Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Mark Schemes

Q1.

(a) (i) $p_2 = p_1 (V_2/V_1)^{1.4} = 1.0 \times 10^5 (2.1/1.2)^{1.4}$ ✓

OR $1.0 \times 10^5 \times (2.1 \times 10^{-5})^{1.4} = p_2 \times ((1.2 \times 10^{-5})1.4$ ✓

$p_2 = 2.2 \times 10^5$ Pa ✓

2

(ii) $$T_2 = \frac{p_2 V_2 T_1}{p_1 V_1} = \frac{2.2 \times 10^5 \times (1.2 \times 10^{-5}) \times 290}{1.0 \times 10^5 \times 2.1 \times 10^{-5}}$$ ✓

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 ✓

$T_2 = 360$ K ✓ 2 sig fig ✓

3

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

$Q = 0$ (and W negative) ✓

So ΔU (= - W) = 1.4 J ✓

2

(c) (slow) compression is (nearly) isothermal / at constant temperature ✓

greater change in volume needed to rise to same final pressure ✓

(OR correct p-V sketches showing adiabatic and isothermal processes ✓)

hence less / piston pushed in further ✓

3

[10]

Q2.

(a) (i) $T = Fr = 32 \times 0.15$

$= 4.8$ N m ✓

1

(ii) $\omega = 2600 \times 2\pi/60$ (= 270 rad s^{-1}) ✓ accept 272 rad s^{-1}

total torque = 4.8 + 1.2 = 6.0 N m ✓

$P = T\omega$

$= 6.0 \times 270 = 1620$ W ✓

3

(b) $\alpha = \dfrac{270 - 0}{8.5} = 32$ rad s^{-2} ✓

$I = T/\alpha = \dfrac{1.2}{32} = 0.038$ ✓ kg m^2 ✓

OR use of $\Theta = \frac{1}{2}(\omega_2 + \omega_1)t$ (= 1150 rad) ✓

and $\frac{1}{2}I\omega^2 = T\Theta$ leading to I = 0.038 ✓ kg m^2 ✓

3

(c) $E = \frac{1}{2}I\omega^2$

$= 0.5 \times 0.038 \times 270^2 = 1400$ J ✓

$P = E/t = 1400/ 0.005 = 280$ kW ✓

2

[9]