



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

JUNIOR CERTIFICATE EXAMINATION, 2005

MATERIALS AND TECHNOLOGY

METALWORK – HIGHER LEVEL

100 Marks

Tuesday, 21 June – 2.00 – 4.00

INSTRUCTIONS

- 1. Answer Question 1, Sections A and B, and three other questions.**
- 2. All answers must be written in ink on the answer book supplied. Diagrams should be drawn in pencil.**
- 3. Squared paper is supplied for diagrams as required.**
- 4. Please label and number carefully each question attempted.**

**SECTION A – 20 MARKS
COMPULSORY**

Answer any **five** questions.

The diagram, Fig. 1, shows some of the main parts of a basic four-stroke engine. Questions (b) to (e) relate to this diagram.

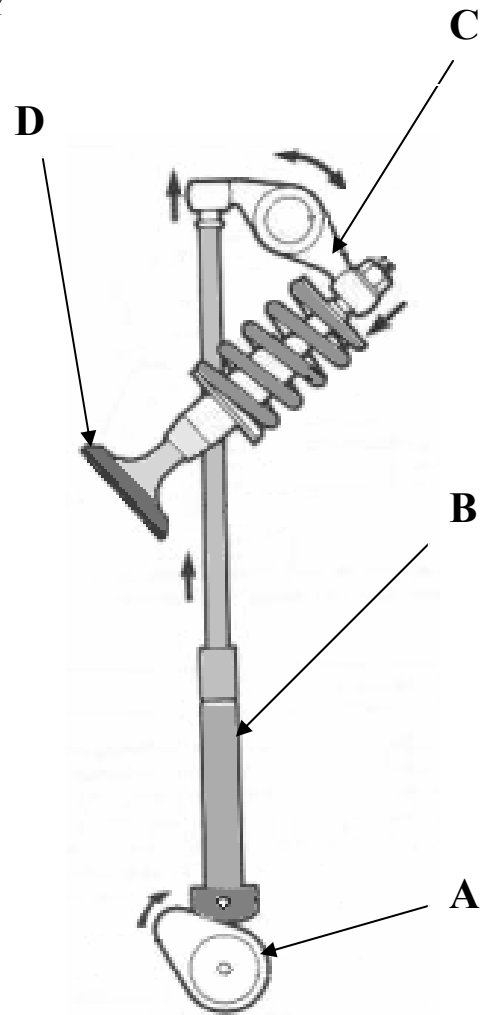


Fig. 1

(a) Briefly describe, the contribution made to technology by **one** of the following people:

- (i) John P. Holland, or
- (ii) Nicholas Otto, or
- (iii) Isaac Singer.

(4 marks)

(b) (i) Name Part 'A'.
(ii) Explain the purpose of Part 'A'.

(4 marks)

(c) Briefly describe the function of Part 'B'.

(4 marks)

(d) (i) Name Part 'C'.
(ii) Explain the purpose of Part 'C'.

(4 marks)

(e) (i) Name Part 'D'.
(ii) Explain how Part 'D' is closed.

(4 marks)

(f) Define any **two** of the following material properties:

- (i) Ductility;
- (ii) Hardness;
- (iii) Tensile Strength;
- (iv) Toughness.

(4 marks)

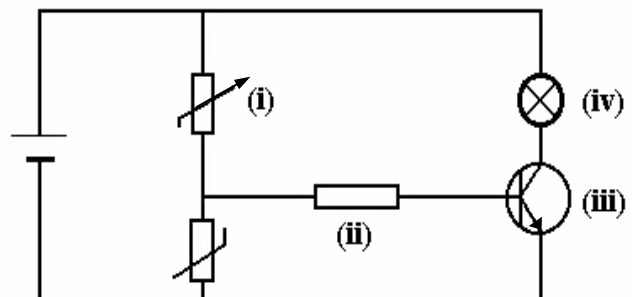


Fig. 1a

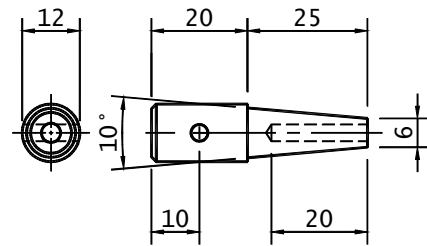
(g) (i) Name and identify by number, any **two** of the four electronic components, shown in Fig. 1a.
(ii) Outline the function of the thermistor shown.

(4 marks)

**SECTION B – 20 MARKS
COMPULSORY**

Answer any five questions

The drawings in Fig. 1b show the Water Cannon, Electric Circuit and an assembly drawing of the 2005 Metalwork Higher Level Project, Model Service Vehicle.



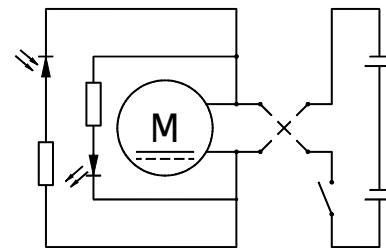
Water Cannon

- (a) Outline **four** steps required to remove the slots from the base and cab of the vehicle.
(4 marks)

- (b) Describe how the Windscreen, made from polycarbonate, is bent to shape.
(4 marks)

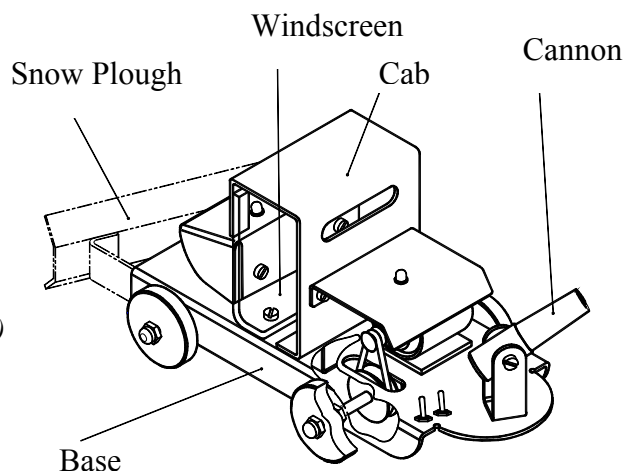
- (c) List **three** lathe processes used to make the Water Cannon.
(4 marks)

- (d) Briefly outline the operation of the Electric Circuit shown, used to power the vehicle.
(4 marks)



Electric Circuit

- (e) (i) Design a suitable removable Snow Plough for the vehicle, which may be attached at the front as shown.
(ii) Illustrate how the Snow Plough may be attached to the body of the vehicle.
(4 marks)

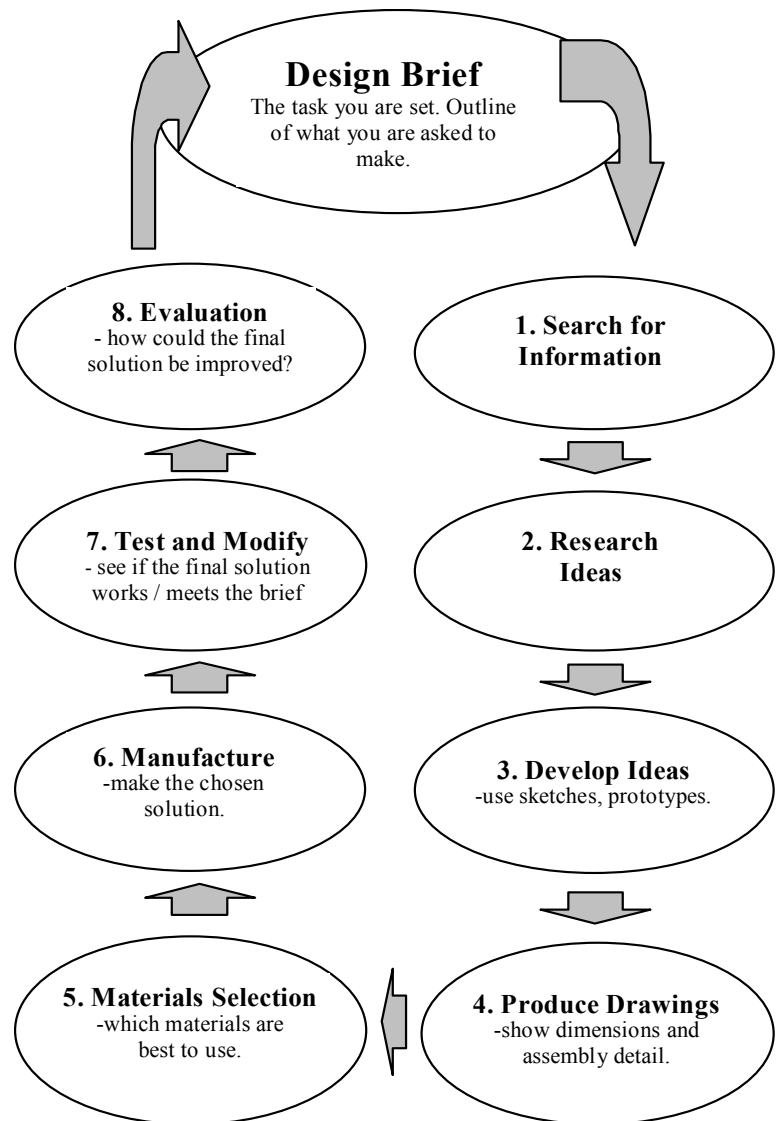


Model Service Vehicle

- (f) Outline **two** important design features of the Snow Plough to ensure efficient removal of the snow from a roadway.
(4 marks)

Fig. 1b

A simple model of a design process is shown opposite.



(a) (i) List any **two** important points, which should be considered, at the “Production Drawings” stage.

(ii) Discuss any **two** factors to be considered, at the “Manufacture” stage.

(6 marks)

(b) The diagram in Fig. 2 shows a television and a wall bracket for the television.

- (i) Draw an elevation of the television, looking in the direction of arrow ‘X’.
- (ii) Suggest a suitable metal for the bracket.
- (iii) Using simple sketches and notes show how the bracket may be improved to allow the television be swivelled.
- (iv) Briefly describe, using a sketch, how the bracket may be attached to the wall.

(14 marks)

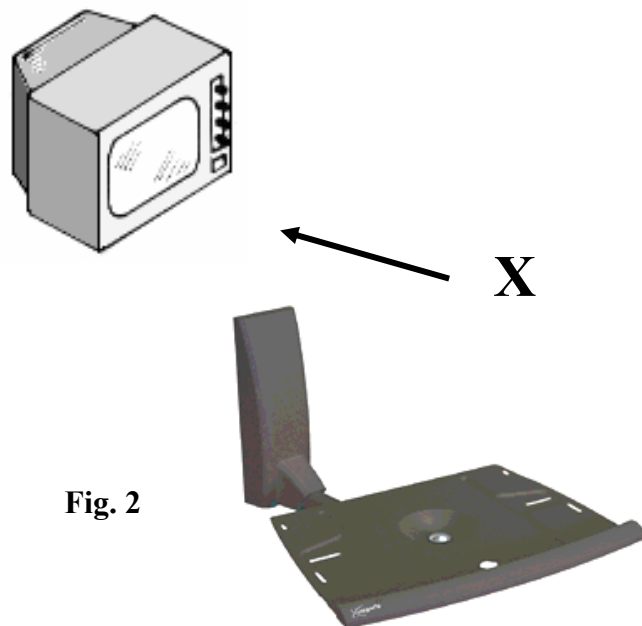


Fig. 2

Fig. 3 shows two drill bits A and B, and two holes X and Y.

- (a) (i) Name **both** drill bits shown.
- (ii) Explain how **both** drill bits may be held in a pillar-drilling machine. (6 marks)
- (b) (i) If hole 'X' is to be tapped M6, what size drill bit should be used?
- (ii) Name the type of hole drilled at 'Y'.
- (iii) Explain how hole 'Y' may be tapped M6. (6 marks)
- (c) A 5mm diameter hole is to be drilled through aluminium plate. The aluminium has a cutting speed of 60m/min. Using the given formula, calculate the speed in RPM. (Take π as 3)

$$N = \frac{S \times 1000}{\pi \times D}$$

(4 marks)

- (d) Explain the function of any **two** of the following:
 - (i) Countersinking bit;
 - (ii) Drill Gauge;
 - (iii) Plug tap;
 - (iv) Reamer.(4 marks)

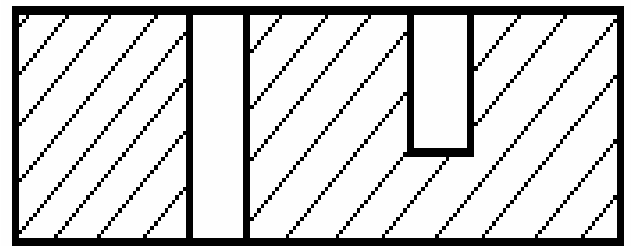


Fig. 3

- (a) Name the type of furnace shown in Fig. 4. (1 mark)
- (b) Explain how the furnace is charged. (2 marks)
- (c) List the materials in the charge. (3 marks)
- (d) Name **both** parts of the furnace marked A and B. (2 marks)
- (e) Explain how parts A heat or melt the charge. (2 marks)
- (f) Explain the function of part B. (3 marks)
- (g) Redraw the table into your answer book. Complete the table, naming the alloys, alloy elements and listing **one** application of each. (7 marks)

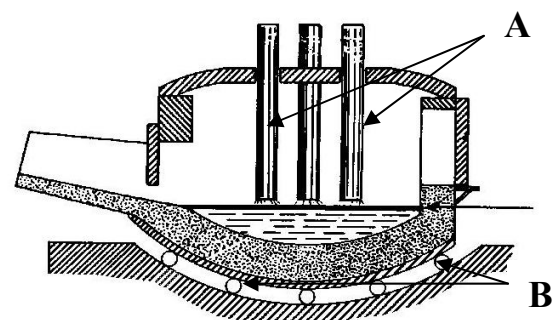


Fig. 4

Alloy Name	Alloy Elements	Application
High Speed Steel	Iron + Carbon +	Drill Bits
Brass	Copper +	Water fittings
	Iron + Carbon + Chromium	Kitchen Sinks

5

20 Marks

An electric golf buggy and gear mechanism are shown in Fig. 5.

- (a) Name suitable materials for Parts 'A', 'B', 'C' and 'D'. (4 marks)
- (b) The light (bulb) at 'E' is specified as 12 V and 21 W. Explain the meaning of these terms. (6 marks)
- (c) The buggy uses a chain and sprocket drive. If the driving sprocket has 12 teeth, and the driven sprocket, attached to the rear axle, has 48 teeth, what is the gear ratio? (4 marks)
- (d)
 - (i) Name the gear mechanism shown.
 - (ii) Suggest **one** use for this mechanism on the buggy shown.
 - (iii) List **two** examples where this mechanism may be found in a school workshop. (6 marks)

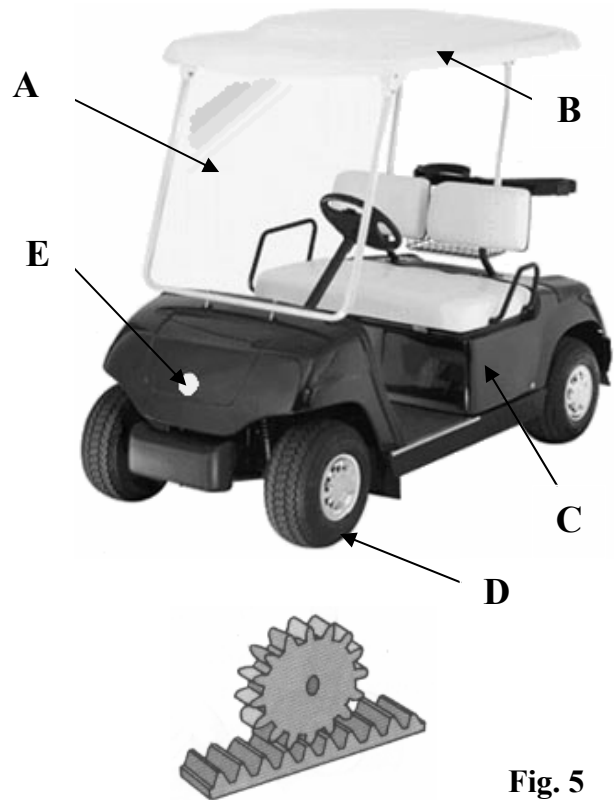


Fig. 5

6

20 Marks

Heat treatment of a cold chisel and shaping of a copper bowl are shown in Fig. 6.

- (a)
 - (i) Name a suitable material from which the chisel is made.
 - (ii) Describe how the chisel is hardened by heat treatment.
 - (iii) Describe briefly the heat treatment process carried out after hardening. (8 marks)
- (b)
 - (i) Describe the process used to shape a copper plate into a bowl as shown.
 - (ii) Name the heat treatment process required to prevent the copper from work hardening.
 - (iii) Suggest **one** decorative finish, which could be applied to the bowl.
 - (iv) Using simple sketches and notes, briefly describe **one** improvement, which could be applied to the bowl, to allow it to rest on a flat surface. (12 marks)

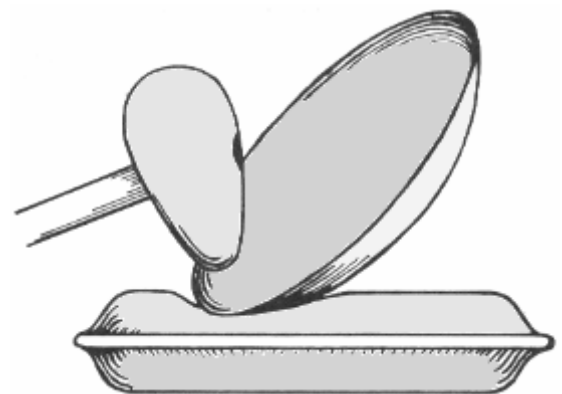
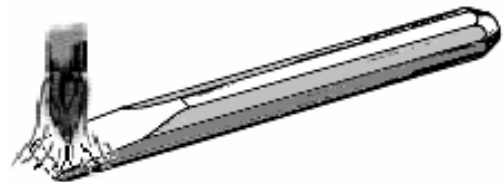


Fig. 6

- (a) (i) Identify **one** safety feature incorporated into the CNC lathe shown in Fig. 7.
- (ii) Name the **three** parts of the CNC lathe shown.
- (iii) State **one** advantage of a CNC lathe over a conventional lathe.
- (iv) Explain any **two** of the following associated terms:
- Jog keys;
 - M-codes;
 - Tool offsets;
 - X Co-ordinates.
- (v) State, for any **three** devices shown in Fig. 7a, whether they are *input* or *output* devices.

(12 marks)

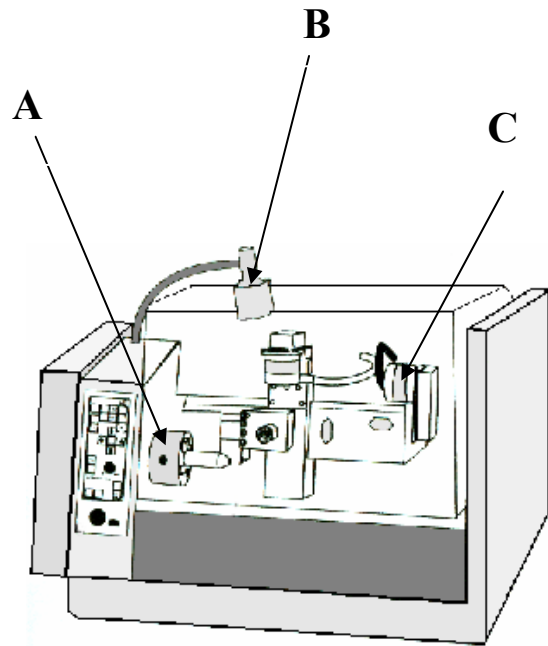


Fig.7 CNC Lathe



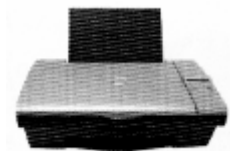
Monitor



Mouse



Keyboard



Printer

- (b) (i) Explain what is meant by a:
- CAM process;
 - CAD process.
- (ii) List **two** advantages of either of these processes.

(8 marks)

Fig. 7a

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