



EXAMINATIONS 2012 / 2013 **AHOLIADAU 2012 / 2013**

Semester 2

FACULTY OF: Applied Design & Engineering

NAME OF COURSE/PROGRAMME: BEng Manufacturing Systems Engineering
BEng Mechanical & Manufacturing Engineering

YEAR OR LEVEL: Year 2 – Part time Resit

NAME OF MODULE/UNIT/EXAM PAPER: Stress Analysis and Dynamics

MODULE NO:

DATE OF EXAMINATION: ??

EXAMINATION TIMES:

START TIME: ?? pm

FINISH TIME: ?? pm

TIME ALLOWED: 2 hours

INSTRUCTIONS TO CANDIDATES:

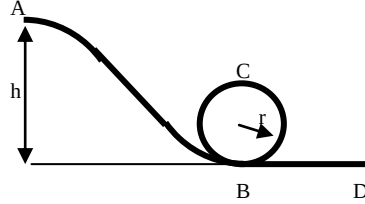
Answer 3 from 4 questions.

Assume acceleration due to gravity, $g = 9.81 \text{ ms}^{-2}$

Attach any graph paper used to your answer booklet

Question 1

- a. A roller coaster, shown below, consists of a sloping section AB, a circular loop-the-loop section BC of radius r , and a straight horizontal section BD;



- i. By considering the transfer of energy, determine the least height, in terms of r , of A above B, from which the car can start from rest without falling off of the track at C.
[5 marks]
 - ii. Briefly discuss the assumptions that you have made in your answer to part (i)
[2 marks]
- b. A winding drum raises a cage of mass 300kg through a height of 80m. The winding drum has a mass of 205kg, a radius of 0.45m and a radius of gyration of 0.4m. The mass of the rope is 1.5kg/m. The cage has at first an acceleration of 1.2ms^{-2} until a velocity of 7ms^{-1} is reached, after which the velocity is constant until the cage nears the top, then the final retardation is 4ms^{-2} . Find;
- i. The time taken for the cage to reach the top
[5 Marks]
 - ii. The starting torque on the drum
[5 Marks]
 - ii. Briefly discuss the assumptions that you have made in your answers to part (i) and (ii)
[3 marks]

Question 2

- a. i.
Explain why it is often necessary to determine the velocity and acceleration of points in a mechanism.

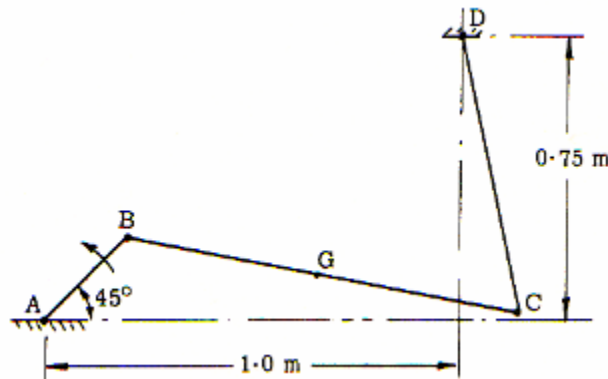
[2 marks]

- ii.
When constructing a velocity diagram explain what assumptions you make in order to construct the diagram.

[4 marks]

- b.
Attached to this exam paper is a 'line diagram' of the below mechanism, which has been drawn to scale. The diagram shows a mechanism in which the crank AB rotates anticlockwise about A at 70 rev/min. The link CD swings about D and is connected to the crankpin B by the link BC. The lengths are; AB, 0.25m, BC, 1.0m, CD, 0.75m. Draw the velocity diagram and hence find the velocity of C relative to D.

[10 marks]

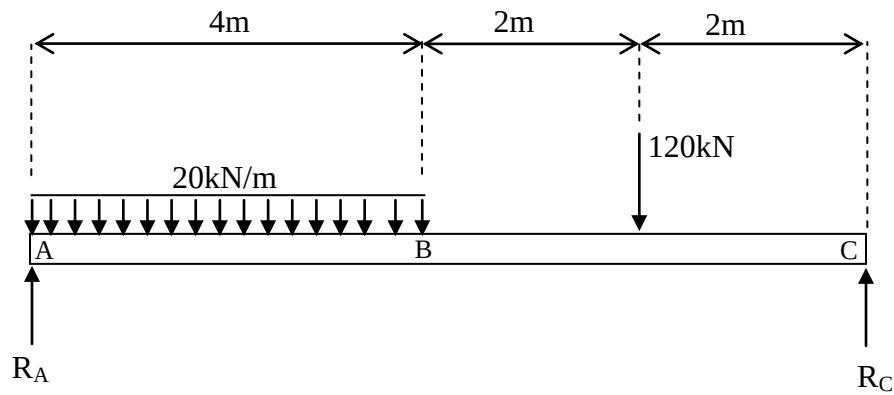


- c.

Briefly discuss why, when constructing an acceleration diagram, the acceleration of one point relative to another potentially has two components.

[4 marks]

Question 3



A simply supported beam is loaded as shown above. Show that;

a. The slope at A is given by: $\frac{dy}{dx} = \frac{-540}{EI}$

[14 Marks]

b. The slope at C is given by: $\frac{dy}{dx} = \frac{606.6}{EI}$

[3 Marks]

c. The deflection at B is given by: $y = \frac{-1413.3}{EI}$

[3 Marks]

Question 4

a.

In the context of complex stress, explain what is meant by the terms 'Principal Stress' and 'Principal Plane'?

[3 marks]

b.

At a given section a shaft is subjected to a bending stress of 20MPa and a shear stress of 40MPa.

i) Draw a Mohrs circle to represent the above condition. [5 marks]

Hence determine;

ii) The principal stresses and the planes on which these act. [4 marks]

iii) The maximum shear stress and the plane on which this acts [2 marks]

iv) Determine the tensile stress, which acting alone would produce the same maximum shear stress. [3 marks]

v) Determine the shear stress, which acting alone would produce the same maximum tensile principal stress. [3 marks]

EX 2

B&M

QUESTION ONE

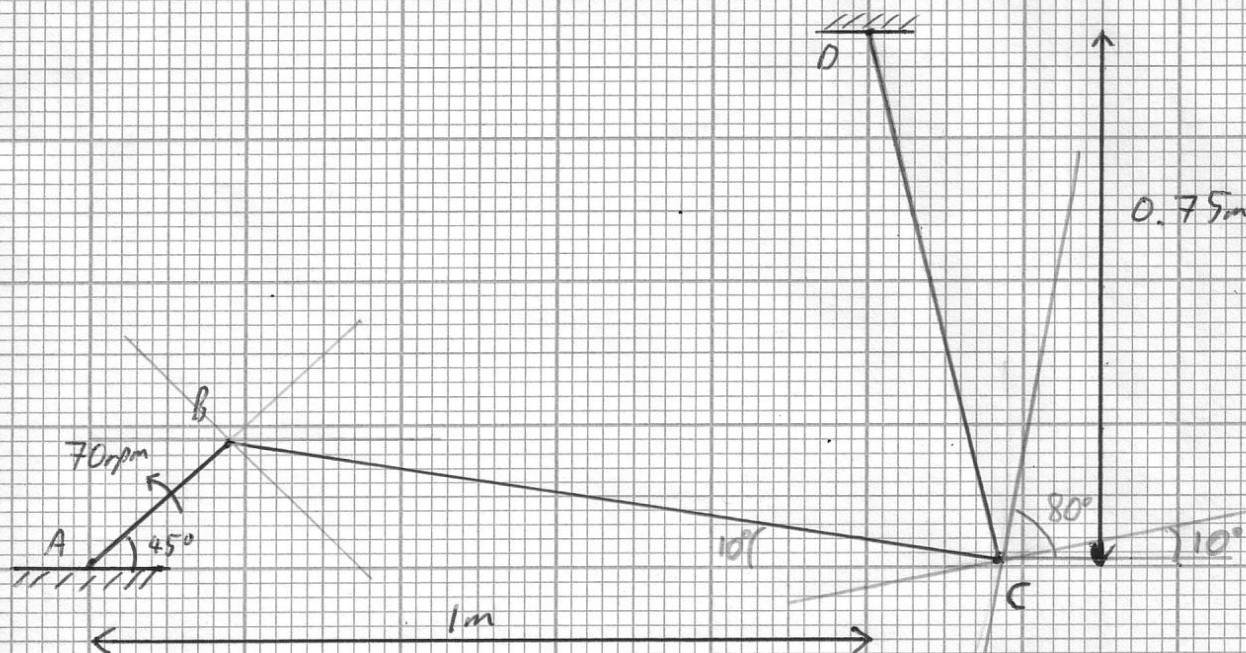
V440 (10)

①

$$AB = 250 \text{ mm} = 0.25 \text{ m}$$

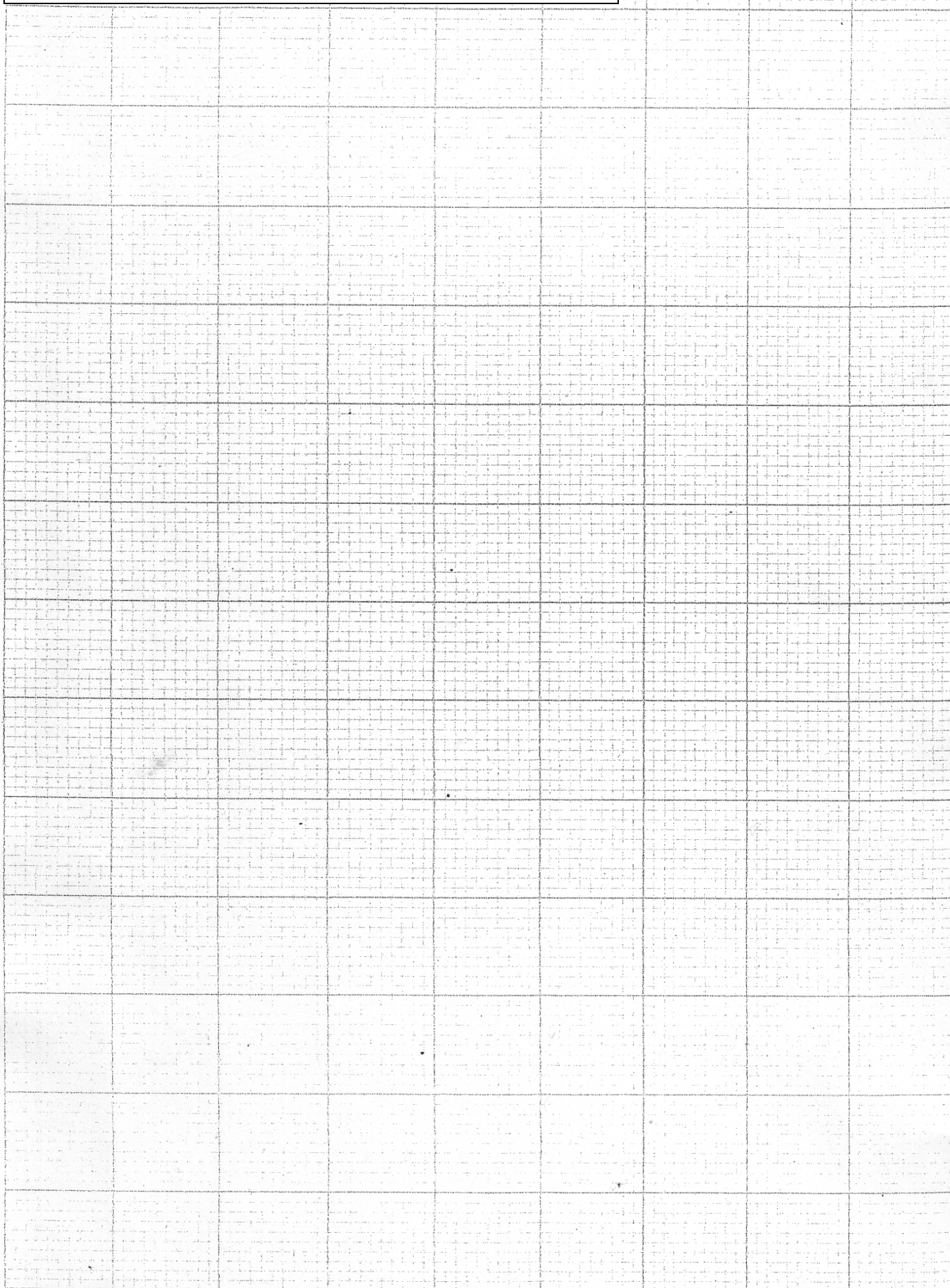
$$BC = 1000 \text{ mm} = 1 \text{ m}$$

$$CD = 750 \text{ mm} = 0.75 \text{ m}$$



Graph Paper for question 4 b
(Scale 1m/s=5cm)

ad



Formula Sheet

Dynamics

Assume $g = 9.81\text{ms}^{-2}$ in all calculations

$$\text{Centripetal Force} = \frac{mv^2}{r}$$

Momentum = Mass x Velocity

Force = Mass x Acceleration

$$T = I\alpha$$

$$I = mk^2$$

$$\text{Kinetic Energy} = \frac{1}{2} mv^2$$

Linear acceleration

$$v = u + at$$

$$s = ut + \frac{1}{2} at^2$$

$$v^2 = u^2 + 2as$$

Slope and deflection of beam theory;

$$EI \frac{d^2y}{dx^2} = M \quad \text{Bending moment.}$$

$$Q = EI \frac{d^3y}{dx^3} \quad \text{Shear Force}$$

$$w = EI \frac{d^4y}{dx^4} \quad \text{Load}$$