OCR
RECOGNISING ACHIEVEMENT

GENERAL CERTIFICATE OF SECONDARY EDUCATION

DESIGN AND TECHNOLOGY
ELECTRONICS AND CONTROL SYSTEMS
Technical Aspects of Designing and Making
Mechanisms

A514/03

Candidates answer on the question paper.

OCR supplied materials:
None

Other materials required:
• A calculator may be used

Wednesday 22 June 2011
Morning

Duration: 1 hour 15 minutes

Candidate forename		Candidate surname	

Centre number						Candidate number					

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.

> A calculator may
> be used for this
> paper

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Turn over
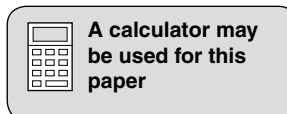
Section A

Answer **all** questions.

1 Fig. 1 shows a mechanism used to join two shafts together.

Fig. 1

(a) Name the mechanism in Fig. 1.

(i) ....

Describe the purpose of the mechanism shown in Fig. 1.

(ii) ....

....

.... **[2]**

(b) Fig. 2 shows a drum, motor and drive belt assembly in a tumble dryer.
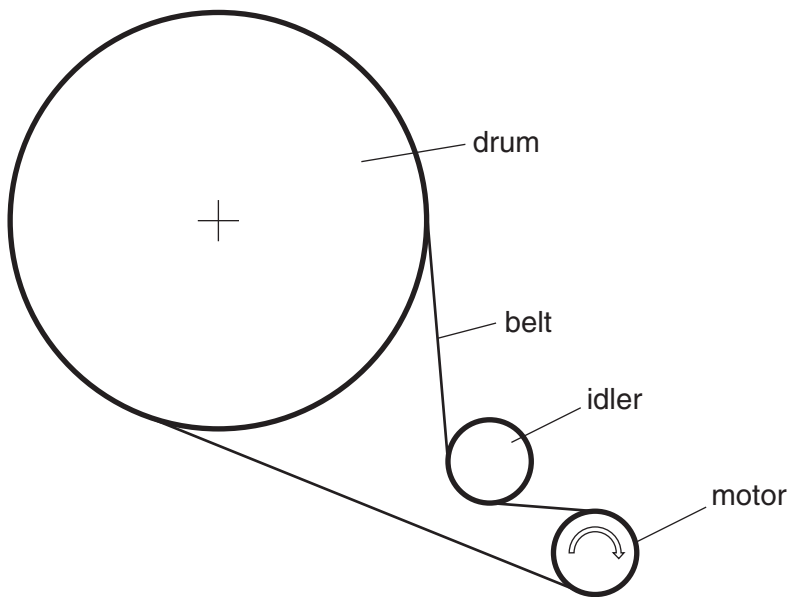
Fig. 2

In use the belt would wear and require a tensioning device.

Draw on Fig. 2 the best position for a belt tensioning device. **[1]**

(c) Belt tensioning systems are often spring-loaded and fully automatic.

Give **two** benefits of automatic belt tensioning systems.

Benefit 1 ....

Benefit 2 .... **[2]**

(d) State the purpose of the idler pulley shown in Fig. 2.

.... **[1]**

(e) Fig. 3 shows the section of a poly-vee belt.

Fig. 3

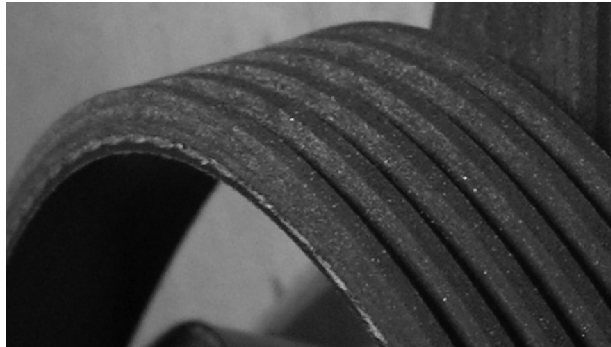Poly-vee belts are often used in preference to vee-belts.

Give **two** reasons, other than cost, why poly-vee belts are used.

Reason 1 ....

Reason 2 .... **[2]**

(f) Fig. 4 shows a clutch plate used in a car.

Fig. 4

Label the clutch plate friction material on Fig. 4. **[1]**
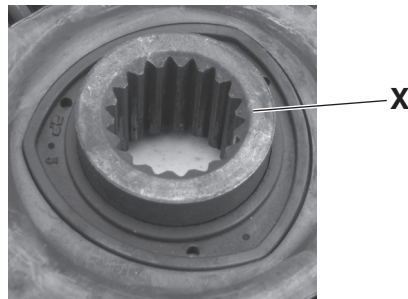
Fig. 5

(g) Fig. 5 shows an enlarged view of part of the clutch plate shown in Fig. 4.

  (i) Name the engineering feature **X** shown in Fig. 5.

  .... **[1]**

  (ii) Explain what the engineering feature shown in Fig. 5 allows the clutch plate to do.

  ....

  ....

  .... **[2]**

[Total: 12]

2 Fig. 6 shows a pair of pincers.

Fig. 6

(a) Indicate clearly on the pincers in Fig. 6:

   (i) effort

   (ii) fulcrum

   (iii) load

   [3]

(b) State what class of lever is used in the pair of pincers.

.... **[1]**

(c) Fig. 7 shows a pair of pincers being used to remove a nail.

Fig. 7

Indicate clearly on Fig. 7:

   (i) effort

   (ii) fulcrum

   (iii) load

   [3]

(d) When two or more levers are used together they are said to form a:

.... lever.   **[1]**

Turn over

(e) Fig. 8 shows a tool for removing corks from bottles.
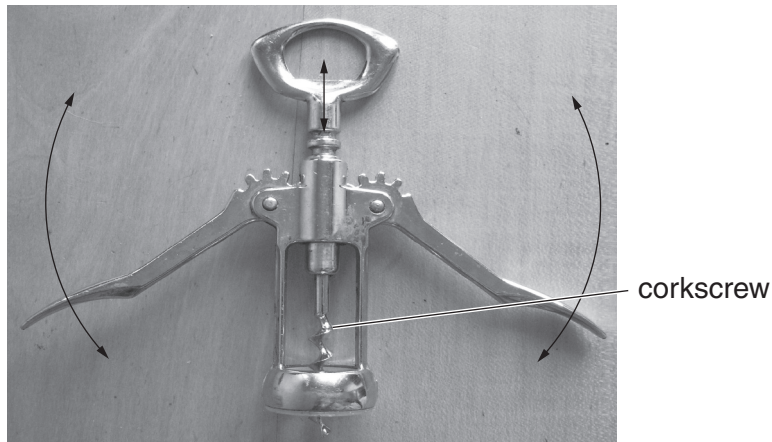
corkscrew

Fig. 8

In use, both handles and corkscrew move as shown in Fig 8.

State the conversion of motion that takes place when the handles are moved.

.... motion in the handles is converted to

.... motion in the corkscrew. **[2]**

(f) Name the mechanism used in the tool above to remove the cork.

.... **[1]**

(g) The top of the corkscrew includes an additional feature designed to open crown cap bottles.

Fig. 9 shows the device in use.

load

pivot

effort
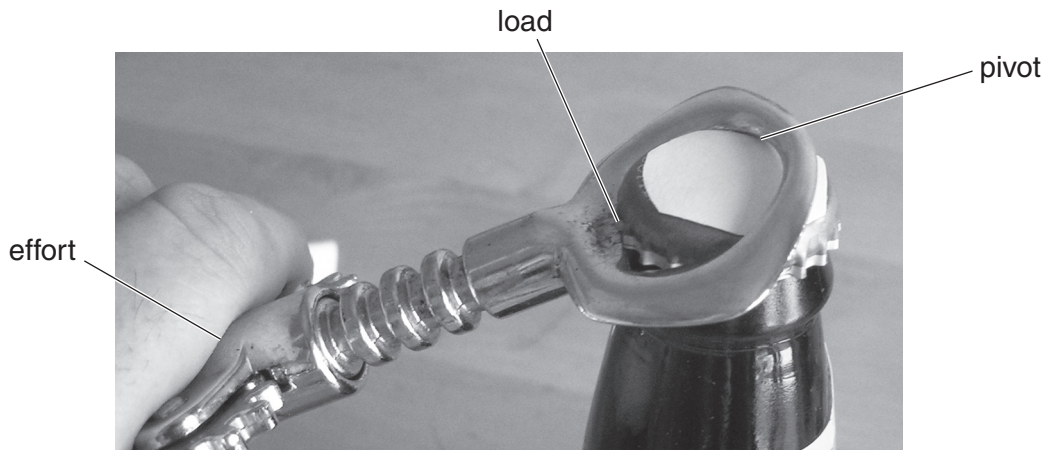
Fig. 9

State the class of lever being used in Fig. 9.

.... **[1]**

[Total: 12]

3 (a) Fig. 10 shows three different ball bearing assemblies.
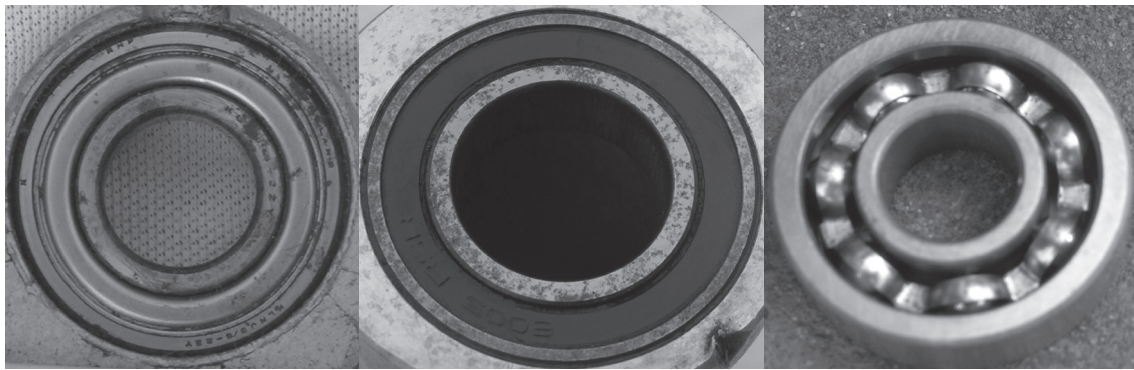
shielded bearing   sealed bearing   open cage bearing

Fig. 10

   (i) Match each type of bearing to the applications listed below.

   Inside a high speed engine use a .... bearing.

   On an off-road vehicle operated in dusty conditions use a

   .... bearing.

   On a fuel economy vehicle running on a clean tarmac race track use a

   .... bearing.

                                                                                   [3]

   (ii) Give **one** reason why bearings are lubricated.

   .... **[1]**
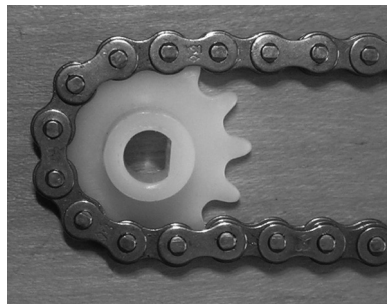
Fig. 11

(b) Fig. 11 shows a nylon sprocket designed for a low speed chain drive.

   (i) Give **one** reason why nylon is a suitable material for a light duty chain drive.

   .... **[1]**

   (ii) State how drive is transmitted from a drive shaft to the nylon sprocket shown in Fig. 11.

   .... **[1]**

Turn over

(c*) During 2009 the British Government launched a scheme to scrap old cars.

Many of the cars scrapped were in working order with many years life remaining.

Discuss the environmental issues raised by this scheme.

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.... **[6]**

[Total: 12]

Section B

Answer **all** questions.
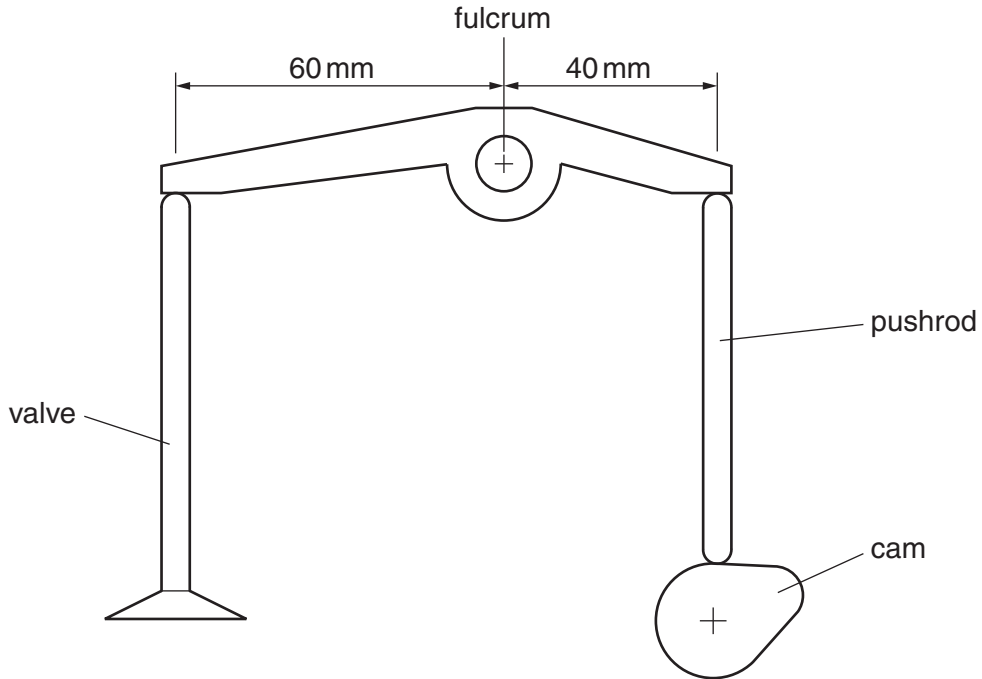
4 Fig. 12 shows a valve rocker assembly.

Fig. 12

(a) If the pushrod exerts a force of 4 NM, calculate the force applied to the intake valve.

Use the formula below

Moment = force × distance
In equilibrium Mc = Mac
Mc = clockwise moment   Mac = anticlockwise moment

....

.... **[2]**

(b) Fig. 13 shows part of the mechanism on a piece of old farm machinery.
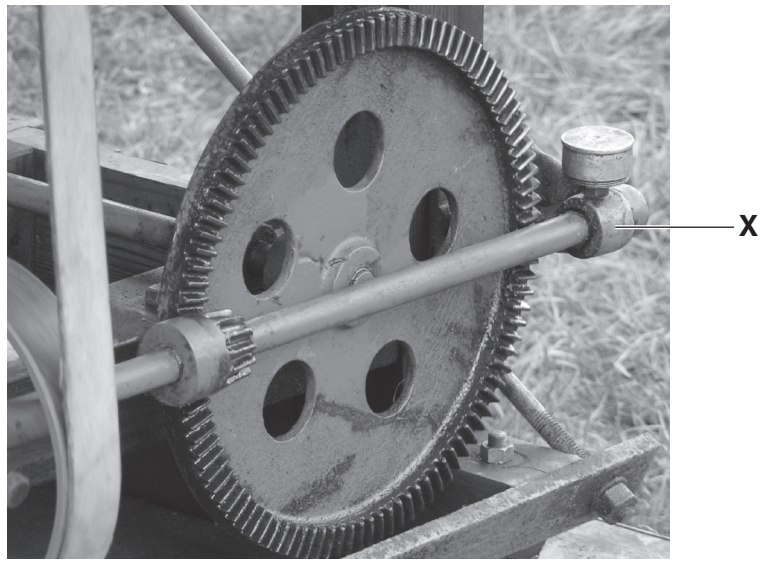
Fig. 13

Name the type of gears shown in Fig. 13.

.... [1]

(c) The bearing at **X** is lubricated by grease.

State why grease is used rather than oil.

....

.... [1]

(d) (i) Calculate the velocity ratio of the pair of gearwheels shown in Fig. 13.

The small driving gear wheel has 10 teeth. The large driven gearwheel has 110 teeth.

Use the formula VR = number of teeth on driver / number of teeth on driven.

....

.... [2]

(ii) If the large gearwheel rotates at 12 rpm, calculate the rpm of the small gear wheel.

....

.... [2]

(e) Fig. 14 shows a piece of farm machinery driven by an engine.

Fig. 14

The drive belt between the engine and the machinery has been crossed over.

Give the reason for crossing the belt.

.... **[1]**

(f) The belt used is a Vee belt and the driven machinery is fitted with the correct section pulley for that type of belt. The engine is fitted with a flat belt pulley. For the purpose of a demonstration the system worked.

State on which pulley the belt would slip on first, if a greater load was placed on the machinery.

.... **[1]**

(g) Describe a modification that would help prevent slippage.

....

....

.... **[2]**

[Total: 12]

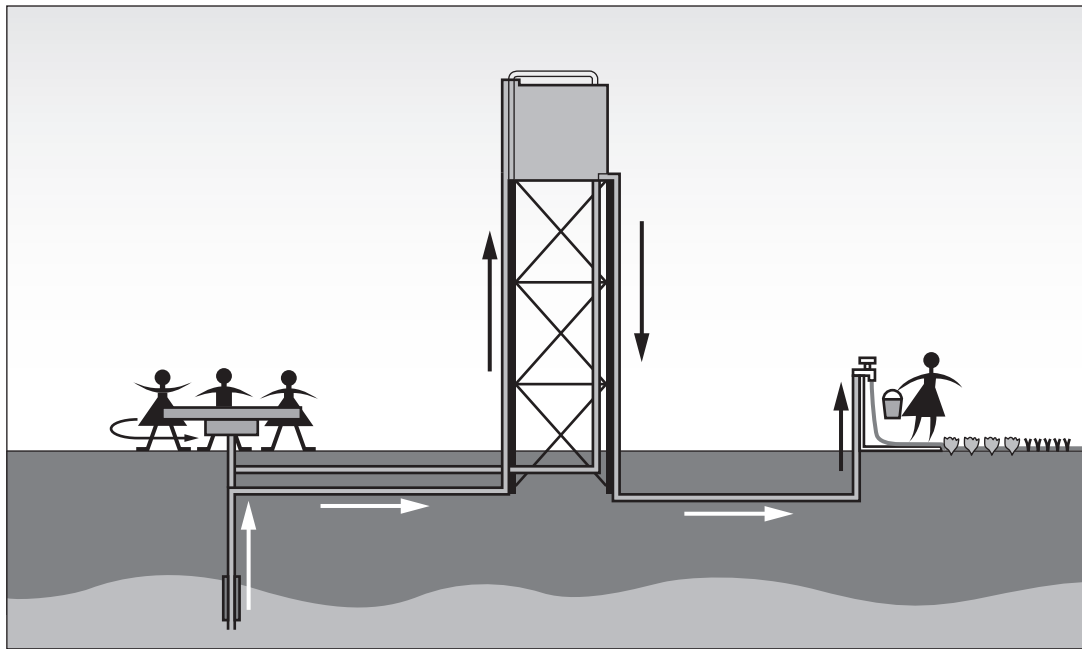**5** Fig. 15 shows the basis of a water pumping system.

Fig. 15

PlayPumps International is an organisation that has funded and donated more than 1,200 PlayPump ®™ systems in Africa. It provides the benefits of clean drinking water to millions.

While children have fun spinning on the PlayPump ®™ merry-go-round, clean water is pumped from underground into a tank. A tap is used to fill buckets with water.

(a) The whole product is shipped partly assembled. When the steel tower arrives it requires several different parts to be joined together without access to welding processes.

   (i) Name a suitable temporary fixing for use in assembling the steel tower.

     .... **[1]**

   (ii) State a suitable process that would help prevent corrosion of the steel tower.

     .... **[1]**

(b) Waterwheels are often used in areas of high rainfall. They are powerful but turn slowly.

Show on Fig. 16 below, a mechanism that will change rotary motion from the waterwheel shaft into **reciprocating** motion to operate the bellows that blow air for the blacksmiths forge.

The bellows require a maximum stroke of 300 mm.

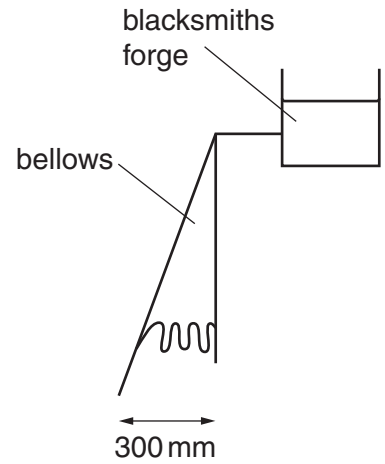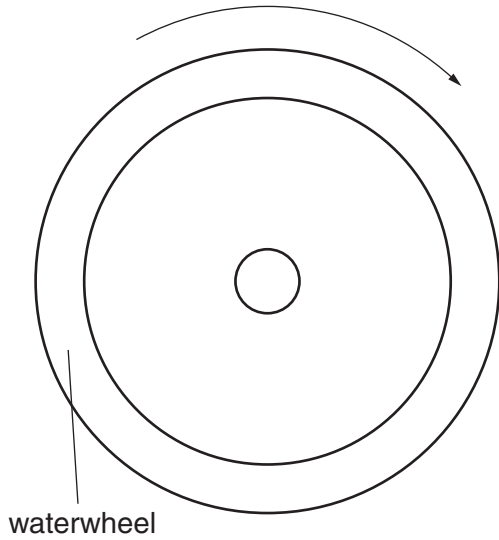Name and dimension key parts of your design.

waterwheel

blacksmiths forge

bellows

300 mm

Fig.16

[4]

(c*) The Playpump merry-go-round shown in Fig. 15 is a multi-purpose mechanism.

Discuss the factors that would have been considered in the design of the Playpump merry-go-round.

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.... **[6]**

[Total: 12]

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