

GENERAL CERTIFICATE OF SECONDARY EDUCATION
DESIGN AND TECHNOLOGY
ELECTRONICS AND CONTROL SYSTEMS

A514/03

Technical Aspects of Designing and Making
Mechanisms

Candidates answer on the question paper.

OCR supplied materials:

None

Other materials required:

- A calculator may be used

Tuesday 25 January 2011
Morning

Duration: 1 hour 15 minutes



Candidate forename		Candidate surname	
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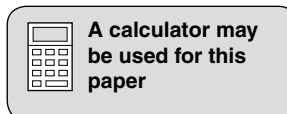
Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions in **Section A and Section B**.
- Do **not** write in the bar codes.
- 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.
- The total number of marks for this paper is **60**.
- Marks will be awarded for the use of correct conventions.
- Your quality of written communication is assessed in questions marked with an asterisk (*).
- Dimensions are in millimetres unless stated otherwise.
- This document consists of **16** pages. Any blank pages are indicated.



Section A

Answer **all** questions.

1 Fig. 1 shows a school-built electric car designed to compete in a national race series.

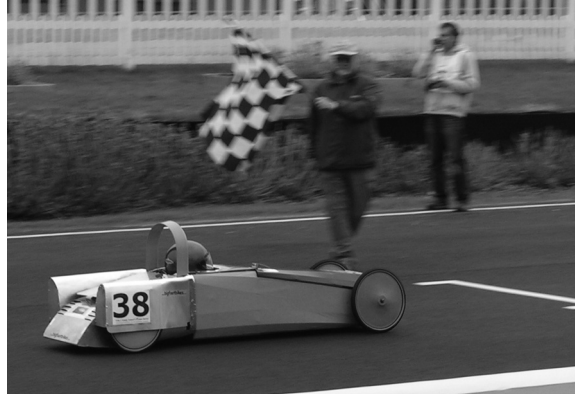


Fig. 1

(a) The car is powered by a permanent magnet DC electric motor.

Give **two** environmental benefits of using an electric motor as a source of power.

- 1
- 2 [2]

(b) The electric motor manufacturer states that the motor is 73% efficient.

State **one** form of wasted energy.

..... [1]

(c) The team are designing a new car and are considering two different drive train solutions;

- chain and sprocket
- vee-belt and pulley.

Other than cost, give **one** advantage and **one** disadvantage for each drive solution.

(i) Chain and sprocket.

Advantage

Disadvantage [2]

(ii) Vee-belt and pulley

Advantage

Disadvantage [2]

(d) Fig. 2 shows an electric motor with a chain and sprocket drive.

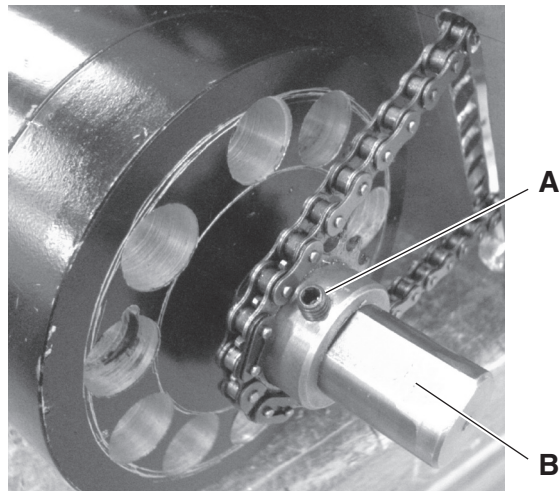


Fig. 2

(i) Draw on Fig. 2 to show the **pitch** of the chain. [1]

Component **A** is used to fix the sprocket in place.

(ii) Name component **A**.
..... [1]

(iii) Name the feature labelled **B** and state its purpose.
Feature
Purpose [2]

Fig. 2 shows holes that have been machined in the electric motor casing. There are a similar number of holes at the other end of the motor.

(iv) State the purpose of the holes [1]

[Total: 12]

2 Fig. 3 shows a G clamp.

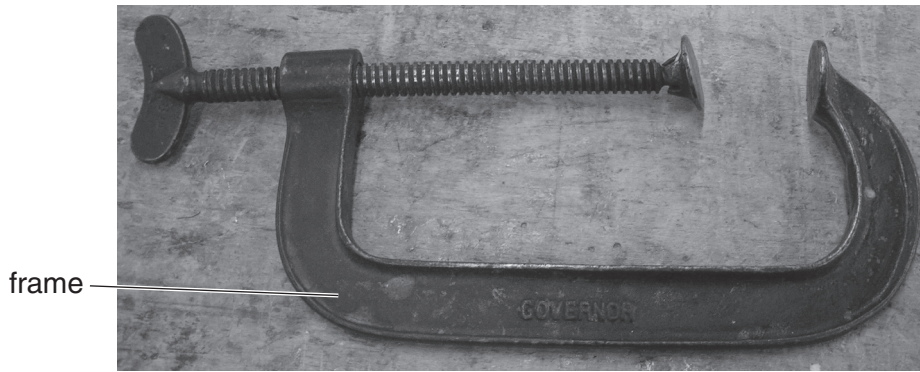


Fig. 3

(a) Fig. 4 shows the coarse pitch thread used in the G clamp.

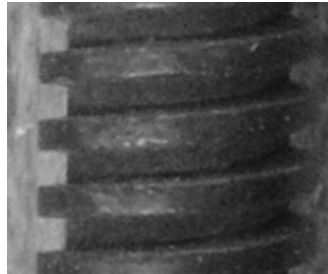


Fig. 4

Name the thread form shown in Fig. 4.

..... [1]

(b) Fig. 5 shows two operating handles that can be used in G cramps.

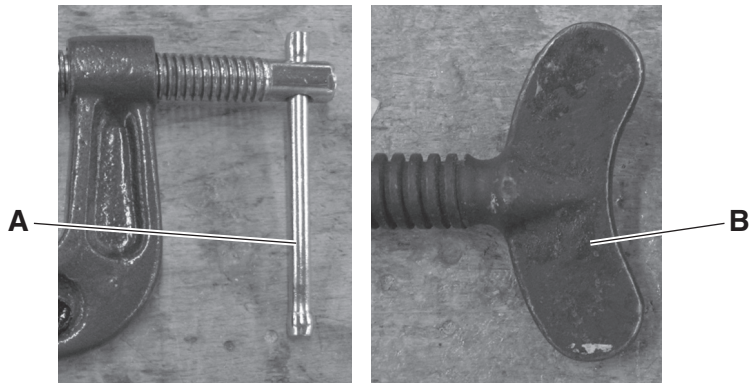


Fig. 5

Give **two** advantages of operating handle **A** over **B**.

- 1
- 2 [2]

(c) (i) Name the material used for the G clamp frame shown in Fig. 3.

..... [1]

(ii) State a method of manufacture for the G clamp frame shown in Fig. 3.

..... [1]



Fig. 6

Fig. 6 shows a pair of light duty clamps suitable for model making. Clamp **A** is made of steel with rubberised handles and clamp **B** is made of a plastics material.

(d) What class of lever does clamp **B** employ?

..... [1]

3 Fig. 7 shows a torque wrench.

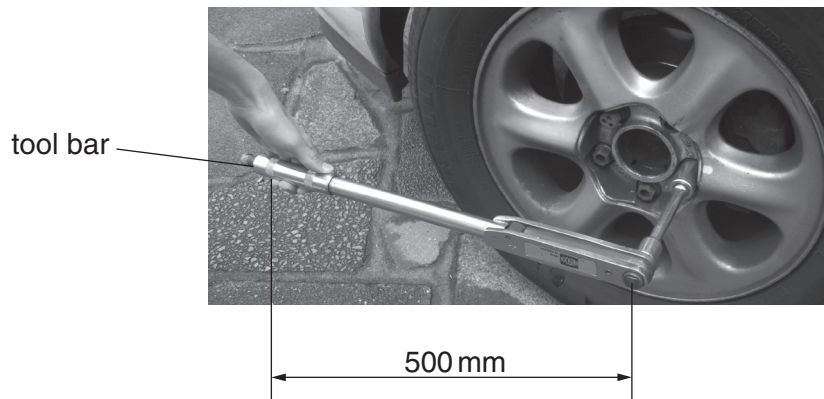


Fig. 7

(a) State what is meant by 'torque'.

..... [1]

(b) The length of the tool bar is 500 mm and the torque setting for the wheel nut is 94 NM. Calculate the force required to achieve a torque of 94 NM.

Use the formula below.

Moment = force × distance

In equilibrium $M_c = M_{ac}$

M_c = clockwise moment M_{ac} = anticlockwise moment

..... [2]

(c) Good quality tools are often made of alloys which have undergone forging during the manufacturing process.

(i) State what is meant by the term 'alloy'.

..... [1]

(ii) State what is meant by the term 'forging a metal'.

..... [1]

(d) (i) Give **one** reason good quality tools are often finished by electro plating.

..... [1]

(ii) Name **one** metal used for electroplating tools.

..... [1]

(e) Fig. 8 shows two types of 20 mm sockets.

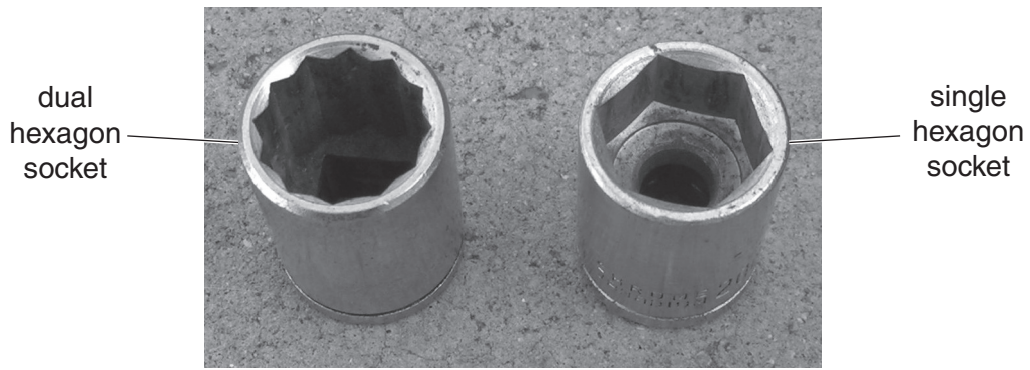


Fig. 8

(i) 20 mm refers to the A/F dimension of a 20 mm hexagon nut.

State what is meant by the term A/F.

..... [1]

(ii) Give **two** advantages of the single hexagon socket type.

Advantage 1

Advantage 2 [2]

(iii) Give **two** disadvantages for the dual hexagon socket type.

Disadvantage 1

Disadvantage 2 [2]

[Total: 12]

Section B

Answer **all** questions.

4 Fig. 9a shows a cam demonstration unit designed for use in a school workshop.

The three cam shapes used in the model are shown in Fig. 9b.

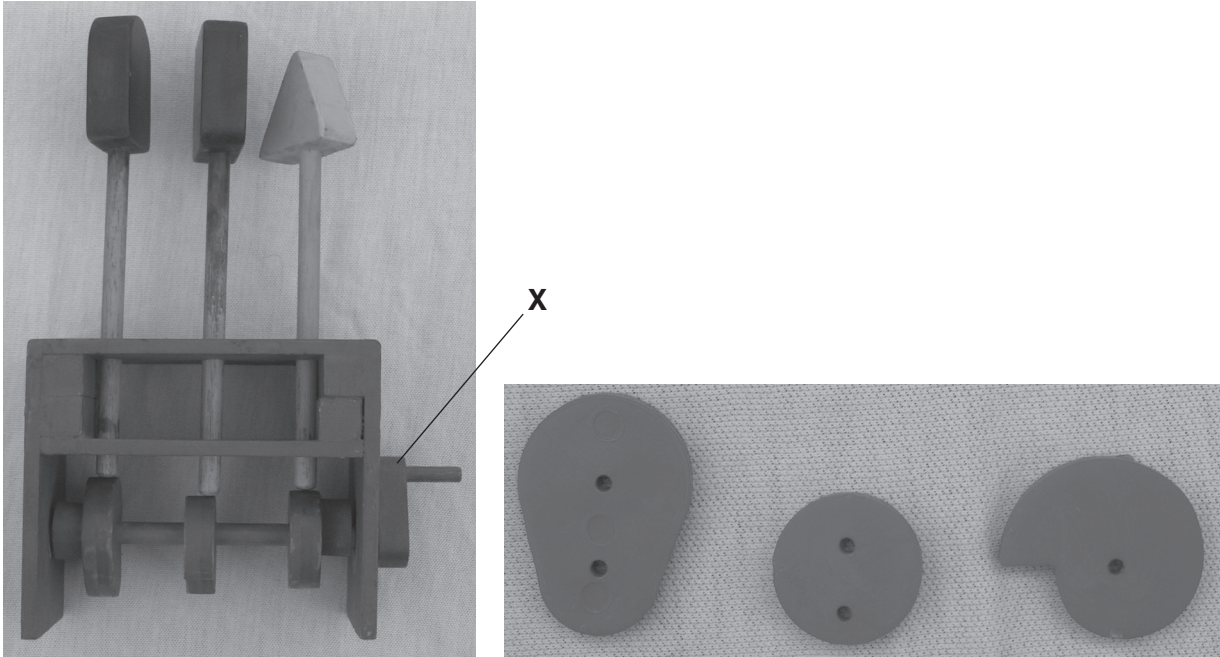


Fig. 9a

Fig. 9b

The demonstration unit is hand operated by turning handle **X**.

(a) Name the mechanism used to operate the demonstration unit.

..... [1]

(b) State the technical name of the vertical rods that rest on each cam.

..... [1]

(c) The operator finds that the unit will only turn in one direction.

State the reason why.

.....
..... [1]

(d) The cam demonstration unit uses three different cam profiles.

Match the name of the cam to the type of motion they produce.

pear-shaped cam eccentric cam snail cam

The cam produces a sudden rise and fall.

The cam produces a steady rise and fall.

The cam produces a slow rise and a sudden fall.

[3]

Fig. 10 shows a toy made by a pupil.

When the handle is turned the bird rotates.

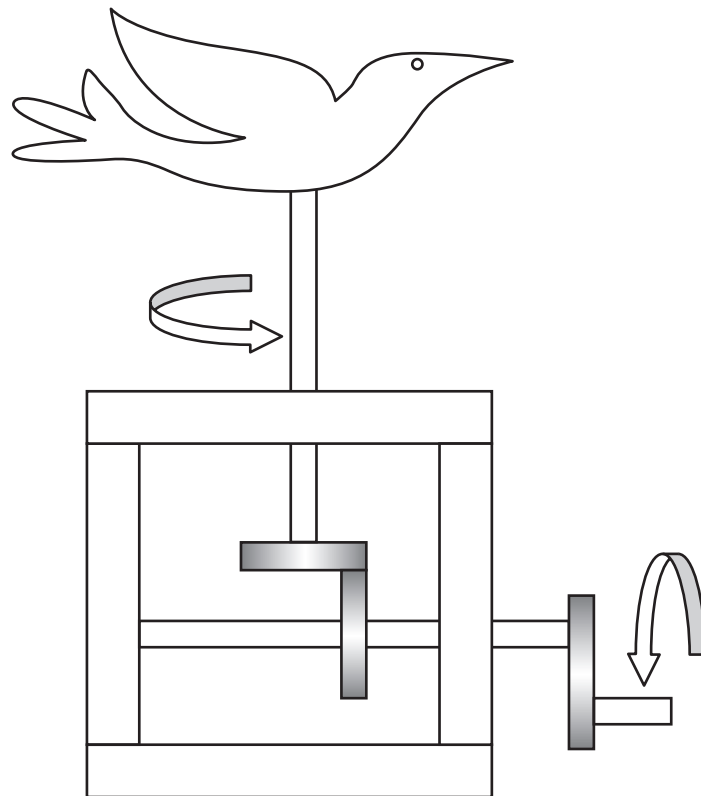


Fig. 10

(e) In the space below, draw a modification to the toy that would cause the bird to move up and down in addition to the rotary motion it currently performs.

[3]

(f) In use, the drive that makes the bird rotate slips.

Describe how this could be prevented.

.....

..... [1]

(g) In the space below draw a cam profile that will cause a slow rise and fall **three** times per revolution.

[2]

[Total: 12]

5 (a) CAD and CAM processes are often used in school and industry.

(i) State what the abbreviation CAD stands for.

..... [1]

(ii) State what the abbreviation CAM stands for.

..... [1]

(b) Fig. 11 shows a rear wheel bracket for a kit car.

It is made from different pieces of steel that have then been welded together.



Fig. 11

During the welding process the parts are held in a jig.

Give **two** benefits of using a jig.

Benefit 1

Benefit 2 [2]



Fig.12

(c) Fig. 12 shows a nut and bolt used to secure the bracket to the kit car chassis.

Name the type of nut shown and give a reason why this type of nut was chosen.

Name

Reason

..... [2]

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