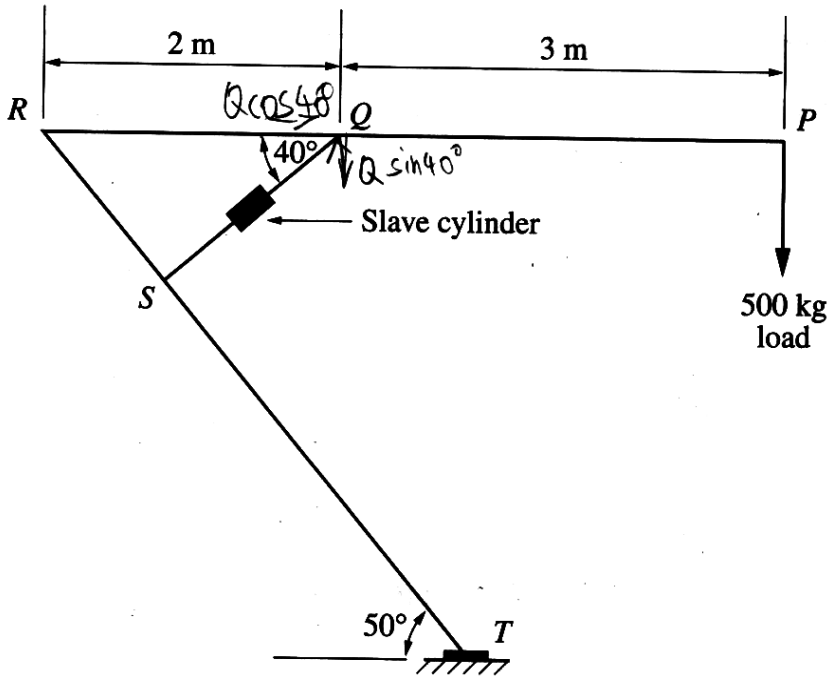
Marks

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**

Data
W = 500 x 9.8
= 400N

$\Sigma M_{RP} = 0$
$0 = Q_S \sin 40 \times 2 - 400 \times 5$
$2000 = Q_S \sin 40$
$Q_S = 3111.4477$

Minimum force = 3111.4 N

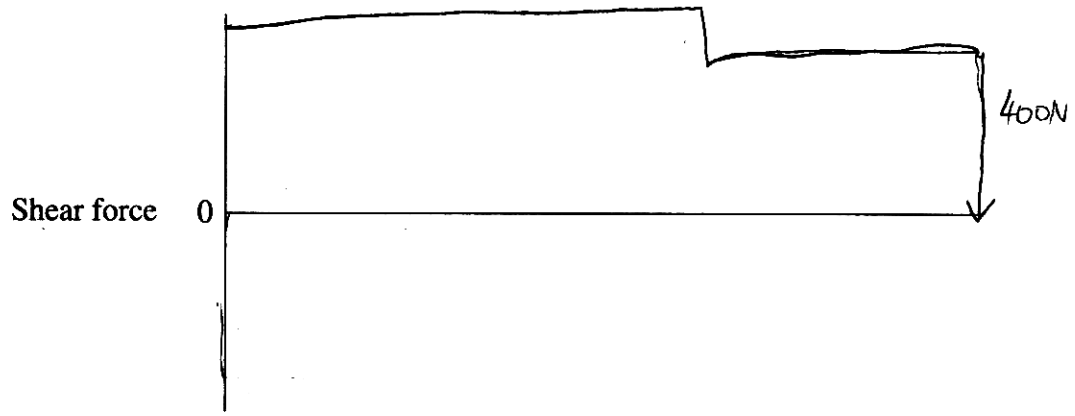
Question 14 continues on page 19

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=3

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

$VR = \frac{d_E}{d_L}$

$\frac{\pi \times d}{4} = 2800$

$d = 3565$

$= 3.565 \times 10^3$

Diameter = 3565m = 3.565×10^3

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.

Goring

End of Question 14