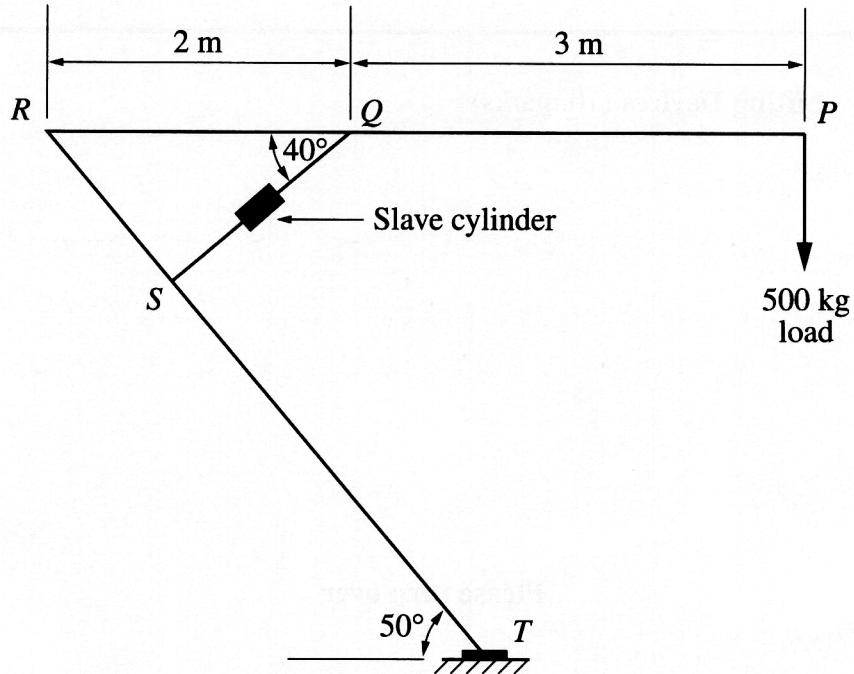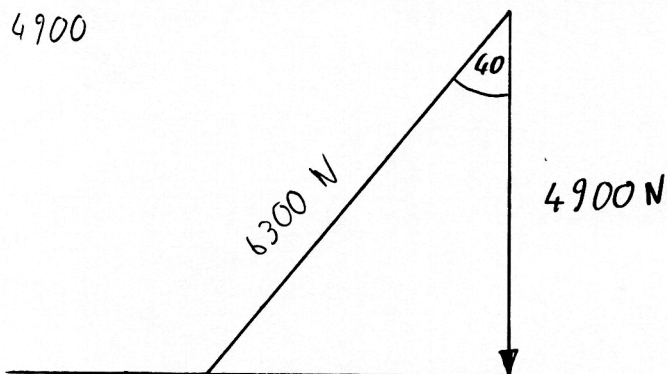**Question 14 — Lifting Devices** (10 marks)

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.
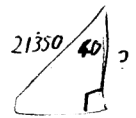
2

4900

6300 N   4900 N   40
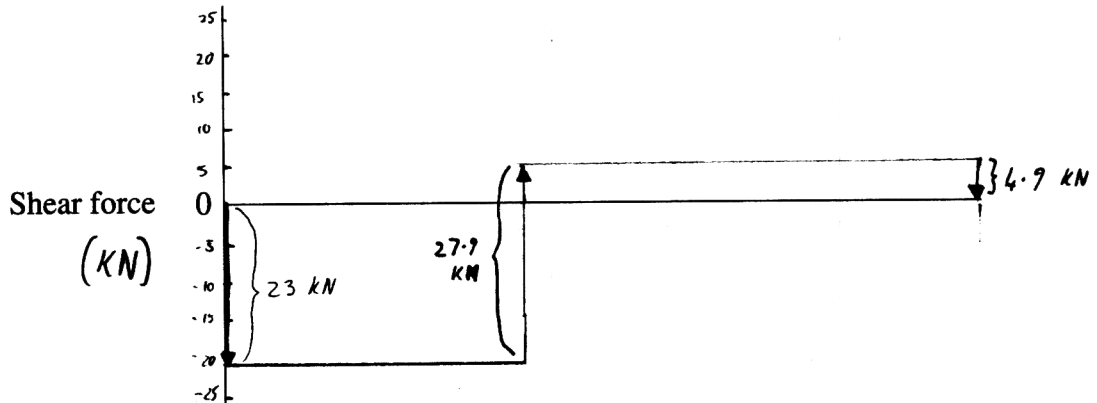
Minimum force = ... 6300 ....

Question 14 continues on page 19

Question 14 (continued)

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

$21350 \diagup 40$

(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

$Cos 40 = \dfrac{21350}{?}$

$? = \dfrac{21350}{Cos 40}$

$= 27.87\,kN$

Shear force (kN)

(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 mm².

3

$MA = \dfrac{L}{E} = \dfrac{3}{1} = 3$

$\dfrac{F}{A} = P$

Diameter = ...

Question 14 continues on page 20

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Question 14 (continued)

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

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

Casting can also be used to form
gears but when casting you can not
at lubricants to the powder, like you
can in powder forming, to make
the gear self lubricating.

End of Question 14