

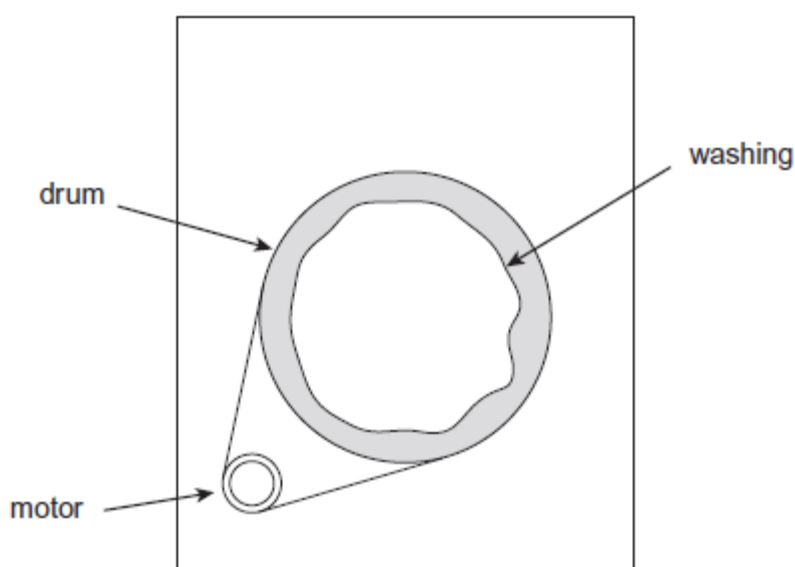
Name of the Student: _____

Max. Marks : 18 Marks

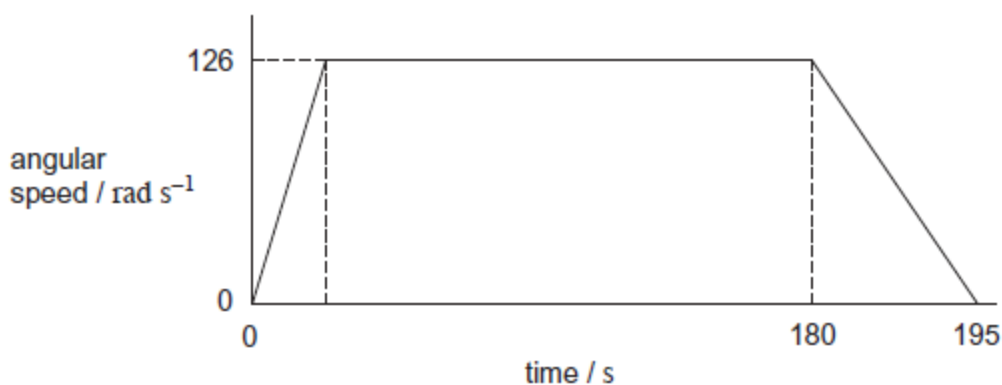
Time : 18 Minutes

Q1.

During the spin part of a washing machine programme the maximum rotational speed is 126 rad s^{-1} ($1200 \text{ rev min}^{-1}$). The moment of inertia of the drum and washing at the start of the spin part of the cycle is 0.565 kg m^2 . Assume that the wet washing is evenly distributed around the drum as shown in **Figure 1**.

Figure 1

- (a) **Figure 2** shows the variation of angular speed with time for the spin part of the cycle. The graph is not drawn to scale.

Figure 2

The motor provides a torque of 8.80 N m to accelerate the drum to 126 rad s^{-1} . The drum rotates at 126 rad s^{-1} until near the end of the spin cycle, when the drum decelerates uniformly to zero angular speed in 15 seconds. Friction at the bearings may be neglected. Assume that

during acceleration the moment of inertia of the drum and washing remains constant.

(i) Show that the drum accelerates for about 8 s.

(2)

(ii) Calculate the total number of revolutions made by the drum during the 195 s shown in **Figure 2**.

number of revolutions = _____

(3)

(b) (i) In practice, at the start of the cycle the acceleration will not remain constant. Draw on **Figure 2** a line to show how the initial part of the graph will change.

(1)

(ii) Explain your reasons for the line you have drawn.

(2)

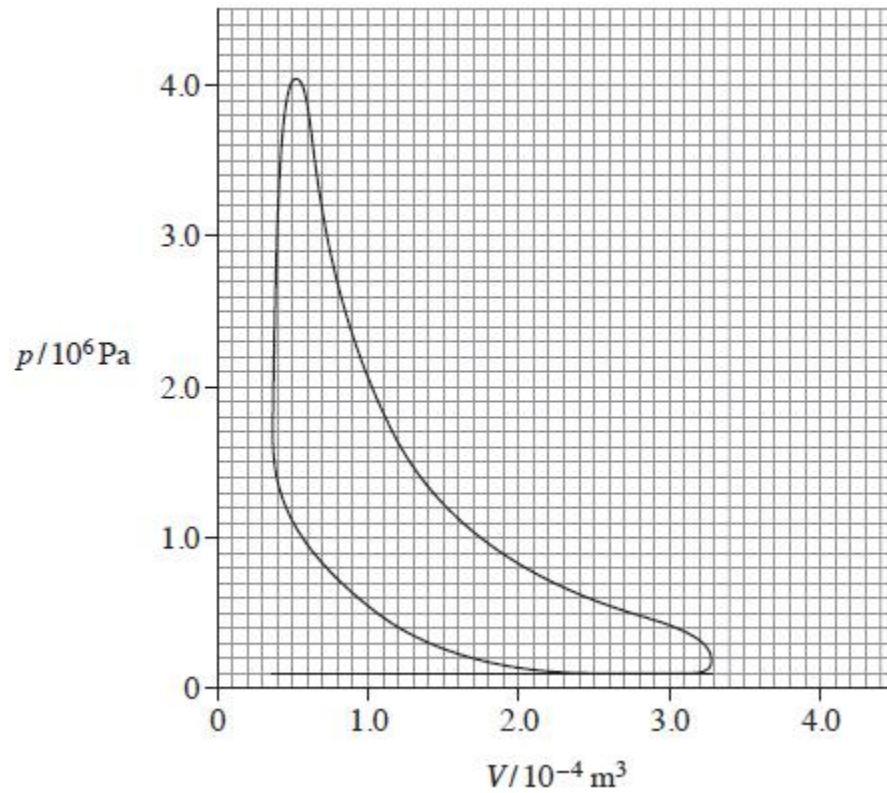
(Total 8 marks)

Q2.

(a) Explain the **basic** differences in operation between a petrol engine and a diesel engine.

- (b) **Figure 1** shows the indicator diagram taken during a test from one cylinder of a four cylinder four-stroke petrol engine.

Figure 1



Data from the test are as follows:

engine speed: $2000 \text{ rev min}^{-1}$

calorific value of fuel: 44.0 MJ kg^{-1}

fuel consumption: $1.1 \times 10^{-3} \text{ kg s}^{-1}$

- (i) Draw an **X** on the graph to show where in the cycle the spark would occur.

(1)

- (ii) Calculate the indicated power of the engine.

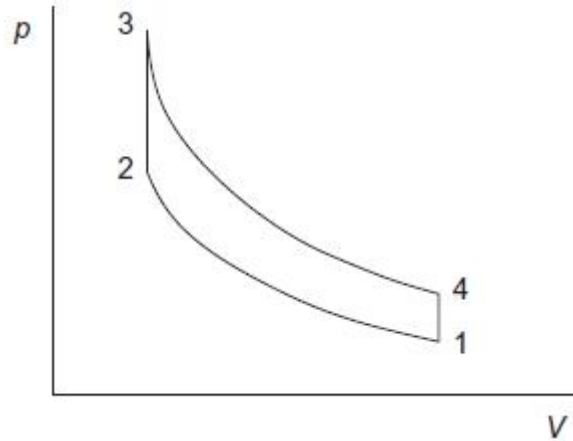
power = _____ W

(4)

- (iii) Calculate the thermal efficiency of the engine.

(c) **Figure 2** shows the $p - V$ diagram for a theoretical or ideal petrol engine (Otto) cycle.

Figure 2



Which **one** of the following lines in the table best represents what is occurring in different parts of the ideal cycle of **Figure 2**?

Place a tick (✓) in the right-hand column to show the correct answer.

1 → 2	2 → 3	3 → 4	4 → 1	✓ if correct
induction	compression	expansion	exhaust	
compression	heating	expansion	cooling	
induction	heating	cooling	exhaust	
cooling	compression	heating	expansion	

(1)

(Total 10 marks)