Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

(a) Energy is supplied to the air by heating only in process 2 → 3 ✔

Automarked

1

(b) Claim A: Each square represents 10 J ✔
Area of loop 4 → 5 → 1 → 4 = 9 squares
Giving increase in work done = 90 J ✔

Claim B: area enclosed by loop 1 → 2 → 3 → 4 → 1 = 55 sq /550 J ✔
(Each square represents 10 J)
Increase in efficiency = 9 sq/55 sq or 90 J/550 J = 16% ✔
So claim A not met, claim B efficiency better than claimed ✔

OR Claim B:
Area enclosed by loop 1 → 2 → 3 → 4 → 1 = 55 sq /550 J ✔
Divides 550 J and 640 J by any same value for (heat) input energy
And calculates increase in efficiency ✔
Draws correct conclusion for A and B for answers ✔

W done per square = $0.1 \times 10^{-3} \times 1.00 \times 10^{5} = 10$ J
Allow 8 to 11 squares giving 80J to 110 J
Accept answers where area 4 → 5 → 1 → 4 is approximated to a triangle giving 112(.5) J
Allow 50 to 60 squares giving 500 to 600 J
ECF from above areas if out of tolerance
Allow last mark only if statements re claims agree with answers
Example *550/1000 = 0.55 or 55%; 640/1000 =.64 or 64%*
Increase in efficiency = 9%
Values for input energy must > 640 J

5

(c) Q: energy supplied/transferred/input (to system/gas by heating/heat transfer) ✔

OR energy transferred/lost/output (from system/gas by cooling heat transfer) if Q negative

ΔU: increase/change in internal energy ✔

OR decrease if negative

Do not allow 'heat' in place of 'energy'
'Heat transferred' on its own is not enough
Accept heat energy supplied but not heat supplied

2

(d) $W = p\Delta V = 1.0 \times 10^5 \times (3.00 - 1.50) \times 10^{-3}$ J (= 150 J) ✔

(Use of $Q = \Delta U + W$)

gives $Q = -150 + (-374) = (-)\ 524$ J ✔

Check that sign convention is consistent for 2nd mark
Allow if − sign not seen on answer line

2

(e) Attempt to use $pV = nRT$ ✔

Recognises max temperature is at point **3** in the cycle ✔

Substitution of *p*, *V* and *n* in $T = \frac{pV}{nR}$ for point 3

Giving *T* = 1310 K ✔

2nd mark can be implied from values of p and V used in the equation
*p from **14 .2** × **10**^{5} to **14.8** × **10**^{5} Pa*
*V from **0.42** × **10**$^{-3}$ to **0.48** × **10**$^{-3}$ m^3*

3

[13]

Q2.

(a)

Translational dynamics	Rotational dynamics
force	torque ✔
mass	moment of inertia ✔

Do not allow 'inertia'

2

(b) $I_T = 2.6 \times 10^7 + (2.2 \times 10^3 \times 35^2) = 2.9 \times 10^7$ (kg m^2) ✔

Mark only awarded for arriving at correct answer to more than 1 sf.

1

(c) Use of (total) area under graph = (angular) displacement/distance ✔

$\omega_{max}((½ \times 30) + 20 + (½ \times 45)) = 4.7$

$\omega_{max} = 0.082$ (rad s-1) ✔

Alternative route is area of trapezium
½ ω_{max} (20 + 95) = 4.7

2

(d) moment of inertia of rotating jib + load increases as trolley moves outwards ✔

reference to $T = I\alpha$ with T constant, so α decreases ✔

decreased α means longer time to stop(than 95 s) ✔

3

[8]