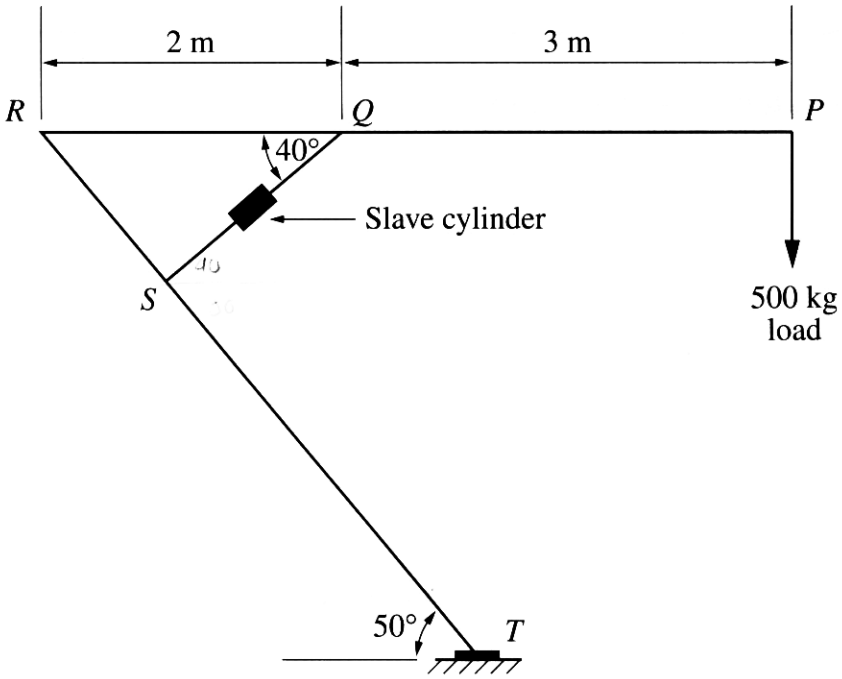
Marks

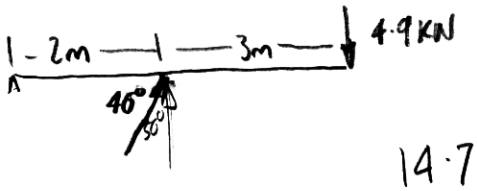
Question 14 — Lifting Devices (10 marks)

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**

W = mg
= 500 × 9.8
= 4900
= 4.9kN



$\sum M_Q = 0$
= (3 × 4.9kN)
= 14.7kN

14.7

$\cos 50 = \frac{14.7}{x}$

$x = \frac{14.7}{\cos 50}$

$x = 22.869\text{kN}$

Minimum force = 22.9kN

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 = VR if 100%

Efficiency = $\frac{MA}{VR}$

MA = $\frac{load}{Area}$

MA = 3 $\qquad \frac{F_2}{A_2} = \frac{F_1}{A_1}$

$A_2 = 2800$

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.

Gears can be not drop-forged. this will give the gears components directional strength through grain flow patterns. The drop-forging process is ~~the~~ better as the gears ~~teeth~~ teeth will ~~be~~ have increased hardness. The powder forming process allowes gears to be internally lubricating. Complex shapes can be achieved by powder processes. The drop forging process is more time consuming than powder forming and drop forging requires human ~~presen~~ to operate machinery.

End of Question 14