Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

(a) Law of conservation of angular momentum applies and $I_1 \omega_1 = I_2\omega_2$
OR Law of conservation of angular momentum applies and angular momentum = $I\omega$ ✓
(because no external torque acts)

Adding plasticine increases I ✓

So ω must decrease to maintain $I\omega$ constant / to conserve angular momentum ✓

3

(b) $I \times 3.46 = (I + 0.016 \times 0.125^2) \times 3.31$ ✓
$I = 0.00552$ kg m^2 ✓ 3 sf ✓

Useful: $mr^2 = 2.5 \times 10^{-4}$
Sig fig mark s an independent mark
If method correct but incorrect conversion of g to kg or mm to m, award 1 mark out of first 2 marks

3

(c) (i) $\Delta E = \frac{1}{2} I \omega_1^2 - \frac{1}{2}(I + mr^2)\omega_2^2$
$= [\frac{1}{2} \times 5.52 \times 10^{-3} \times 3.46^2] - [\frac{1}{2} \times 5.77 \times 10^{-3} \times 3.31^2]$ ✓
$= 1.39 \times 10^{-3}$ J ✓

CE for I of turntable or I of plasticine from 2b
Answers will vary depending on rounding e.g. accept 1.43×10^{-3}

2

(ii) Work done against friction / deforming plasticine as it collides with turntable / to move or acclerate plasticine ✓

Allow heat loss on collision
Do not allow energy to sound

1

[9]

Q2.

(a) **E** to **X** circled

1

(b) (i) $p_1V_1 / T_1 = p_2V_2 / T_2$
$T_2 = p_2V_2T_1 / p_1V_1$ ✓

$$= \frac{4.6\times10^5 \times 1.5\times10^{-4} \times 310}{1.0\times10^5 \times 5.0\times10^{-4}}$$

=430 K ✓

Also: work out n or nR in $p_1V_1 = nRT_1$

Substitute in $p_2V_2 = nRT_2$

Accept use of 4.5×10^5 Pa for p_2

Giving $T_2 = 420$ K

nR = 0.161

$n = 1.94 \times 10^{-2}$

2

(ii) Work per cycle = area enclosed by loop ✓

Suitable method for calculating area used correctly e.g. counting squares ✓

E.g. 355 small sq $\times$ 0.2 $\times$ 10^5 $\times$ 0.1 $\times$ 10^{-4}

OR

14 $\times$ 1 cm squares $\times$ 1.0 $\times$ 10^5 $\times$ 0.5 $\times$ 10^{-4}

Correct scaling factor used leading to 70J ± 5 J ✓

If no. of squares incorrectly counted but correct scaling factor used for their squares give CE for final answer

3

(iii) P = 70 × 420 / 60 = 500 W ✓

CE from ii

1

(iv) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.

0 marks
The information conveyed by the answer is sketchy, and neither relevant nor coherent.
The candidate shows inadequate understanding of the operation of the compressor and how its performance will change.

Level 1 (1−2 marks)
The information conveyed by the answer is poorly organised and may not be relevant or coherent. There is little correct use of specialist vocabulary.
*The candidate has some appreciation of how the performance will change, but is only likely to cover **up to three** of the points listed below, and probably without reasons.*

Level 2 (3−4 marks)
The information conveyed in the answer may be less well organized and not fully coherent. There is less use of specialist vocabulary or specialist vocabulary may be used or spelled incorrectly. The form and style of writing is less appropriate.
The candidate is able to make some correct predictions concerning how the diagram, work done, power and temperature (but not all) will change, but reasoning will be less confident.
Answers will include 4 to 6 of the points listed below.

Level 3 (5−6 marks)
The information conveyed by the answer is clearly organized, logical and coherent, using appropriate specialist vocabulary correctly. The form and style of writing is appropriate to answer the question.
A good attempt is made at how the compressor will operate at higher pressures. Statements are made relating to the diagram, work or power, temperature and

flywheel, backed up by some sound reasoning.
Answers at this level will include more than 6 of the points listed below.

examples of the points made in the response

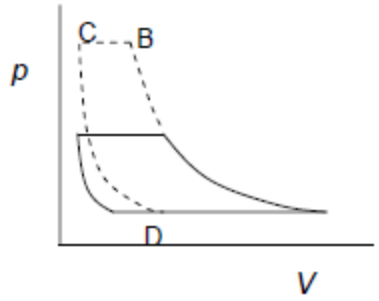
1. area of loop increases as *p* increases
2. BC at higher pressure / point B moves up and to left
3. *p* higher in $W = p\Delta V$ for BC / higher *p* more work to force air into tank
4. (so) work done per cycle increases
5. input power increases (if speed constant)
6. temperature will increase
7. reason: because B gets further from graph origin / $p_2V_2$gets larger / int energy increases because little time for heat transfer
8. higher *p* means more applied crankshaft torque (between dead centres)
9. so jerkier motion
10. flywheel needed to smooth motion of crankshaft
11. flywheel acts as energy store
12. speeding up / gaining energy - then slowing down / losing energy when torque needed is high / takes piston over dead centres
13. application of $T = I\alpha$: fluctuations in ω small if I large
14. expansion of air in clearance volume will have negative effect on area
15. vol of air drawn in per cycle will decrease
16. increase in work per cycle gets progressively smaller as *p* increases

check to see if Fig 3 drawn on

Bullet points 1, 14 and 15 can be supported by diagram

Expect to see: BC to be at higher pressure and loop to get narrower

Candidates are unlikely to show the effect of clearance volume (CD)



Point 6: accept correct use of pV/T constant

14,15,16 unlikely but give credit in lieu of other points

6

[13]