Practice Question Set For A-Level
Subject : Physics
Paper-3 Topic: Section B (Section 11_ Engineering Physics)

Merit Minds
www.merit-minds.com
Exam Preparation and Free Resources

Name of the Student:____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

(a)

	Place a tick or ticks in this column
The moment of inertia will decrease	
The angular velocity will decrease	✔
The angular momentum will be unaltered	✔

1

(b) Flywheel acts as store of energy ✔

Able to deliver large amount of E_K in short time ✔

Without flywheel motor would stall during stamping (as load torque excessively high) ✔

max 2

(c) Converts rev min^{-1} to rad s^{-1}: 67.0 and 37.7 rad s^{-1}✔

$$E_K = \frac{1}{2} \times 25 \times (67.0^2 - 37.7^2) = 3.83 \times 10^4 \text{ J}$$ ✔

2

(d) $\alpha = (\omega_2 - \omega_1)/t$

$= (67.0 - 37.7)/5.0 = 5.86$ rad s^{-2} ✔

$T = I\,\alpha$

$= 25 \times 5.86 = 147$ ✔

If (67 - 0)/5.0 used, leading to T = 335 give 1 mark

Allow approach using angular displacement θ and $\frac{\text{change in energy}}{\theta}$

2

(e) $P = \Delta E_K / t = 7.7$ kW ✔

OR $P = T \times \omega_{AVE} = 147 \times 52.4 = 7.7$ kW ✔

Allow CE from 01.4

(f) For smaller speed variation, greater I required ✔

I proportional to $\rho t r^4$ $\quad (I = \frac{1}{2}\pi r^2 t \rho r^2)$ ✔

Shows that greatest $\rho t r^4$ is for flywheel B ✔ (hence B)

OR discusses qualitatively:

A has smaller *r* but compensated for by greater *t* and ρ (hence greater *m*) ✔

B has smaller mass because of low ρ and *t* but <u>much greater</u> *r*
r is squared twice ✔

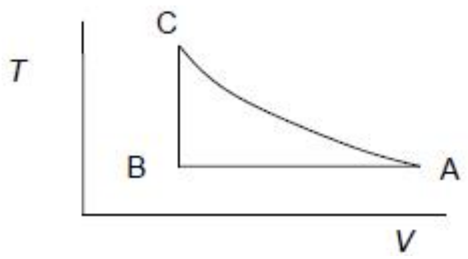
m_A = 498 kg, m_B = 228 kg
i.e. m_A roughly 2 × m_b
but r_B^2 is roughly 3 × r_A^2
hence $I_B > I_A$

3

[12]

Q2.

(a)



Shape ✔

Labels ✔

CA must be a curve.

2

(b) Work done (per cycle) = area of indicator diagram ✔

Appropriate method for finding area e.g. counting squares ✔

Correct scaling factor leading to area = 70 J ± 10 J ✔

1 small sq = 0.4 J.
1 large sq = 10 J.
Other methods accepted e.g. strips.

3

(c) 'Answer to part **(b)**' × 80 correctly evaluated ✔

1

(d) **The mark scheme gives some guidance as to what statements are expected to be seen in a 1 or 2 mark (L1), 3 or 4 mark (L2) and 5 or 6 mark (L3) answer. Guidance provided in section 3.10 of the *Mark Scheme Instructions* document should be used to assist**

marking this question.

L3 5-6 marks	Both parts of the question are addressed in detail with some quantification of the efficiency, either ideal, actual or both. The answer includes at least 8 answer points from the list below.	The student presents relevant information coherently, employing structure, style and sp&g to render meaning clear. The text is legible.
L2 3-4 marks	The answer includes some discussion related to each part. The answer includes 5 - 7 of the answer points below.	The student presents relevant information and in a way which assists the communication of meaning. The text is legible. Sp&g are sufficiently accurate not to obscure meaning.
L1 1-2 marks	The answer addresses one part in some detail but efficiency may not be quantified. There may be consideration of up to 4 of the answer points below.	The student presents some relevant information in a simple form. The text is usually legible. Sp&g allow meaning to be derived although errors are sometimes obstructive.
0 marks	Little or no discussion of relevant content.	The student’s presentation, spelling, punctuation and grammar seriously obstruct understanding.

- *CA would have to be very fast to ensure no heat transfer.*
- *AB would have to be very slow to ensure constant temperature.*
- *very difficult to arrange a slow 'stroke' and a fast 'stroke' in one engine.*
- *Output speed would vary over a cycle.*
- *Difficulty in arranging for end of expansion and start of compression to occur at one point.*
- *For heating at constant volume, engine would have to stop, or combustion be very fast.*
- *Max poss efficiency is (590 - 295)/590 = 0.5 or 50%.*
- *Actual efficiency of this ideal cycle = 43/251 = 0.17.*
- *Real efficiency will be << these efficiencies and much less than engines currently available.*
- *Power output is very small for a 1 litre engine so* ***not*** *wise to go ahead*

6

[12]