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| Candidate Name | Centre Number | Candidate Number |
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OXFORD CAMBRIDGE AND RSA EXAMINATIONS
General Certificate of Secondary Education

DESIGN AND TECHNOLOGY
(SYSTEMS AND CONTROL TECHNOLOGY)

1957/7

PAPER 7: MECHANISMS
 FOUNDATION TIER

Specimen Paper 2003

Additional materials: Formulae Sheet OCR (Tables 2)

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the boxes above.

Answer **all** questions.

Write your answers, in blue or black ink, in the spaces provided on the question paper.

Read each question carefully and make sure you know what you have to do before starting your answer.

Show all your working out for calculations.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

Marks will be awarded for the use of correct conventions.

Dimensions are in millimetres unless stated otherwise.

Total marks for this paper is **50**.

| Question Number | For Examiner's use only |
|-----------------|-------------------------|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| TOTAL | |

1 Fig. 1 shows a toy Go-kart made in a school workshop.

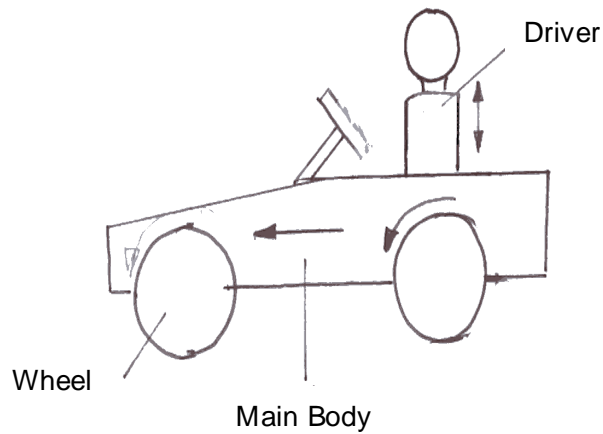


Fig.1

(a) Complete the table below to give examples of the motion of the parts labelled.

| Part | Type of Motion |
|-----------|----------------|
| | Rotary |
| Main Body | |
| | Reciprocating |

[3]

Fig.2 shows part of the toy in detail.

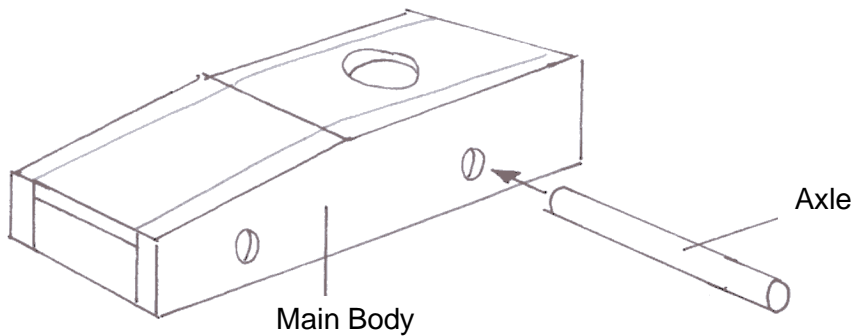


Fig.2

(b) (i) Name the force that acts between the **Axle** and the **Main Body** which must be kept as low as possible to make sure the axle moves freely

[1]

- (ii) The main body of the go-kart is made in 6mm thick plywood, and the axle is made in 4mm-diameter birch dowel.

Give **two** practical actions you could take when making the toy to make sure the axle moves freely.

Action 1 _____ [1]

Action 2 _____ [1]

Fig.3 shows part of the mechanism for the toy.

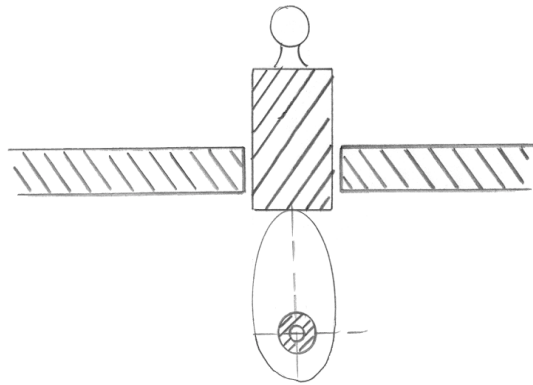


Fig. 3

- (c) Label Fig.3 to show the 'cam' and the follower. [2]

- (d) Use notes and sketches on Fig, 3 to explain how the mechanism works.

[2]

2 A hand drill shown in Fig. 4 was used to drill the holes in the main body for the axle.

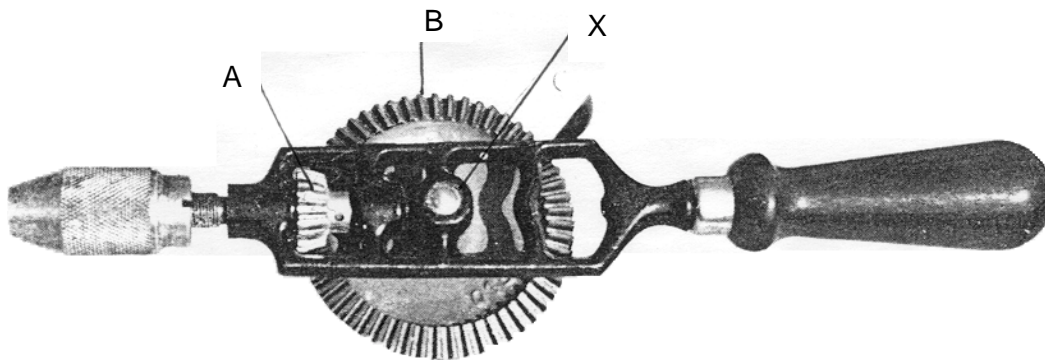


Fig. 4

A and B are called Bevel Gears and have teeth cut on a cone instead of a cylinder.

(a) (i) Explain why bevel gears are used for the hand drill.

[2]

(ii) Gear A has 10 teeth and Gear B has 60 teeth. Explain what effect this has upon the speed of the chuck compared to the speed of the hand wheel.

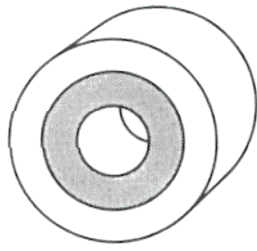
[2]

(b) A bearing is used at point X to reduce friction and make the handwheel easier to turn. A problem is that bearings can wear, which can make the drill difficult to turn.

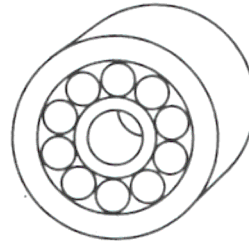
State the most suitable type of lubricant used to keep the bearing running freely.

[1]

(c) Fig. 5 shows two types of bearing that could be used at point X.



bearing Y



bearing Z

Fig. 5

(i) Name the **two** types of bearing shown.

Bearing Y _____ [1]

Bearing Z _____ [1]

(ii) Explain which type of bearing is the better for this application.

_____ [2]

(iii) State a suitable material for the bearing you have chosen.

_____ [1]

3 Fig. 6 shows the power system for a real Go-kart.

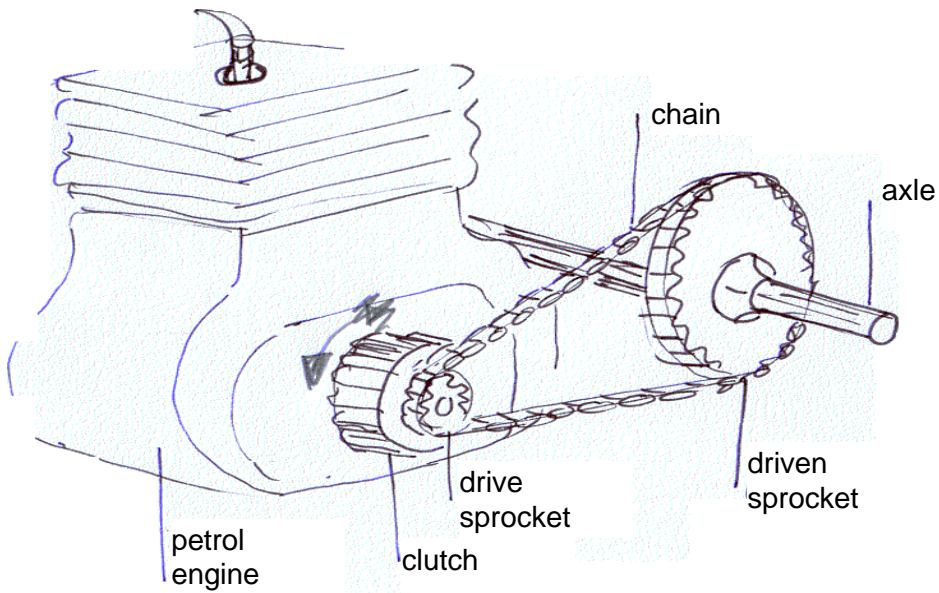


Fig. 6

(a) An incomplete block diagram for the power system of the Go-kart is given below. Complete the block diagram by adding the missing words.



[3]

Fig. 7 shows a larger diagram of the sprockets and chain.

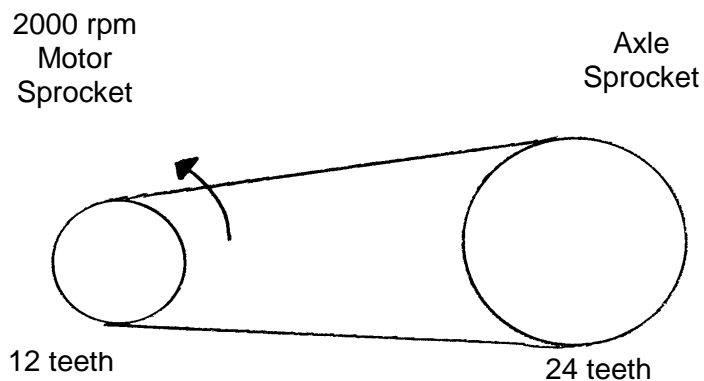


Fig. 7

(b) The arrow on the Motor Sprocket shows the direction it rotates. Add an arrow to Fig. 7 to show the direction the Axle sprocket would rotate.

[1]

(c) Calculate the speed of rotation of the axle. Show all stages of your calculation.

[2]

(d) The design in Fig.7 does not control the speed of the axle to a suitable speed. In the space below draw a method of reducing the axle speed to 500 r.p.m. using suitable sprockets and a chain.

[4]

4 The Go-kart uses a disc brake for a braking system.

Fig. 8 shows details of the disc rotor.

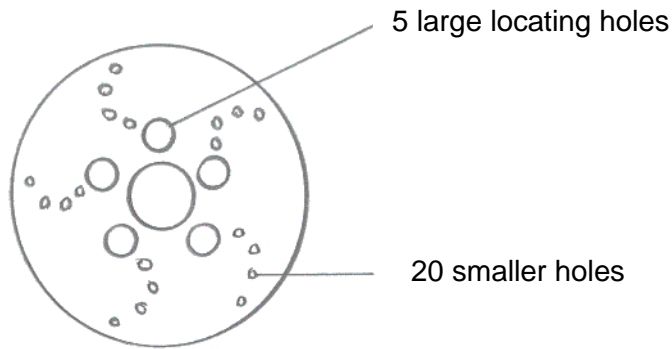


Fig.8

(a) The disc rotor has holes machined into it.

Give two reasons why the holes are produced.

[2]

(b) The designer produced a number of different layouts of the holes using C.A.D.

Give **two** benefits of using C.A.D. for the designer.

Benefit 1 _____

[1]

Benefit 2 _____

[1]

(c) The disc rotor is machined using C.A.M.

Give one benefit of using C.A.M. to the manufacturer other than cost.

[1]

(d) The rotors are made from a round bar of steel.

Which type of C.N.C machine would be most suitable to machine the disc rotor to the correct diameter?

[1]

- (e) After the disc rotor has been machined to the correct diameter the holes are then machined out.

Which type of C.N.C. machine would be most suitable for machining out these holes?

_____ [1]

- (f) The disc rotors are to be produced using a 'Just in Time' commercial production method.

Give a benefit of using a Just in Time manufacturing system for this product.

_____ [1]

- (g) The rotors are produced using a 'Cell Production' system. The cell is responsible for quality control.

Give **two** critical control points, which the cell would need to set up.

Critical control point 1 _____ [1]

Critical control point 2 _____ [1]

5 Fig. 9 shows the parts of the braking system.

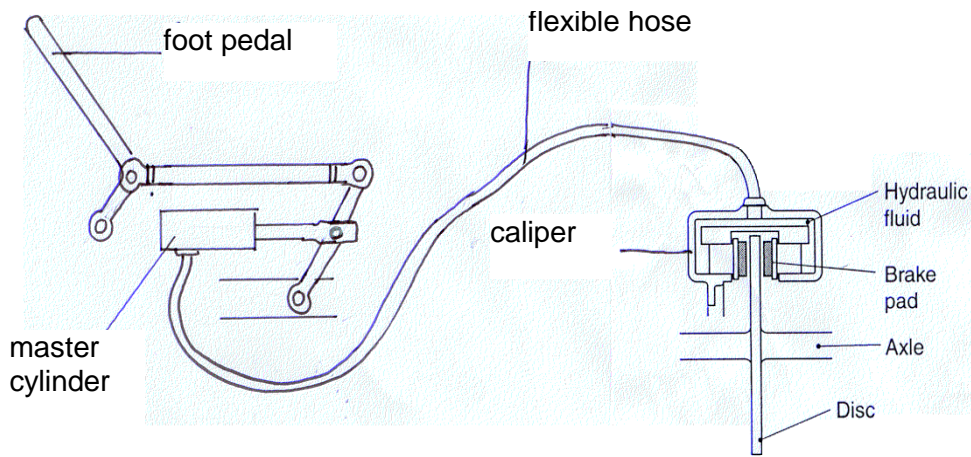


Fig. 9

(a) One criteria point for the specification of the system is given below.

Complete the specification by adding **three** more criteria points.

Criteria 1 - The brake pads must be easy to change

Criteria 2 - _____ [1]

Criteria 3 - _____ [1]

Criteria 4 - _____ [1]

(b) Explain how anthropometric data would be used to make sure the design was safe to operate.

_____ [1]

- (c) The brake system works effectively but the pedal needs to be pushed very hard.

Using notes and sketches show a development that could be made to the design to make it easier to produce a greater force to operate the brake.

[4]

- (d) The brake pads were previously made from asbestos but are now replaced by ceramic pads.

Give **two** reasons why asbestos pads are no longer used.

Reason 1 _____ [1]

Reason 2 _____ [1]

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PAPER 7: MECHANISMS OPTION

FOUNDATION TIER

MARK SCHEME

Specimen Paper 2003

- 1 (a) Wheel
Linear
Driver
1 mark for each answer [3]
- (b) (i) Friction [1]
- (ii) Clearance hole above 4mm diameter
Make sure the axle is smooth
Make sure the hole is clear
1 mark for each answer, max 2 marks [2]
- (c) Cam correctly labelled
Follower correctly labelled
1 mark for each answer [2]
- (d) Cam goes round
Follower goes up and down
1 mark for each answer [2]
- [Total: 10]

- 2 (a) (i) Motion is turned through 90 degrees [2]
- (ii) Speed of chuck is greater [2]
- (b) Grease [1]
- (c) (i) Y = plain bearing
Z = ball bearing
1 mark for each [2]
- (ii) plain bearing
simple/ low cost/ suitable for low speed applications
1 mark for each answer, max 2 marks [2]
- (iii) brass/ bronze/ phospher bronze [1]
- [Total: 10]

- 3 (a) INPUT
PROCESSING
OUTPUT
1 mark for each answer, max 3 marks [3]
- (b) Clockwise arrow [1]
- (c) V.R. = $12/24 = 1/2$ or 0.5 (1 mark)

2000 x 0.5 = 1000 r.p.m. (2 marks) [2]
- (d) Drawing showing increased size of Axle sprocket (2 marks)
Label indicating velocity ratio of $\frac{1}{4}$ (i.e. 12 teeth on motor sprocket and 48 teeth on the axle sprocket) (2 marks) [4]
- [Total: 10]**
- 4 (a) Location holes allow disc to be attached to axle flange
Additional holes are for cooling
1 mark for each answer, max 2 marks [2]
- (b) Designs can be altered rapidly
Producing the drawings faster than by hand
Dimensions are added automatically
1 mark for each answer, max 2 marks [2]
- (c) Accuracy of finish
Faster machining (saves time)
Material requirement planning (M.R.P.)
Automatic control of the machines removes repetitive manual jobs
1 mark for each answer, max 1 mark [1]
- (d) C.N.C. Lathe [1]
- (e) C.N.C. Milling machine [1]
- (f) Less storage of stocks
Less time wasted moving stocks around the factory
Stock does not become redundant due to changes in the design
1 mark for each answer, max 1 mark [1]
- (g) Thickness of the rotors
Diameter of the rotors
Number of holes
Position of holes
1 mark for each answer, max 2 marks [2]
- [Total: 10]**

- 5 (a)** The linkages must move freely (low friction)
 The joints in the linkages must not wear
 The master cylinder must produce sufficient amplification of pressure
 The foot pedal must give sufficient amplification of movement (leverage)
 The foot pedal must be of a length to fit to the driver's foot
 The seals must not leak
 The flexible hose must resist the hydraulic pressure
 The disc must be able to be attached/ detached from the axle
 The pistons must move freely in the bores
 There must be a means of attaching the caliper to the Go-kart
 1 mark for each answer, max 3 marks **[3]**
- (b)** The length of the distance from the heel to the ball of the drivers foot gives the length for the foot pedal **[1]**
- (c)** Greater ratio of distance between A-B to B-C (2 marks)
 Quality of notes (1 mark)
 Quality of sketches (1 mark) **[4]**
- (d)** Danger of asbestosis to mechanics/ driver
 Danger of pollution to refuse/ landfill sites
 Danger of asbestosis to workers at the manufacturing company
 1 mark for each answer, max 2 marks **[2]**
- [Total: 10]**