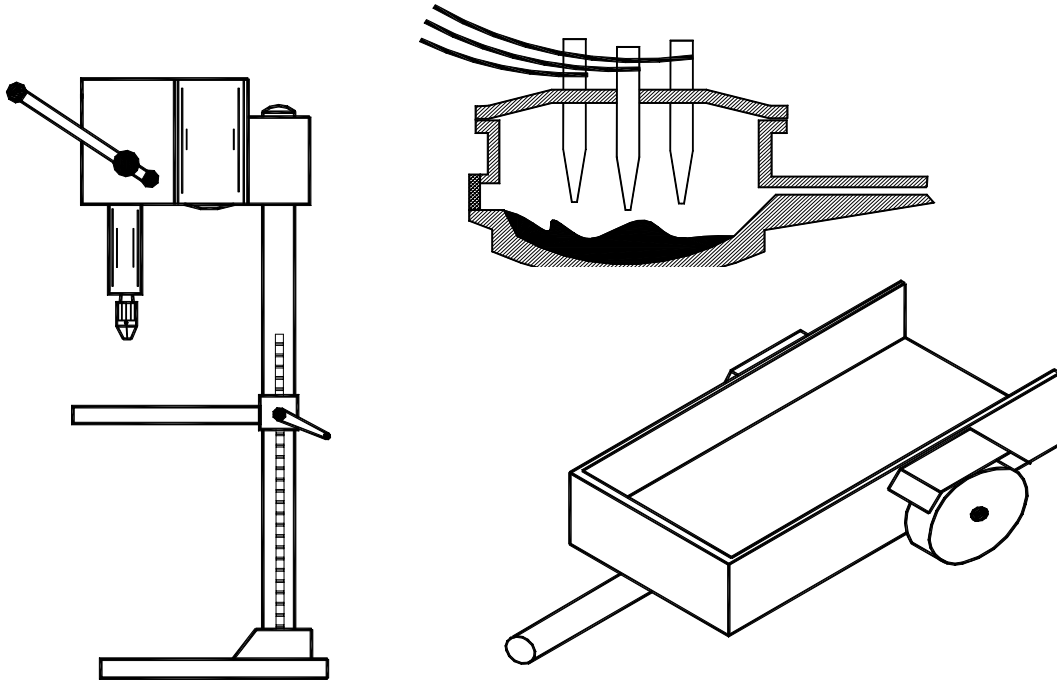




**Coimisiún na Scrúduithe Stáit  
State Examinations Commission**

**Junior Certificate Examination 2007**

**Materials and Technology Metalwork  
(Higher Level – 100 marks)**



**Sample Answers and Marking Scheme**

Answer Question 1, Section A and B, and three other questions.

## Question One – Section A

20 marks

### Five parts only to count.

- (a) (i) **Heinrick Focke** - developed the helicopter.  
(ii) **Henry Ford** - developed assembly line manufacture and model T car.  
(iii) **Nicholas Otto** – developed the four stroke engine.  
*Any one @ 4 marks* 4 marks
- (b) (i) **B** is the crank or crankshaft. *2 marks*  
(ii) The crankshaft is where the reciprocating motion of the piston is converted to rotary motion. This is turn can be applied to the car wheel via the transmission system. *2 marks* 4 marks
- (c) The piston rings provide a gas seal between the piston and the cylinder. The rings also prevent lubricating oil from passing into the combustion chamber. *4 marks* 4 marks
- (d) (i) **Induction** – the inlet valve is open while the exhaust valve is closed. As the piston moves down the cylinder the fuel air mixture flows into the cylinder. This is induction.  
(ii) **Ignition** – at the end of the compression stroke the fuel mixture is ignited by a spark from the spark plug. This creates a large force on the surface of the piston forcing it downwards. Both valves are closed during this stroke. *Any one @ 4 marks* 4 marks
- (e) (i) Gases are given off by engines and these contribute acid rain and global warming. *2 marks*  
(ii) Regular servicing or the use of alternative fuels are ways which may help reduce the effects of pollution. *2 marks* 4 marks
- (f) (i) Polyvinylchloride (PVC) is the most commonly used plastic used to make guttering. *2 marks*  
(ii) PVC is a Thermoplastic. *2 marks* 4 marks
- (g) (i) Component ‘C’ is a toggle switch. *1 mark*  
Component ‘D’ is a resistor. *1 mark*  
(ii) **9V** this stands for 9 volts. This refers to the value of the force driving the current around the circuit. *2 marks* 4 marks

## Question One – Section B

20 marks

### Five parts only to count.

(a) Safety precautions to be observed include:

- Wear eye protection when working on machines
- Tie back long hair when working on machines
- Tie up loose clothing
- Ensure hand tools are in good condition.

*Any **Four** safety precautions @ 1 mark each*

**4 marks**

(b) Processes used to manufacture the valve chest include:

- Marking out
- Rough filing
- Smooth filing
- Drilling  $\text{Ø}4.2$  and  $\text{Ø}5$
- Bend Perspex using the strip heater
- Tapping.

*Describe any **two** processes @ 2 marks each*

**4 marks**

(c) Lathe processes used to make the flywheel include:

- Facing (Surfacing)
- Parallel Turning (Sliding)
- Drilling.

*2 marks + 1 mark + 1 mark*

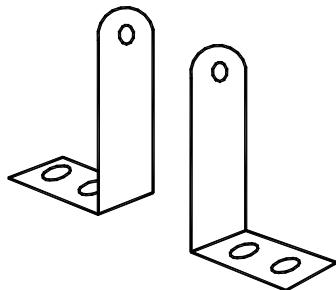
**4 marks**

(d) As steam enters the cylinder the piston is forced to move. This in turn gives rotary motion to the flywheel. The flywheel is connected to the sliding valve which is forced to slide from side to side. As the valve moves to each side it makes contact with a switch. Each switch turns on an LED.

*Suitable description @ 4 marks*

**4 marks**

(e)



*Suitable design @ 2 marks  
Suitable diagram @ 2 marks*

**4 marks**

(f) Applications for steam engines include:

- Engine used in steam trains to pull train carriages
- Engine used in the past for steam boats.

*Two suitable applications @ 2 marks each*

**4 marks**

## Question Two

20 marks

- (a) (i) Elements to be included in working drawings are:

- Materials used
- Dimensions
- Assembly detail.

Any **three** elements @ 1 mark each

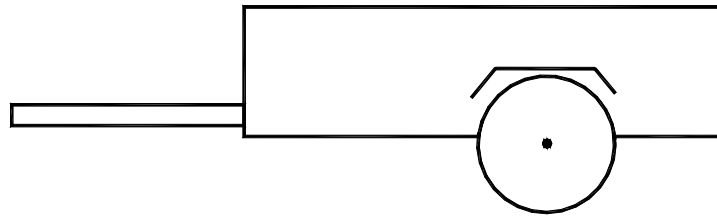
- (ii) Factors which should be considered at the test stage Include:

- Testing the accuracy of dimensions
- Testing and checking the assembly detail.

2 marks + 1 mark

**6 marks**

- (b) (i)



Elevation of the trailer @ 3 marks

- (ii)



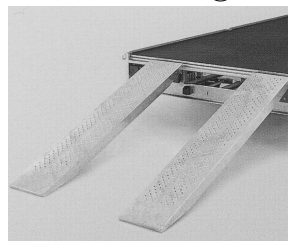
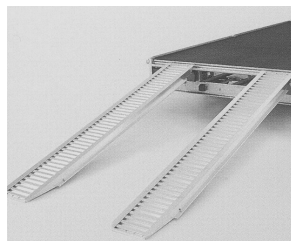
Coupling eye



Ball hitch with coupling head

Suitable method to attach @ 3 marks

- (iii)



Suitable design @ 2 marks  
Suitable diagram @ 2 marks

- (iv) Steel and Aluminium are the most suitable metals. Painting may be the most suitable finish.

Suitable material @ 2 marks  
Suitable finish @ 2 marks

**14 marks**

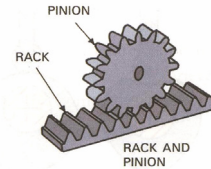
## Question Three

20 marks

- (a) (i) Part 'A' is the feed lever.  
 Part 'B' is the chuck.  
 Part 'C' is the table.  
 Part 'D' is the base.

Name each part @ 1 mark each

- (ii) The table is raised and lowered by means of a rack and pinion.



Description of mechanism @ 2 marks

- (iii) Safety precautions include:

- wear eye protection
- remove the chuck key from the chuck.

Any **two** safety precautions @ 1 mark each

8 marks

- (b) Correct substitution in formula, correct answer.

2 + 2 marks

Answer 1500 RPM – (if correct answer only – 4 marks)

4 marks

- (c) (i) **Countersinking** is the enlarging of the mouths of holes to accommodate the heads of countersunk screws.



**Counterboring** is the increasing of the diameters of holes to certain depths.



- (ii) **Clearance holes** are slightly larger than the diameter of the bolt or screw which passes through it.

**Tapping hole** is the hole drilled before cutting an internal thread.

- (iii) A **Tapered tap** is tapered over the first 6 to 10 threads. It is used to start a thread.



A **plug tap** has only a short taper and is used to finish a thread or to thread a blind hole.



Any **two** @ 4 marks each

8 marks

## Question Four

20 marks

- (a) The furnace shown is an electric arc furnace.  
*Furnace name 1 mark* 1 mark
- (b) The charge consists of:  
Scrap metal  
Lime  
Mill scale or iron ore  
*three elements @ 1 mark each* 3 marks
- (c) The charge is heated by electric arcs. These arcs are generated by bringing the electrodes close to the charge in the furnace. Once the gap is small enough the arcs will jump from the end of the electrodes onto the charge and the heat generated will melt the charge.  
*Description @ 2 marks* 2 marks
- (d) **Part 'A'** is the electric cable which is attached to the electrode. This cable supplies the electricity required by the electrode. *1 mark*
- Part 'B'** is the tapping spout. This is where the molten steel is poured from the furnace when it is tilted. *1 mark* 2 marks
- (e) (i) Steel is produced by the electric arc furnace. *1 mark*
- (ii) Steel is strong and malleable when heated.  
*Any two properties @ 1 mark each* 3 marks
- (f) **Brass** – Copper and Zinc. *2 marks*  
**Solder** – Lead and Tin. *2 marks*  
**Steel** – Iron and Carbon. *2 marks*
- Brass** – used in musical instruments, water fittings, screws etc.  
**Solder** – used to join electrical circuits.  
**Steel** – used in screws, ships, car bodies etc.  
*One application for each alloy @ 1 mark each* 9 marks

## Question Five

20 marks

- (a) (i) Windscreen - made from glass  
Cab Frame - made from steel  
Tyres - made from rubber

*Name of suitable material for each part @ 1 mark each*

(ii) Engine oil would be a suitable lubricant 2 marks

(iii) Diesel would be a suitable fuel for the tractor. 2 marks

(iv) Tyres inflated with air are known as pneumatic tyres. 2 marks

(v) Power is transmitted by means of a PTO shaft which can interchange with the different attachments fitted to the back of the tractor. 3 marks

<b>12 marks</b>
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(b) (i) Wheel 'C' also rotates in a clockwise direction. 2 marks

(ii) Gear ratio is 1:2 4 marks  
*(if 20:40 give 2 marks, if 2:1 or 40:20 give 1 mark)*

(iii) Wheel 'C' turns at a speed of 250 RPM. 2 marks

<b>8 marks</b>
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## Question Six

20 marks

- (a) (i) Silver Steel is usually used to make screwdriver blades.

2 marks

- (ii) Tempering is carried out after hardening to remove some of the hardness and increase the toughness. The material is heated to a suitable temperature (the higher the temperature the greater the reduction in hardness and brittleness) and then cooled in oil or water. The screwdriver is heated to about 300°C before being cooled in order to get the correct balance between hardness and toughness.

4 marks

- (iii) Safety precautions include –

- Wearing of protective clothes.
- Hold a torch away from you when lighting.
- Never pick up a piece of metal without being sure it is cold.
- Use a suitable oil that will not ignite for cooling.

Any **two** suitable precautions @ 1 mark each

8 marks

- (b) (i) **Annealing** is a heat treatment process that makes a material as soft as possible.

- (ii) **Brittleness** is when a material fractures easily by impact.

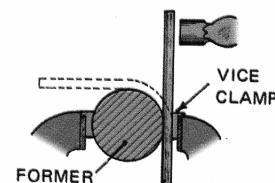
- (iii) **Conductivity** is the ability of a material to allow heat and electricity to flow through it.

- (iv) **Ductility** is the ability of a material to be stretched permanently without rupture.

Explain any **two** terms @ 2 marks each

4 marks

- (c) (i) The bracelet is formed using a circular former which is held in the vice and then striking the blank with a mallet using glancing blows.



Suitable description @ 2 marks

Suitable diagram @ 2 marks

- (ii) **Engraving** cutting designs into metal using a sharp tool.

**Enamelling** is the fusing of enamel (a glass powder) onto the metal surface by firing in a kiln.

**Etching** acid is used to bite away portions of a metal surface to produce a desired design.

Any **two** @ 2 marks each

8 marks



## Question Seven

20 marks

- (a) (i) Keyboard - Input  
Printer - Output  
Robotic Arm - Output  
Scanner - Input

*Input or Output @ 1 mark each*

- (ii) **CPU**- This is the central processing unit. This is the main electronic chip that runs the computer. It is considered to be the 'brain' of the computer.

**Monitor**- This is the screen that displays information.

**RAM**- This stands for random access memory. This is memory used to temporarily store files while working on them.

**WWW**- This is the world wide web also known as the internet.

*Any two @ 2 marks each*

- (iii) **Electrical surges**- damage to PCs may be prevented by the use of extension leads with surge protectors. A fuse in the lead would blow if a surge were to occur.

**Virus**- a PC should have anti virus software installed to protect from any virus which could attack and corrupt computer files.

*Explain both @ 1 mark each*

- (iv) **A** - This is a floppy disk.  
**B** - This is a compact disk (CD)  
**C** - This is a removable disk. It may also be called a memory stick, a flash drive, a USB disk or a plug and play device.

*Name each device @ 1 mark each*

13 marks

- (b) (i) **CNC** stands for Computer-Numerical-Control. CNC machines are controlled using codes based on numbers.

*1 mark*

- (ii) Both machines hold the workpiece in a chuck.

*Any one similarity @ 1 mark*

The tool bit is held behind the chuck on the CNC lathe.

*Any one difference @ 1 mark*

- (iii) **CAD/CAM** stands for Computer-Aided-Design and Computer-Aided-Manufacture. This allows for a component to be drawn on computer, a program is then written by the computer from the drawing which then allows the component to be manufactured.

*2 marks*

- (iv) **CAD/CAM** systems are fast and accurate.

*Any two advantages @ 1 mark each*

7 marks