**(b)** A bucket is partially filled with water. The total mass of the bucket and water is M kg. The bucket is attached to one end of a light inextensible string which passes over a smooth light fixed pulley. A block of mass m kg is attached to the other end of the string and is fully immersed in the water in the bucket. The system is in equilibrium and the block does not touch the bucket.

M kg m kg
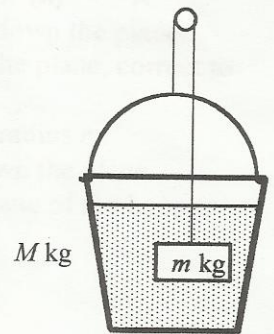
Prove that the relative density of the block is greater than 2.

Block: $T + B = mg$

The block exerts an equal and opposite force on the water

Bucket $T = B + W$

$(mg - B) = B + W$

$mg = 2B + W$

$mg = 2\dfrac{mg(1)}{s} + W$

$mgs = 2mg + sW$

$s = 2 + \dfrac{sW}{mg}$ or $s = \dfrac{2mg}{mg - W}$

$\Rightarrow \quad s > 2$

$2B = mg - W$

$2(1000Vg) = 1000sVg - W$

$s = 2 + \dfrac{W}{1000Vg}$

$\Rightarrow \quad s > 2$

OR

Block $T = B + mg$

System $2T = mg + W$

$2(mg - B) = mg + W$

$2mg - 2\dfrac{mg(1)}{s} = mg + W$

$s = \dfrac{2mg}{mg - W}$

$\Rightarrow \quad s > 2$

5
5
5
5
5

25

5
10
5
5

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