

LOCATION: SWANSEA

LLEOLIAD: ABERTAWE

LEVEL 4

LEFEL 4

EXAMINATION PERIOD
MAY 2020

CYFNOD ARHOLIADAU
MAI 2020

MODULE CODE: M4X02192
Engineering Science

TIME: 2 HOURS

ANSWER ALL QUESTIONS

Equipment or materials required – Scientific Calculator

Adnoddau neu ddefnyddiau sydd eu hangen - Cyfrifiannell Wyddonol

REMEMBER:

Take Gravity as 9.81m/s^2

Give all answers to 2.d.p unless otherwise instructed.

1.



Figure 1: Citroen DS3 WRC

A Citroen DS3 WRC car and occupants have a combined mass of 1150kg. The car can accelerate uniformly from rest up to 90km/h in 5 seconds. The DS3 maintains this speed for 25 seconds, when the brakes are then applied and the car comes to rest in 5 seconds. Draw a velocity time graph [5 marks] and calculate:

- The total distance covered. [6 marks]
- The maximum kinetic energy of the DS3 in kJ [3 marks]

The DS3 generates 223.7kW of power. Calculate:

- The force needed to accelerate the car up to 90km/h. [3 marks]
- The work done in accelerating the DS3 to its maximum velocity. [5 marks]

$$KE = \frac{1}{2}mv^2 \quad P = F.v \quad W.D = F.s$$

2.

The Citroen DS3 develops 350Nm of torque at 3000rpm. Given that the rotating parts of the engine can be accelerated from rest to this speed in 5 seconds, and that they have a radius of gyration of 0.85m, Calculate:

- The angular acceleration. [6 marks]
- The moment of inertia of the crank shaft. [3 marks]
- The mass of the rotating components. [3 marks]
- The kinetic energy of the system in kJ. [3 marks]

$$T = I\alpha \quad I = mk^2 \quad KE = \frac{1}{2}I\omega^2$$

Given that the crank shaft moves a piston and connecting rod assembly of mass 3.25 kg with simple harmonic motion through a stroke of 0.12m, calculate:

- The periodic time of the motion, [2 marks]
- The maximum acceleration, [3 marks]
- The maximum force on the assembly in kN. [3 marks]

$$T = \frac{2\pi}{\omega} \quad a_{\max} = \omega^2 A \quad F_{\max} = m\omega^2 A$$

3.

Abi now drives the Citroen of mass 1150kg up Mount Pleasant hill at a constant speed of 90 km/h, given that the hill is inclined at 1 in 5 measured along the slope, and that there is a constant frictional resistance of 200N to the motion, construct a basic forces diagram [3 marks] and calculate the power needed from the engine in kW [9 marks]. What is the angle of the slope in degrees? [2 marks].

$$P = F \cdot v$$

Diwedd/End