Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Mark Schemes

Q1.

(a) T = 6.0 × 0.036 = 0.22 (N m) ✔

1

(b) power cannot increase ✔

$P = T\omega$ so if ω is 4x greater, T cannot be more than 1/4✔

OR

Work done by (torque) on C cannot be greater than work done (by torque) on B ✔

$W = T\theta$, if θ is 4x greater, T cannot be more than 1/4✔

Or T_C × 4θ_B = $T_B\theta_B$ so T_C = T_B/4

OR

Force same on both/force cannot increase/ r_C is ¼ r_B ✔

F × r_C = F × r_B/4 so TC = T_B/4

Or Because radius is ¼, torque on C must be ¼ ✔

Accept other valid argument e.g. using knowledge that radius of C is 1/4 radius of B, or velocity v at point of mesh of gears is the same for both.

Do not allow 'it is not possible' (WTTE) unless backed up by valid argument.

2

(c) α = 76/2.1 = 36 (rad s^{-1}) (36.2 rad s^{-1}) ✔

$I = T/\alpha = \frac{0.054}{36}$ = 1.5 × 10^{-3} (kg m^2) ✔

ECF for 2nd mark for AE or transposing error.

2

(d) angular impulse = ang. momentum change = $T\Delta t$ ✔

1st mark for statement defining angular impulse

Reference to (large) $\Delta(I\omega)$ in small Δt gives large T ✔

2nd for relating momentum change in small t to high T

($T = F \times r$) so large F on gear teeth. ✔

3rd for relating high T to high force

3

[8]

Q2.

(a) $p_1V_1^{1.4} = p_2V_2^{1.4}$

$p_2 = p_1 (V_1/V_2)^{1.4}$

$= 1.2 \times 10^6 (9.0/6.8)^{1.4}$ ✔ $= 1.8 \times 10^6$ (Pa) ✔

$$T_2 \frac{p_2V_2T_1}{p_1V_1} = \frac{1.8\times10^6\times(6.8\times10^{-5})\times290}{1.2\times10^6\times(9.0\times10^{-5})}$$ ✔

$T_2 = 328$ (K) ✔

OR use of $p_1V_1 = nRT_1$ to find n or nR ✔
and substitute in
$p_2V_2 = nRT_2$ to find T_2 ✔

1st mark for substituting correct values into either equation
2nd mark for answer p_2
3rd mark for substituting correct values into
$p_1V_1/T_1 = p_2V_2/T_2$ or $T_2 = \frac{p_2V_2T_1}{P_1V_1}$
4th mark for answer T_2
ECF for p_2
With rounding answers range from 320 to 330 K

4

(b) in adiabatic compression there is no heat transfer/$Q = 0$ ✔

If compression is quick there is no time for heat transfer ✔

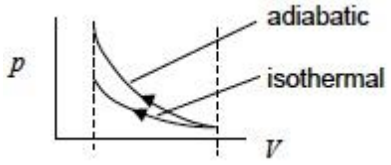
(so can be considered adiabatic)

2

(c) For isothermal compression (for same volume change) (final) pressure not as high **OR** adiabatic compression curve is steeper (on p - V diagram) than isothermal ✔ Area under a p - V curve between same volumes would be less OR addition of all $p\Delta V$ during compression will be less ✔

So less work done ✔

Give credit for these ideas shown with help of a diagram or diagrams.



Award last mark only if either or both of first two marks have been given.

3

[9]