

Name of the Student: _____

Max. Marks : 20 Marks

Time : 20 Minutes

Mark Schemes

Q1.

- (a) (i) Indicated work per cylinder = area of loop ✓ [either stated explicitly or shown on the Figure e.g. by shading or ticking squares or subsequent correct working.]

appropriate method for finding area e.g. counting squares ✓

correct scaling factor used [to give answer of $470 \text{ J} \pm 50 \text{ J}$] ✓

indicated power = $4 \times 0.5 \times (4100/60) \times 470$

= 64 kW ✓

4

- (ii) (Fuel flow rate = $0.376/100 = 0.00376 \text{ litre s}^{-1}$)

Input power (= c.v. $\times$ fuel flow rate)

= $38.6 \times 10^6 \times 0.00376$ ✓

(= 145 kW)

$\eta_{\text{overall}} = \text{brake power}/\text{input power}$ ✓ seen or implied from correct subsequent working

= $55.0/145 = 0.38$ or 38% ✓

3

- (b) Power expended in overcoming friction

in (all) the bearings / between piston & cylinder ✓

and / or in circulating oil / cooling water ✓

and / or driving auxiliaries (e.g. fuel injection pump) ✓

1

- (c) Represents the induction and exhaust (strokes) (which take place at nearly atmospheric pressure). ✓

1

[9]

Q2.

- (a) (i) use of $PV/T = \text{constant}$

$$\frac{P_D V_D T_A}{n R}$$

$$= \frac{2.5 \times 1.0 \times 300}{1.5 \times 1.0} \checkmark = 500 \text{ K}$$

2

(ii) $Q = \Delta U + W$

$$\Delta U = 0 \checkmark$$

$$Q = W = 173 \text{ J} \checkmark$$

2

(b) (i) work out = $173 - 104 = 69 \text{ J}$ $\checkmark$

1

(ii) efficiency = $69/173 = 0.40$ or 40% $\checkmark$

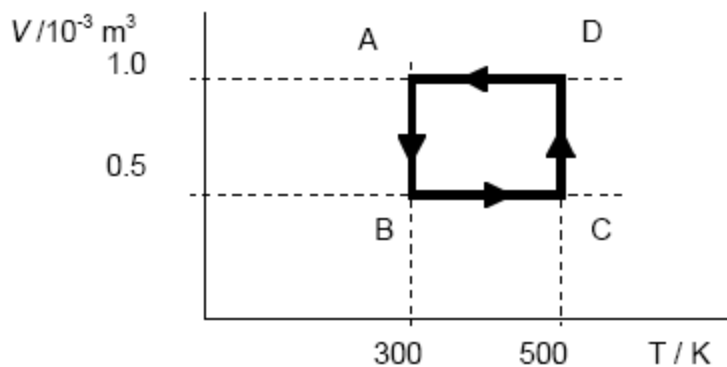
$$\eta_{\max} = (T_H - T_C)/T_H$$

$$= (500 - 300)/500$$

$$= 0.39 \text{ or } 40\% \checkmark$$

2

(c)



rectangle in correct position $\checkmark$

letters correct place $\checkmark$ (arrows optional)

2

- (d)
- isothermal process impossible unless very slow or via perfect conductor
 - engine would have to stop for constant volume processes to take place
 - regenerator would lose heat to surroundings (unless perfectly insulated)
 - long time needed for heat to transfer from regenerator to working fluid
 - regenerator would need to be very large/large surface area for heat transfer to take place quickly
accept other sensible suggestions

do not accept 'heat loss to surroundings' or 'friction'

any two ✓✓

2

[11]