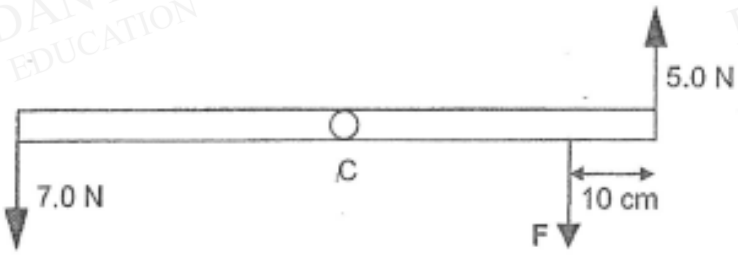


Determine

(i) the sum of the anti-clockwise moments of the forces about the point *C* in newton metre,

anti-clockwise moments = ... Nm [2]

(ii) the downward force F acting 10 cm away from the right-end edge to keep the rod in equilibrium.



F = ... N [2]

Q2

Fig. 10.1 shows a manual car park barrier.

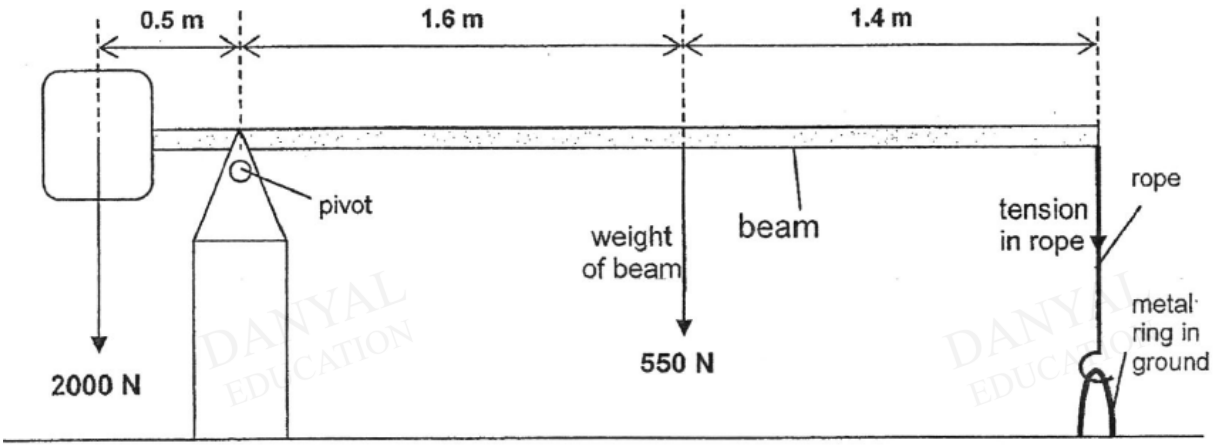


Fig. 10.1

(a) The weight of the barrier beam is 550 N and acts at 1.6 m to the right of the pivot. Calculate the tension needed in the rope in order to keep the beam horizontal.

tension = ... N [3]

(b) Describe and explain what will happen if the rope is suddenly detached from the metal ring.

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..... [2]

Fig. 10.2 shows two similar cones made of wood and metal.

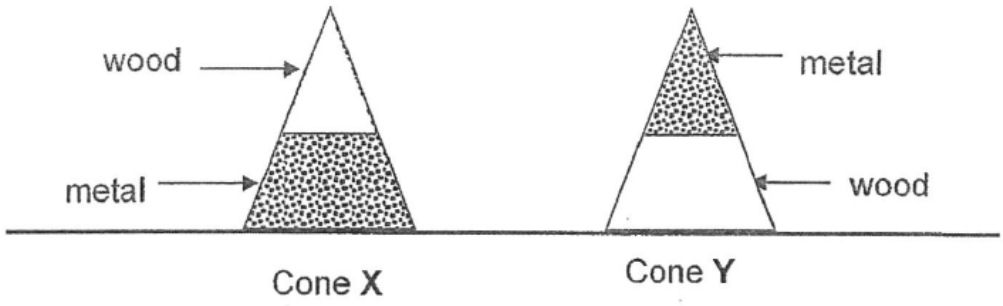

Fig. 10.2

Fig. 10.3 shows the cones being tilted by a force.

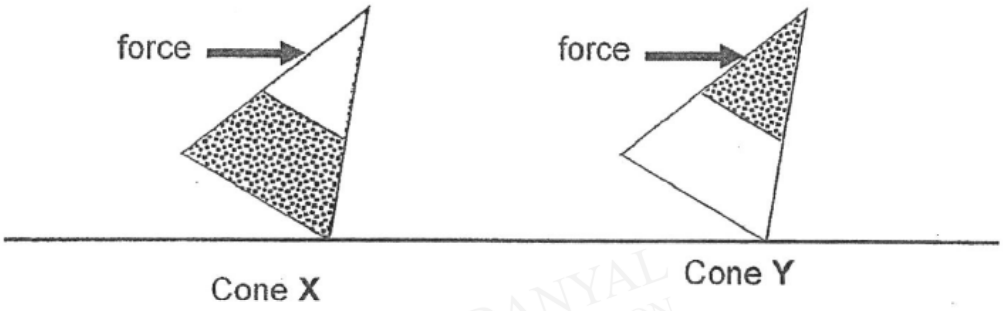

Fig. 10.3

(c) In Fig. 10.3, mark a possible position for the centre of gravity by 'x' and draw an arrow to show the weight for both cone **X** and cone **Y**. [1]

(d) Using your answer for **(c)**, explain why cone **X** is in a state of stable equilibrium.

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.....

..... [2]

(e) Using your answer for **(c)**, explain why cone **Y** is in a state of unstable equilibrium.

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.....

..... [2]

Q3

Fig. 4.1 shows a simple tool to punch holes in a sheet of material. The handle is pushed down to produce the hole.

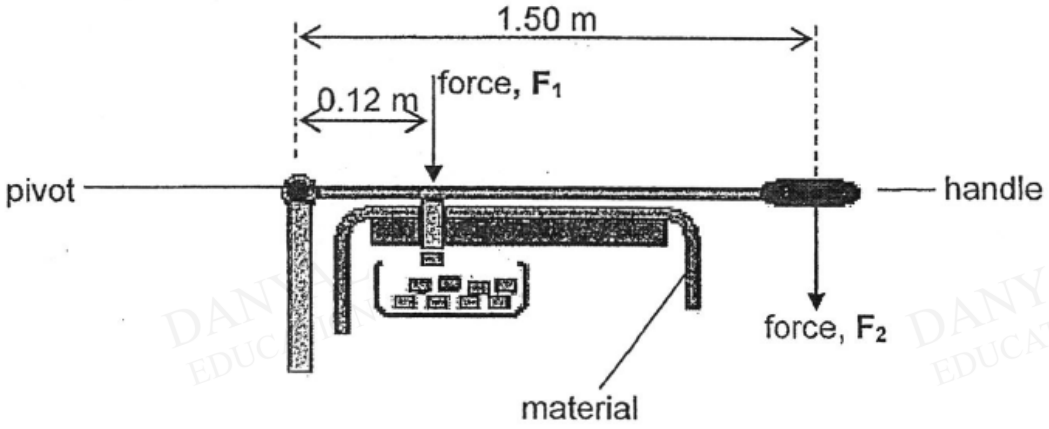

Fig. 4.1

(a) Calculate the punch force F_1 produced when the applied force, F_2 is 2.0 N.

force F_1 = ... N [2]

(b) Describe and explain one way we can modify the tool so that it can be used to punch through a tougher material using the same force, F_2 of 2.0 N.

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.....[2]

Q4

Fig. 4.1 shows a uniform beam XY pivoted at its mid-point. Two masses of weight 25 N and 20 N, are suspended from the beam.

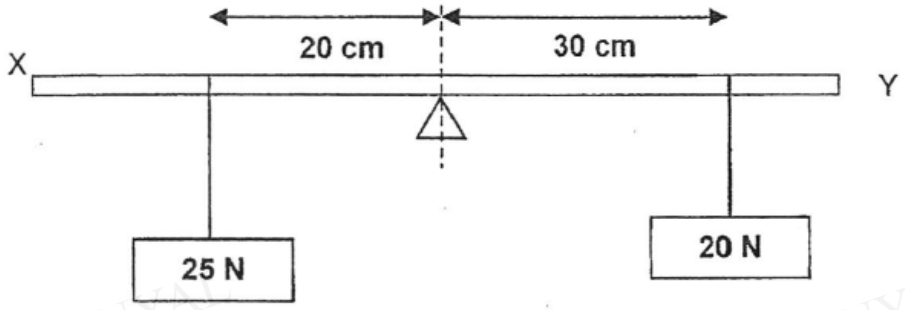

Fig. 4.1

(a) Will end X of the beam move upwards or downwards? Use calculated values to support your answer.

_____

_____

_____ [2]

(b) An additional weight of 10 N is placed on the beam to balance it.

Where should the position that the 10 N weight be placed in order to balance the beam?

_____

_____

_____ [2]

(c) On Fig. 4.1, indicate the line of action of the weight of the beam. [1]

(d) Explain why the weight of the beam does **not** have any effect on the moment of the beam.

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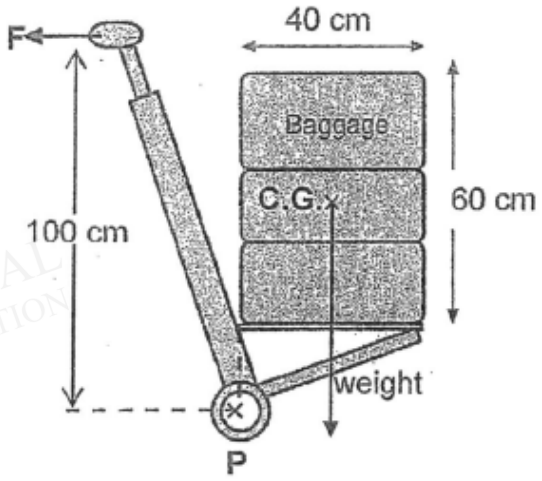
_____ [1]

Q5

An airplane passenger places his baggage, of total mass 20 kg, onto a trolley as shown in the figure. He applies a force **F** at the handle to raise the baggage to the position shown.



(a) Calculate the weight of the baggage.

weight = ... [1]

(b) The axle of the wheels, **P**, acts as a pivot. By taking moments about **P**, calculate the force **F** required on the handle to keep the baggage in the position shown.

F = ... [2]

(c) Explain how the design of the trolley makes it easier to support the load.

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..... [2]

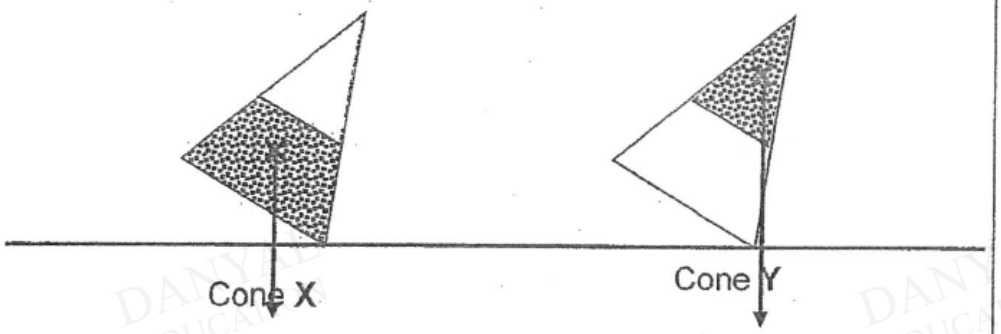
Answers

Moments Test 2.0

Q1

4(a)	The principle of moment states that when a body is in equilibrium, the sum of clockwise moments about a pivot is equal to the sum of anti-clockwise moments about the same pivot.	[1]
(b)(i)	Sum of anti-clockwise moments = 5 x 0.4 + 7 x 0.4 = 4.8 Nm	[1] [1]
(ii)	F x 0.3 = 4.8 F = 16 N	[1] [1]

Q2

(a) Anticlockwise moments = clockwise moments (2000)(0.5) = T(3.0) + (550)(1.6) 1000 = 3.0 T + 880 T = 40 N	1 1 1
(b) If the rope is suddenly detached, the anticlockwise moment is greater than clockwise moment. The barrier will turn anticlockwise.	1 1
(c) 	½ (each)
(d) When the force is released, the weight that acts on a lower centre of gravity falls within the base. An anticlockwise turning effect will bring it back to its original positon.	1 1
(e) When the force is released, the weight acts on a higher centre of gravity will fall outside the base. A clockwise turning effect that will topple it.	1 1

Q3

(a)	$F_1(0.12) = 2\ (1.50)$ $F_1 = 25$ N [1]	[M1] [A1]
(b)	lengthen the handle as moment is the product of force and the perpendicular distance from the pivot. By lengthening the handle, **the perpendicular distance is increased,** hence **increasing the force** acting on the tougher material.	[B1] [B1]

Q4

(a) Upwards. Clockwise moment = (20)(0.3) = 6.0 Nm Anti-clockwise moment = (25)(0.2) = 5.0 Nm There is a net clockwise moment acting on the beam about the pivot, hence, end X of beam will move upwards.	[1] [1]
(b) 10 N weight should be placed 10 cm away from the pivot on the left side of the beam.	[1] [1]
(c) Line of action of weight acting through pivot	[1]
(d) The line of action of weight acts through the pivot. Perpendicular distance between line of action of weight and pivot is zero. Therefore, moment due to its weight about the pivot is zero.	[1]

Q5

(a)	W = mg = 20 x 10 = 200 N	1
(b)	**F** x 100 = 200 x 20 **F** = 40 N	1 1
(c)	The perpendicular distance from **F** to **P** is greater than the distance from the line of action of weight to **P**. Less force is needed to produce the same moment produced by the load.	1 1