



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

**A514/03**

Technical aspects of designing and making  
 Mechanisms

**Tuesday 26 January 2010**  
**Morning**

**Duration: 1 hour 15 minutes**

Candidates answer on the Question Paper

**OCR Supplied Materials:**  
 None

**Other Materials Required:**

- A calculator may be used



Candidate Forename		Candidate Surname	
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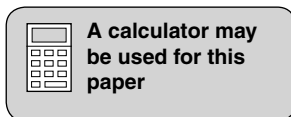
Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.
- 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 **20** pages. Any blank pages are indicated.



## Section A

Answer **all** questions.

1 Screw threads are important components in many mechanisms.

Fig. 1 shows a screw thread with three dimensions marked.

(a) Label the dimensions to show the following features:

- outside diameter;
- core diameter;
- pitch.

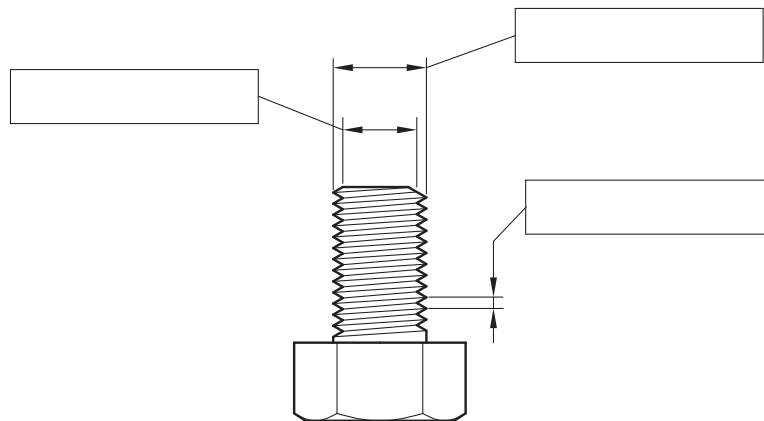


Fig. 1

[3]

(b) When a mechanism is operating, threaded components can vibrate loose.

Use notes and sketches to show **one** method of preventing a nut from vibrating loose once it has been tightened.

[1]

(c) Two types of spanner are shown in Fig. 2; both types could be used on hexagon nuts.



open ended spanner



ring spanner

**Fig. 2**

Give **one** benefit for each of the spanners.

open ended spanner .....

..... [1]

ring spanner .....

..... [1]



5  
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2 (a) Fig. 3 shows nail clippers which are an example of a compound lever system.

In a compound lever system one lever operates another.

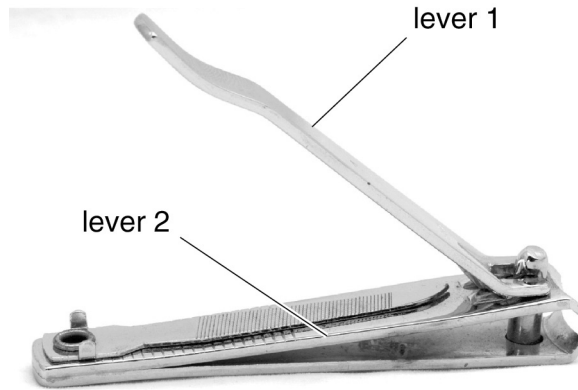


Fig. 3

(i) State the order of each lever.

lever 1 ..... [1]

lever 2 ..... [1]

(ii) A bell crank lever from a railway signal is shown in Fig. 4.

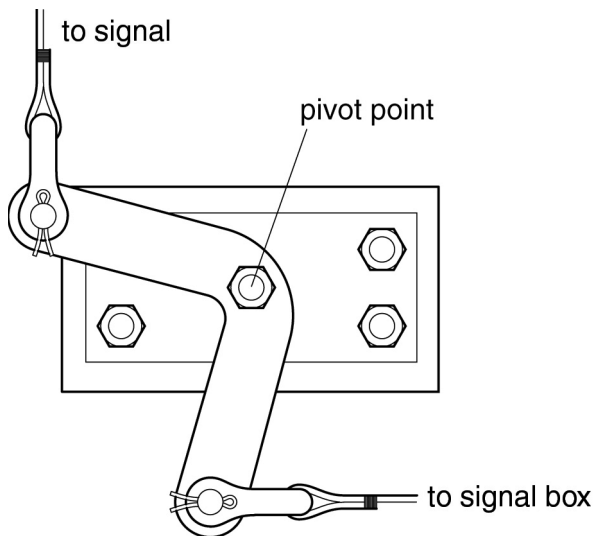


Fig. 4

Give **two** important features of the bell crank lever in Fig. 4.

1 ..... [1]

2 ..... [1]

(b) The collapsible shelf bracket shown in Fig. 5 has two support bars made from mild steel.

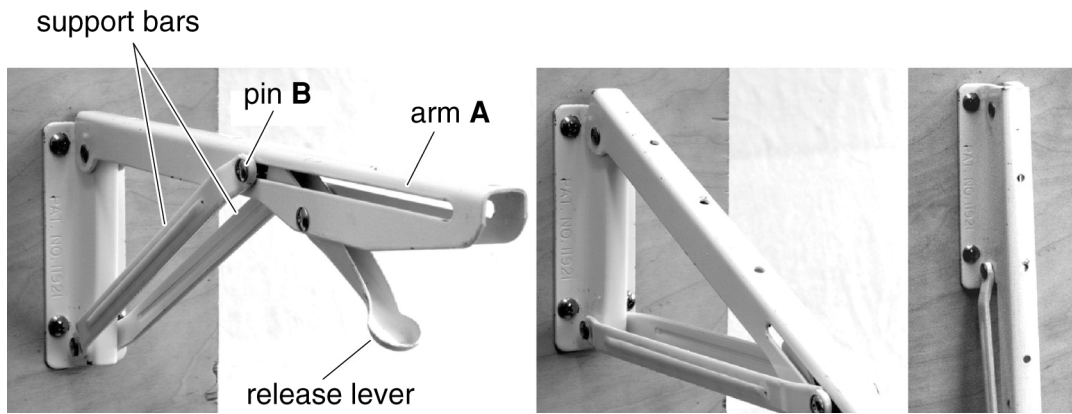


Fig. 5

(i) Give **one** reason for the pressed shaping and bend in each support bar.

..... [1]

(ii) State the conversion of motion that is taking place between arm **A** and pin **B** when the support in Fig. 5 is lowered or raised.

..... motion in arm **A**

is converted to ..... motion in pin **B**. [2]

(c) Fig. 6 shows a decorators skeleton sealant gun.

Pressure is applied at the trigger lever and the pressure plate is forced into the sealant tube, forcing sealant out at the nozzle.

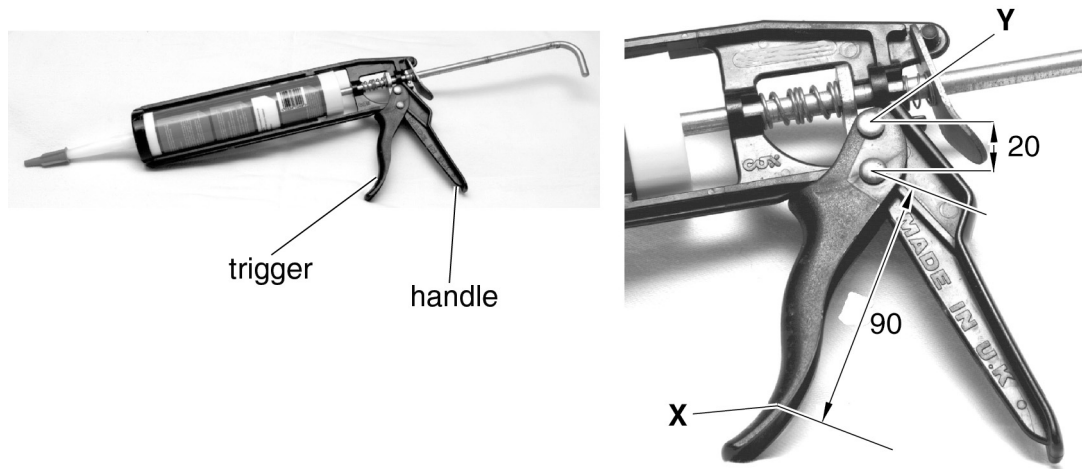


Fig. 6

(i) An effort of 40 N is applied to the trigger at point X.

Calculate the resulting load at point Y.

Use the formula below.

Moment = force × distance

In equilibrium  $M_c = M_{ac}$

$M_c$  = clockwise moment  $M_{ac}$  = anticlockwise moment

.....  
 ..... [2]

(ii) The handle of the sealant gun is injection moulded from ABS.

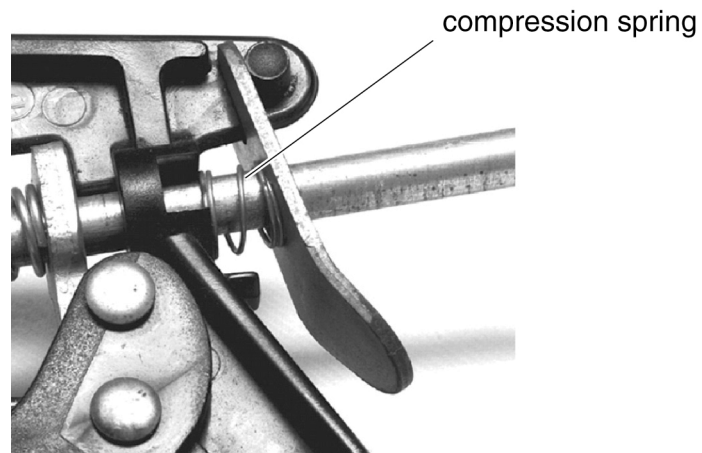
Give **two** reasons for choosing ABS as a suitable material.

1 ..... [1]

2 ..... [1]



- (iii) The release lever which removes pressure from the sealant tube is shown in Fig. 7.  
Effort is provided by thumb pressure on the lever.  
State the load being moved by the lever.



**Fig. 7**

Load ..... [1]

**[Total: 12]**

- 3 (a) Small electric servo motors are used to operate the controls in a model aircraft.

Fig. 8 shows a gearbox on a servo motor.

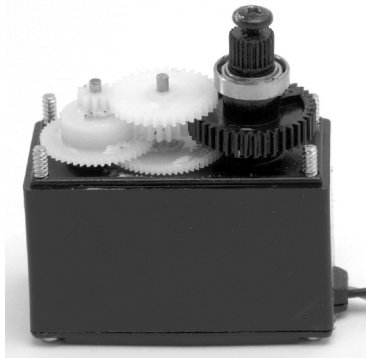


Fig. 8

- (i) Give **two** reasons for using a gearbox on this motor.

1 ..... [1]

2 ..... [1]

- (ii) Calculate the reduction given by the gear system shown in Fig. 9.

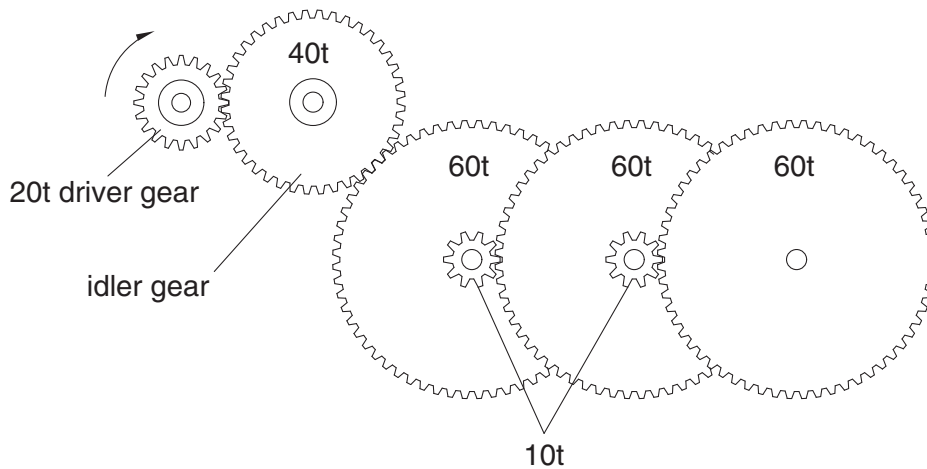


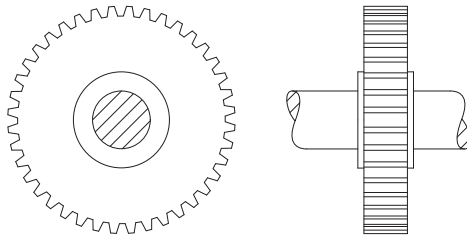
Fig. 9

.....  
 ..... [3]

- (iii) Mark the direction of rotation of the output on the gear system in Fig. 9.

..... [1]

(b) Gears often have to be fixed to a shaft. Fig. 10 shows a gear on a shaft.



**Fig. 10**

Use notes and sketches to describe how the gear in Fig. 10 could be fixed to prevent rotation of the gear on the shaft.

[2]

(c) When designing a gearing system models are often used.

Two model gear systems giving the same reduction are shown in Fig. 11.

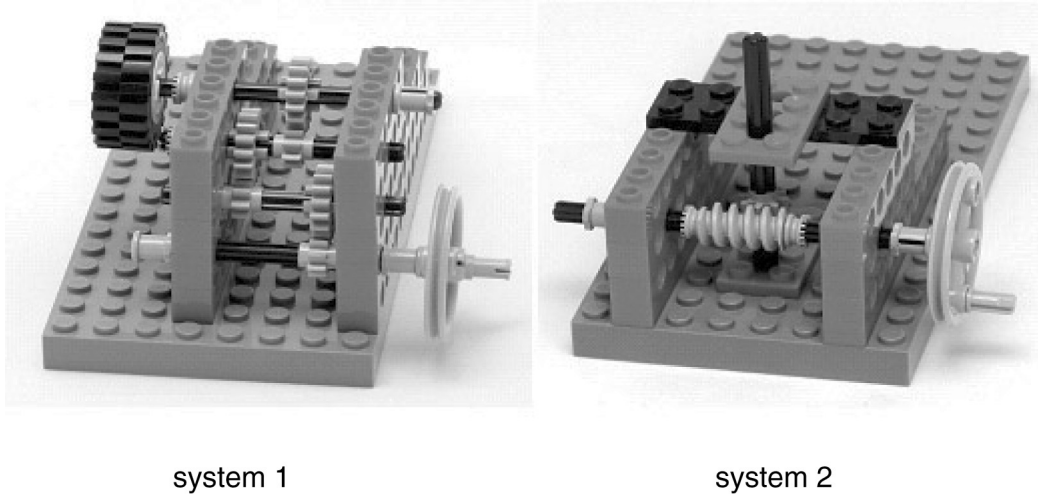


Fig. 11

Give **two** benefits of using system 2 rather than system 1 to obtain the reduction.

- 1 ..... [1]
- 2 ..... [1]

(d) Explain why oil rather than grease is used to lubricate high speed gear systems.

- .....
- .....
- ..... [2]

[Total: 12]

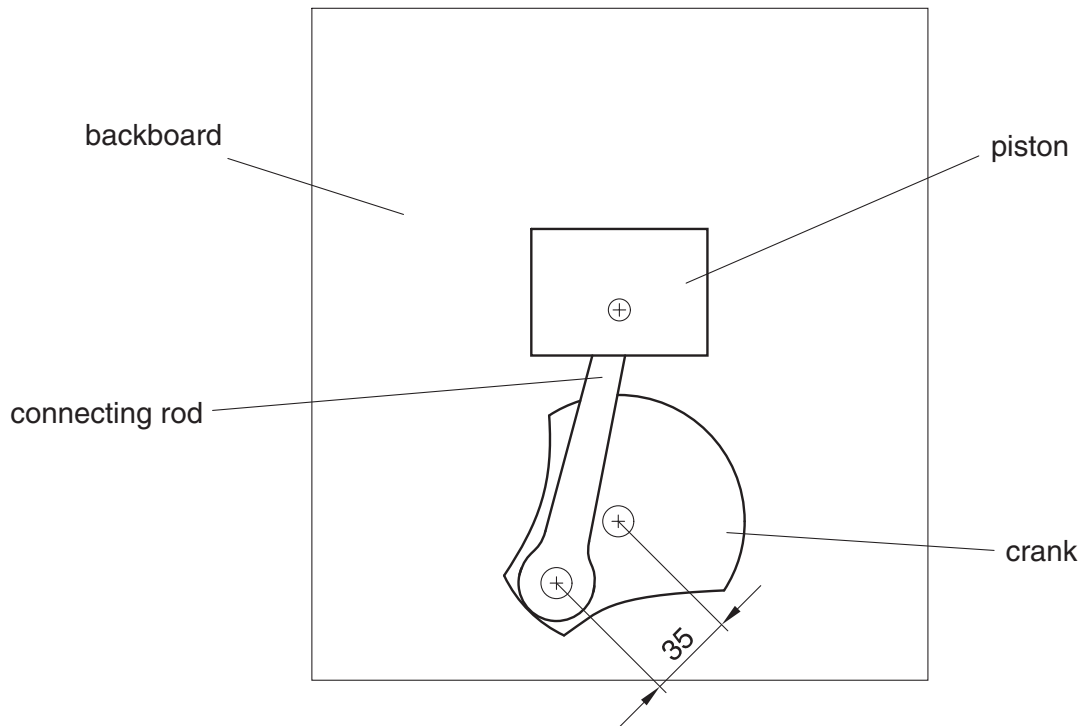
## Section B

Answer **all** questions.

- 4 (a) A model made from 4 mm acrylic sheet will show the principle of a piston engine.

The model will show how a crank can be used to convert reciprocating motion to rotary motion.

The layout of piston, connecting rod and crank is shown in Fig. 12.



**Fig. 12**

- (i) State the distance moved by the piston from highest to lowest position.

..... [1]

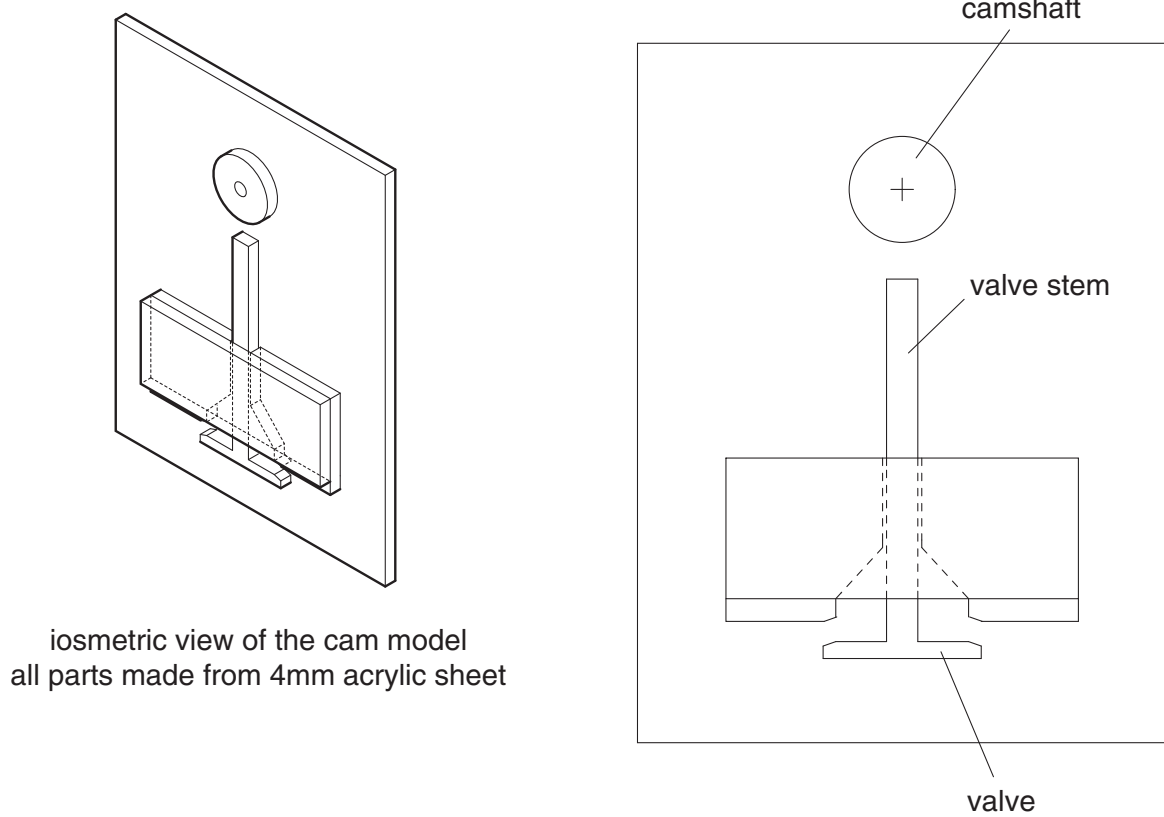
- (ii) The piston must be kept vertical on the backboard of the model but still allowed to move up and down.

Use notes and sketches to show how this can be done using 4 mm acrylic sheet.

[3]

(b) An additional model will be a camshaft that operates a valve.

Fig. 13 shows the arrangement of the components.



isometric view of the cam model  
all parts made from 4mm acrylic sheet

**Fig. 13**

- (i) Draw on Fig. 13 the outline of a cam with a single rise and fall for each rotation of the camshaft. The valve is shown at its lowest position. [2]
- (ii) Use notes or sketches to describe **one** method of keeping the valve stem in contact with the cam at all times.

(c) Designers often have to give instructions to a manufacturer.

Give **two** instructions for polishing the edges of the acrylic used in the model.

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

2 .....  
..... [1]

(d) State **one** environmental reason for making the model from a single material.

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

[Total: 12]



5 (a) Fig. 14 shows the side view of a stair climbing hand truck.

The truck has been designed using a CAD system.

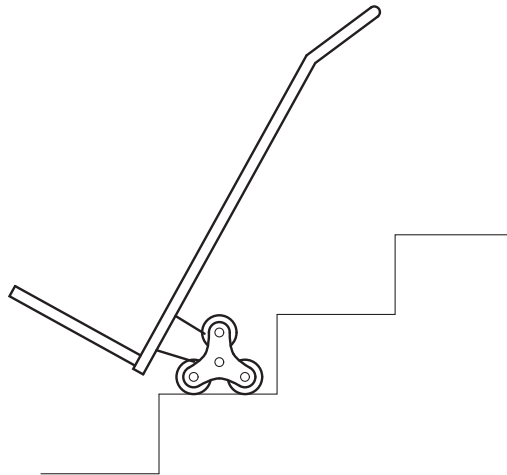


Fig. 14

(i) Give **one** benefit to the designer of using a CAD system

..... [1]

(ii) Give **two** benefits to the manufacturer of using a CAD system.

1 ..... [1]

2 ..... [1]

(b) Fig. 15 shows details of one of the side plates.

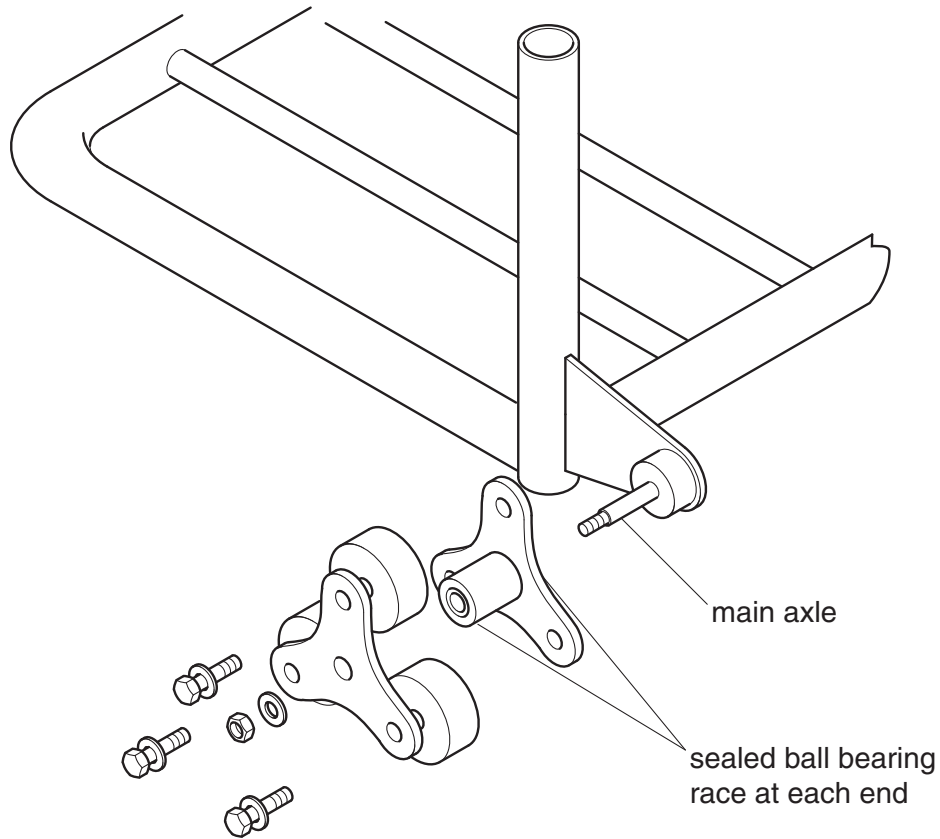


Fig. 15

(i) The bearings chosen for the main axle are sealed ball bearing races.

Explain why this type of bearing is suitable for the truck.

.....  
.....  
..... [2]

(ii) State the name of **one** other type of bearing that could be used for the main axle.

..... [1]



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