Moments

Total marks:19

Q1.

Figure 3 is a diagram of the forces acting on a swing.

The swing is not moving.

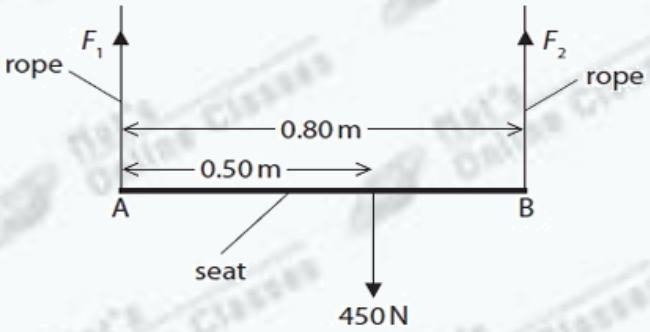

Figure 3

The seat of the swing, AB, is 0.80 m long. A person of weight 450 N sits on the seat. The person's weight acts at a distance of 0.50 m from A as shown in Figure 3.

Ignore the weight of the seat.

The upward forces exerted by the ropes on the seat are F_1 and F_2.

Calculate the force F_2 by taking moments about A.

(3)

force F_2 = ... N

(Total for question = 3 marks)

Q2.

Figure 20 shows a person trying to lift a large rock using a metal bar.

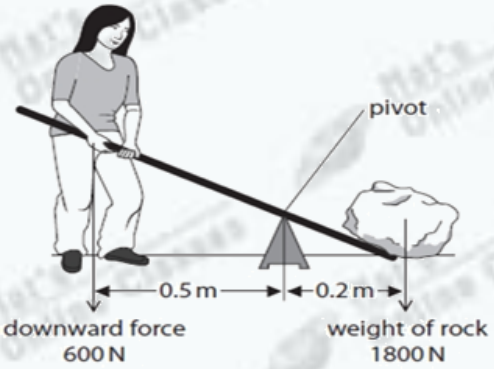

Figure 20

The rock weighs 1800 N.

The person can only produce a downwards force of 600 N.

The person cannot lift the rock.

(i) Explain, using calculations, why the person cannot lift the rock.

(3)

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.....

(ii) Explain **one** change to the arrangement that will make it possible for this person to lift the rock.

(2)

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.....

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.....

(Total for question = 5 marks)

Q3.

Figure 11 shows a lever used to lift a heavy load.

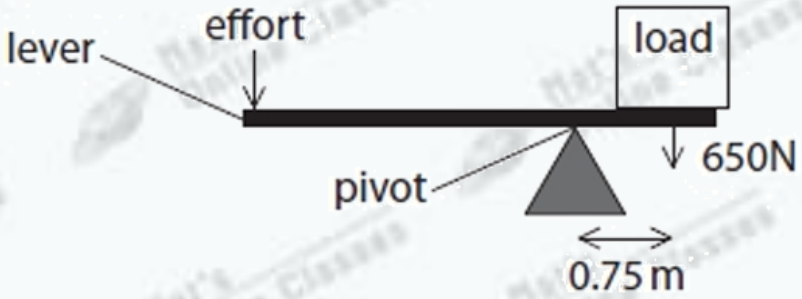

Figure 11

(i) The weight of the load is 650 N.

The centre of the load is 0.75 m from the pivot.
Calculate the moment of the load about the pivot.
State the unit.
Use the equation
moment = force × distance from the pivot

(3)

moment = ... unit .....

(ii) State the principle of moments.

(1)

.....

.....

(iii) An effort of 160 N is applied to the end of the lever to balance the load in Figure 11.

Calculate the distance between the effort and the pivot.

(3)

distance = ... m

(Total for question = 7 marks)

Q4.

Figure 2 shows an open door.

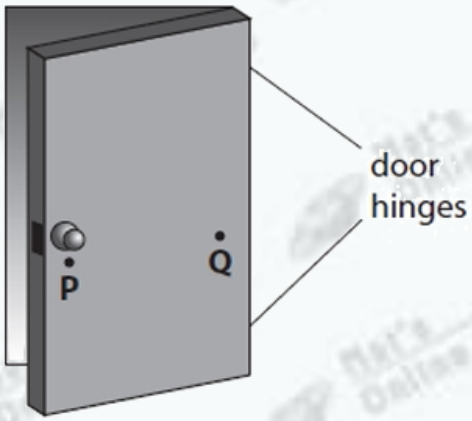

Figure 2

Explain why it is easier to close the door by pushing at point **P** rather than pushing at point **Q**.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q5.

A student investigates moments of forces.

Figure 14 shows the apparatus used.

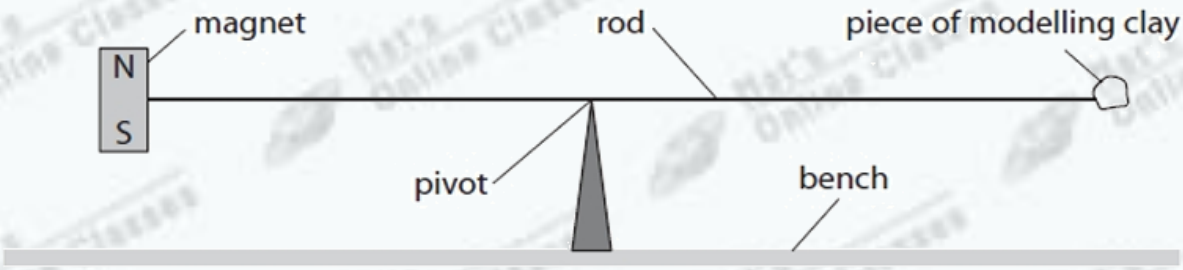

Figure 14

The pivot is under the centre of the rod.

A magnet is fixed to one end of the rod.

A piece of modelling clay is fixed to the other end of the rod.

The system is in equilibrium.

The student reverses the direction of the current in the coil.
Describe how the student can bring the system back into equilibrium without making any changes to the magnet.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Mark scheme:

Q1.

Question number	Answer	Additional guidance	Mark
	any correct moment (1) 450 x 0.50 or 225 or 0.80 x F_2 substitution into prin. of moment equation (1) 450 x 0.50 = 0.80 x F_2 evaluation (1) 280 (N) (for question at end)	 allow 450 x 0.3 moment taken about B allow statement of prin. of moments accept numbers which round to 280 such as 281.25 award full marks for correct answer without working.	**(3)**

Q2.

Question Number	Answer	Additional guidance	Mark
(i)	recall of moment = force x distance (1) (moment of force from person =) 600 x 0.5 **and** (moment of weight of rock =) 1800 x 0.2 (1) **moment** of force from person is less than **moment** of weight of rock. (1)	may be implied in a calculation 300 (Nm) 360 (Nm) independent mark accept reverse argument	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that links increase distance between person and pivot/ reduce distance between rock and pivot / increase force from person (1) increase the moment of the force from the person / decrease the moment of the weight of the rock (1)	 use longer lever / hold lever nearer the end / move pivot nearer to rock / get someone to help to push value of new distance and calculation of new moment	**(2)**

Q3.

Question Number:	Answer	Additional guidance	Mark
(i)	substitution(1) (moment) =650 x 0.75 evaluation(1) 490 unit (1) Nm	 accept any value that rounds to 490 e.g. 487.5 allow a maximum of 1 mark out of the first two marking points for a power of ten error independent mark award full marks for the correct answer without any working	(3) AO 1 1 AO 2 1

Question Number:	Answer	Additional guidance	Mark
(ii)	(sum of the) clockwise moments (about a point) = (sum of the) anticlockwise moments (about that point) (1)	idea that moments on each side of a pivot can be balanced	(1) AO 1 1

Question Number:	Answer	Additional guidance	Mark
(iii)	substitution(1) 160 x distance of effort from pivot = 490	substitution and rearrangement in either order accept 160 x distance of effort from pivot = 487.5 160 x distance from pivot =650 x 0.75	(1) AO 2 1
	rearrangement (1) distance of effort from pivot = $\frac{490}{160}$	accept $\frac{650 \times 0.75}{160}$ $\frac{487.5}{160}$	
	evaluation (1) 3.1(m)	accept any value which rounds to 3 maximum of two marks for a power of ten error award full marks for the correct answer without working	

Q4.

Question number	Answer	Additional guidance	Mark
	an explanation linking distance from hinge/pivot increased (1) (therefore) smaller force needed (to close door)	 P further from hinge than Q accept the greater distance gives greater moment for 2 marks	(2)

Q5.

Question number	Answer	Additional guidance	Mark
	move the (position of) the (0.050 N) weight (1) to the other side of the pivot/3.6 cm from the magnet (1)	adjust mass of modelling clay reduce (mass of modelling clay) by taking some away add (additional) weight between pivot and magnet scores 2 marks	**(2)** **AO3**