

Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Mark Schemes

Q1.

(a) (i) $\alpha = \tau / I = 8.80 / 0.565 (= 15.6 \text{ rad s}^{-2})$ ✓

use of $t = (\omega_2 - \omega_1) / \alpha$

leading to $t = 8.08 \text{ s}$ ✓

2

(ii) $\theta = \frac{1}{2} (172 + 195) \times 126$ ✓

$= 23100 \text{ rad}$

$23100 / 2\pi = 3680 \text{ rev}$ ✓

OR

rev per s = $1200 / 60 (=20)$ ✓

$\theta = \frac{1}{2} (172 + 195) \times 20$ ✓

$= 3670 \text{ rev}$ ✓

*Accept alternative ways of calculating area under graph**Areas are: 504 rad or 80 rev**21670 rad or 3450 rev**945 rad or 150 rev**Numbers will vary if 8.1 s used for acceleration period**Last mark: give CE for wrong θ*

3

(b) (i) Shows curve of increasing gradient up to first vertical dotted line ✓

OR Shows curve of decreasing gradient up to first vertical dotted line ✓

*MARK ii BEFORE i**Answer must match the answer given in part ii**i.e. α increasing: decreasing gradient* *α decreasing: increasing gradient**Mark awarded for shape only; ignore any changes to the height of the graph or where curve reaches 126 rad s^{-1}*

1

(ii) Mass of washing will decrease as it loses water, so M of I will decrease ✓

(T constant) so α increases ✓

OR washing moves closer to drum, increasing M of I ✓

(T constant) so α decreases ✓

OR friction (torque) increases with speed ✓

so α decreases ✓

Do not credit answers in terms of conservation of angular momentum

2

[8]

Q2.

- (a) Diesel: air only is drawn into cylinder
Petrol: air and fuel is drawn into cylinder both points ✓
Diesel: ignition is by temperature rise during compression / compression ignition
Petrol: ignition by means of spark (plug) both points ✓
Accept: heating at constant volume in (ideal) petrol engine and constant pressure in (ideal) diesel engine ✓
Do not allow: petrol engine has spark plug, diesel doesn't WTTE
- (b) (i) X marked on curved compression line between $p = 0.7 \times 10^6$ Pa and 1.7×10^6 Pa ✓
- (ii) Indicated work = area of loop ✓
Appropriate method for finding area e.g. counting squares ✓
Correct scaling factor or used to give work per cycle of between 250 and 325 (J) ✓
(Calculates no cycles per s ($\frac{1}{2} \times 2000/60$) = 16.7)
 $P = 4 \times 16.7 \times 287 = 19.2$ kW ✓
Either stated explicitly or shown on Figure e.g. by shading or ticking squares or subsequent correct working. 287 small squares is a good estimate. Scaling factor is 1 J per small square Allow 10 to 13 1 cm squares Scaling factor is 25 J per 1 cm square CE for 4th mark using incorrect work per cycle
- (iii) Input power = CV $\times$ fuel flow rate
 $= 44 \times 10^6 \times (1.1 \times 10^{-3}) (= 48.4$ kW) ✓
 $\eta_{\text{thermal}} = 19.2/48.4 = 0.40$ ✓
CE from 4 b ii unless $\eta_{\text{thermal}} > 1$
- (c) Tick against second answer line ✓

2

1

4

2

1

[10]