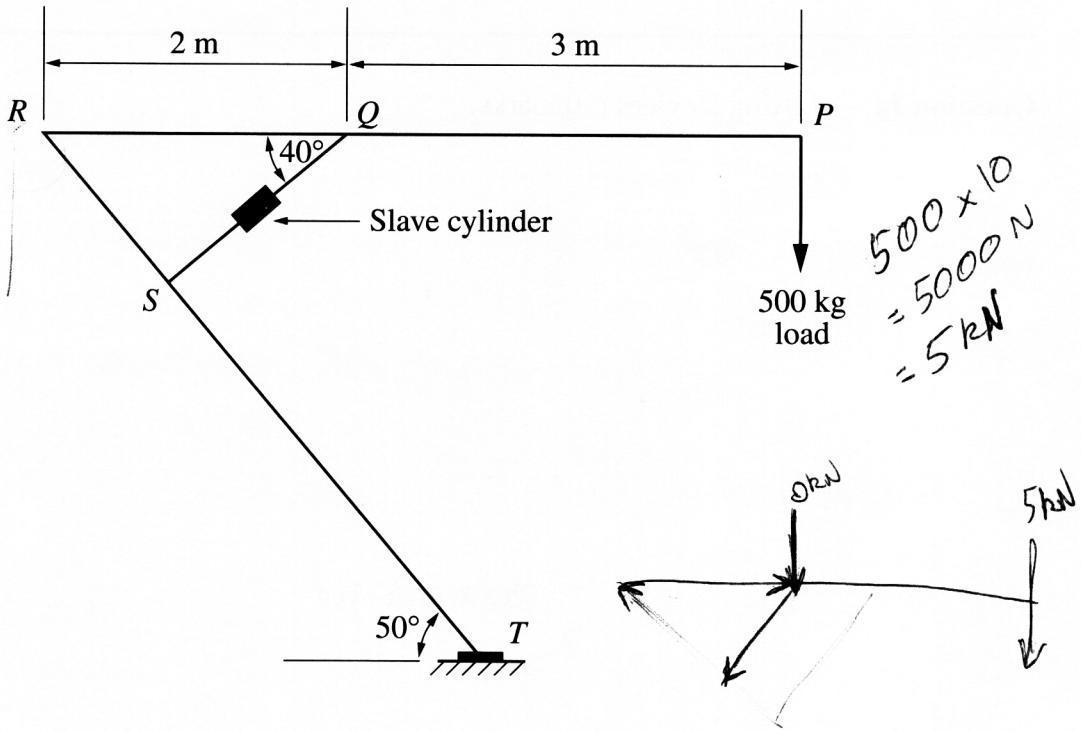
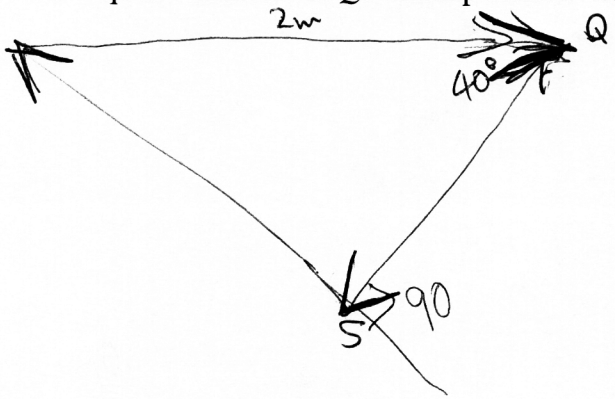
Marks

Question 14 — Lifting Devices (10 marks)

The diagram shows a lifting device. Arm *RP* is raised or lowered by a hydraulic system comprising a master cylinder and a slave cylinder.



(a) The lifting device is required to hold a load of 500 kg. Determine the minimum force required in member *QS* to keep arm *RP* horizontal. **2**



$\Sigma M_{RR} = 0$

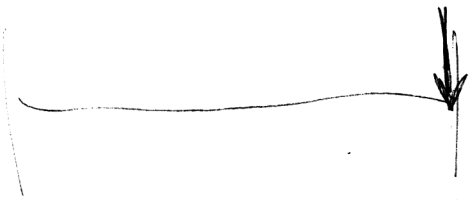
$T_+ = -(5 \times 5) - (Q \times 2)$

$Q = \frac{-25}{2}$

$Q_S = -12.5\ kN$

Minimum force = 12.5 kN

Question 14 continues on page 19

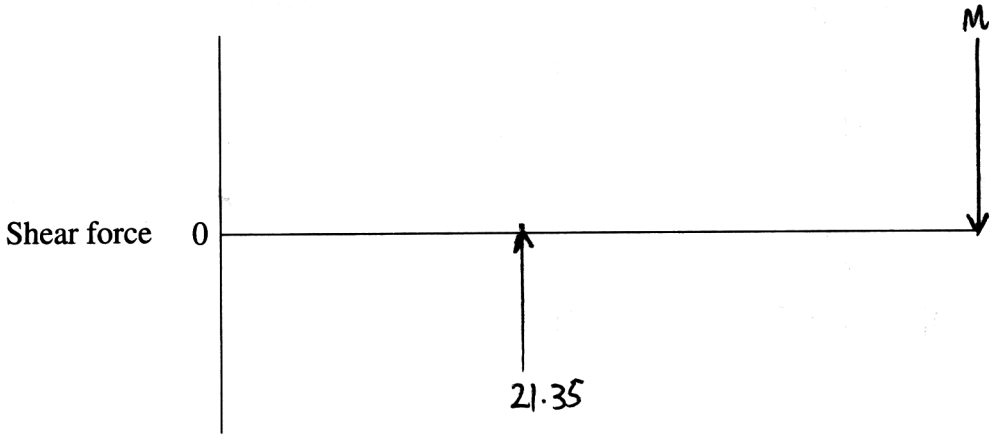


Marks

Question 14 (continued)

(b) For another set of conditions, the force in member *QS* was found to be 21.35 kN.

(i) Draw the shear-force diagram for the arm *RP*. Label the values on the diagram. The mass of the arm should not be considered. **2**



(ii) Determine the diameter of the master cylinder if the mechanical advantage of the hydraulic system is 3. The slave cylinder has a cross-sectional area of 2800 mm^2. **3**

$$MA = \frac{L}{E}$$

$$3 = \frac{2800\ mm^2}{E}$$

Diameter = ...

Question 14 continues on page 20

Marks

Question 14 (continued)

(c) Gears used in lifting devices can be manufactured by powder-forming or by a variety of other processes. **3**

Identify an alternative manufacturing process, and contrast the properties of gears formed by this process with the properties of the powder-formed gears.

Cold formed - Cold forming consists of forming the gears without heating the material and makes the gears stronger wthout being deformed by being heated.

End of Question 14