QUESTION 1: HYDRAULICS

1.1 1.1.1 $Pr = \rho \times g \times h$

$Pr = 1\,000 \times 9{,}8 \times 30$✓

$P = 196$ kPa✓

1.1.2 $Wd = P \times V$

$= (196 \times 10^3) \times 80$✓

$Wd = 15{,}680$ MJ✓

1.1.3 $\text{Power} = \frac{\text{Work done}}{t}$

$= \frac{15{,}680 \text{ MJ}}{3\,600\text{s}}$

$= 4{,}355$ kW✓

$\eta = \frac{\text{Power(out)}}{\text{Power(in)}} \times 100\%$

$= \frac{(4{,}355)}{5} \times 100\%$

$\eta = 87{,}111\%$✓

(3×2) (6)

1.2 1.2.1 $F = \frac{D^2}{d^2} \times f$

$= \frac{(0{,}2)^2}{(0{,}05)^2} \times 310$ kN✓

$F = 4960$ kN✓

1.2.2 $D^2h = d^2H$

$(0{,}2)^2 \times h = (0{,}05)^2 \times 0{,}7$✓

$h = 0{,}04375$ m or 43,75 mm✓

1.2.3 Height = n × h

$46 = n(43{,}75 \times 10^{-3})$

n = 1 051

OR $n = \frac{D^2 \times H}{d^2 \times s}$

$= \frac{(0{,}2)^2 \times 46}{(0{,}05)^2 \times 0{,}7}$ ✓

= 1 051 ✓

(3 × 2) (6)

[12]

QUESTION 2: HYDRAULICS

2.1
- Experiment to show that pressure in a liquid is directly proportional to depth
- Experiment to show upward and downward pressure at a point in liquid
- Experiment on the relationship between directional pressure in a liquid
- Experiment to show that pressure in a liquid is independent of the shape and size of the container

(Any 2 × 1) (2)

2.2 2.2.1 $\text{Area} = \frac{\pi d^2}{4}$

$\text{Area} = \frac{\pi \times (0{,}182)^2}{4}$

Area = 0,026 m^2 ✓

$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$

$\text{Pressure} = \frac{6\,800}{0{,}026}$

Pressure = 26 1538,462 Pa or 261,538 kPa ✓ (2)

2.2.2 Volume = area x stroke length x strokes

Volume = 0,026 x 0,192 x 10 ✓

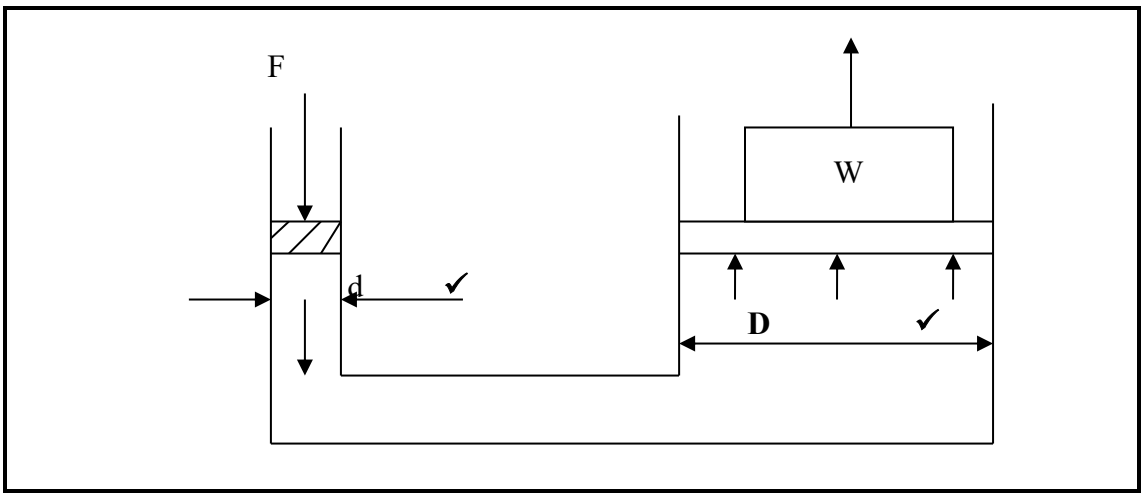
Volume = 0,04992 m^3 ✓ (2)

2.2.3 Work done = force x distance x number of strokes

Wd = 6 800 x 0,192 x 10 ✓

Wd = 13 056 J or 13,06 kJ ✓ (2)

2.3



The smaller piston (plunger) is used to apply force to the liquid and the larger piston (ram) is pushed upwards by the pressure of the liquid. ✓ (3)

[11]

QUESTION 3: HYDRAULICS

3.1 3.1.1 Pressure at a point in a liquid is the force exerted by the liquid due to its weight per unit area, acting downwards.✓

3.1.2 Total pressure on an area means the force or weight acting over the whole area.✓

(2 × 1) (2)

3.2 3.2.1

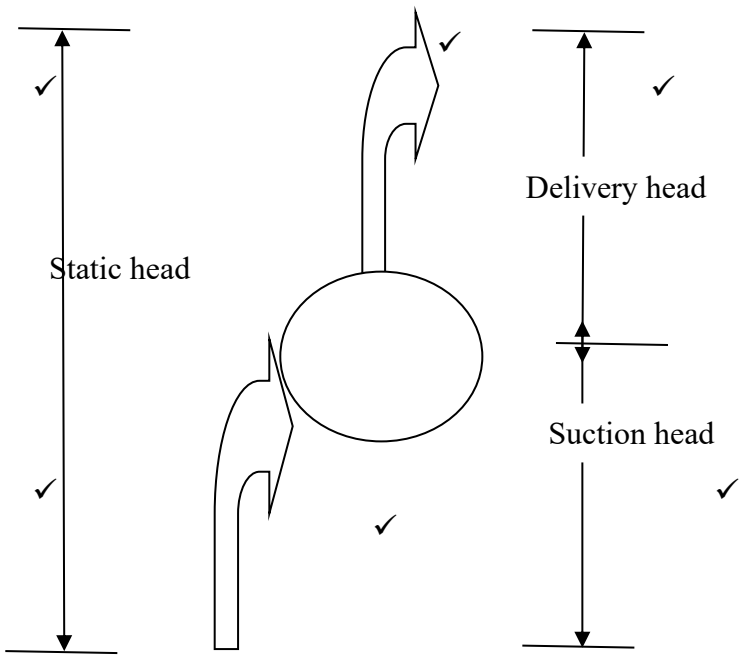
$$P = 550\ 000$$
$$d = 150\,mm = 0{,}15\,m$$
$$L_S = 250\ mm = 0{,}25\ m$$
$$V = A \times L_s$$
$$= \frac{\pi(0{,}15)^2}{4} \times 0{,}25 \quad \checkmark \checkmark$$
$$= 4{,}418 \times 10 \ \ldots$$
$$OR\ 0{,}004418\ m^3$$

3.2.2

$$W = PV$$
$$= 550 \times 10^3 \times 4{,}418 \times 10^{-3} \quad \checkmark$$
$$= 2429{,}826\ J \quad \checkmark$$
$$= 2{,}429\ kJ$$

(2 × 2) (4)

3.3



(6)
[12]

QUESTION 4: HYDRAULICS

4.1 Absolute pressure is zero-referenced against a perfect vacuum, so it is equal to gauge pressure plus atmospheric pressure.✓

Gauge pressure is zero-referenced against ambient air pressure, ✓so it is equal to absolute pressure minus atmospheric pressure.✓ (3)

4.2 4.2.1 $W = mg = 2\,300 \times 9{,}8$

$$F_p = \frac{Wd^2}{\eta \times D^2}$$

$$= \frac{22\,540(0{,}020)^2}{0{,}85(0{,}1)^2} \quad ✓ \quad ✓$$

$$= 1\,060{,}706\ N \quad ✓$$

(3)

4.2.2 No of strokes = $\frac{D^2 \times \text{height lifted}}{D^2 \times \text{strokes}}$

$$= \frac{100^2 \times 126 \ \checkmark}{20^2 \times 5 \ \checkmark}$$

$= 63$ strokes ✓ (3)

4.3 $\Theta = 50$ mm

$H = 30$ Work done = volume x p x g x height

Work done = πd^2 x h x p x g x h ✓

$= \pi$ x $(0,05)^2$ x 30 x 1000 x 9,8 x 30 ✓

$= 17318$ J ✓

$= 17,318$ kJ (3)

[12]