1 Fig. 1 shows a wrist band locker key used in swimming pools. The key swivels into the plastic holder for safety when the wearer is swimming.

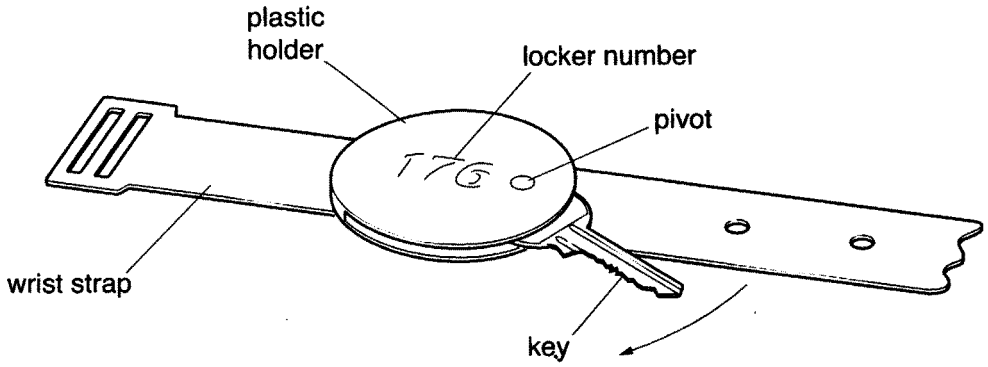


Fig. 1

(a) Name a type of CNC machine that could be used to cut the locker number on each plastic holder.

_____ [1]

(b) Give **three** pieces of information needed to set up the CNC machine.

1 _____ [1]

2 _____ [1]

3 _____ [1]

(c) Explain why the batch production method of manufacturing has been chosen for the wrist band locker key.

_____

_____

_____

_____ [2]

(d) In use the following problems have been identified:

- When closed completely, it is difficult to get the key out of the plastic holder;
- Users leave the key partly out.

Use sketches and notes to make improvements to the plastic holder that will:

- make the key easier to access;
- store the key safely.

[4]

[TOTAL 10]

2 Fig. 2 shows a trigger operated cramp and a G cramp holding pieces of wood together while glueing.

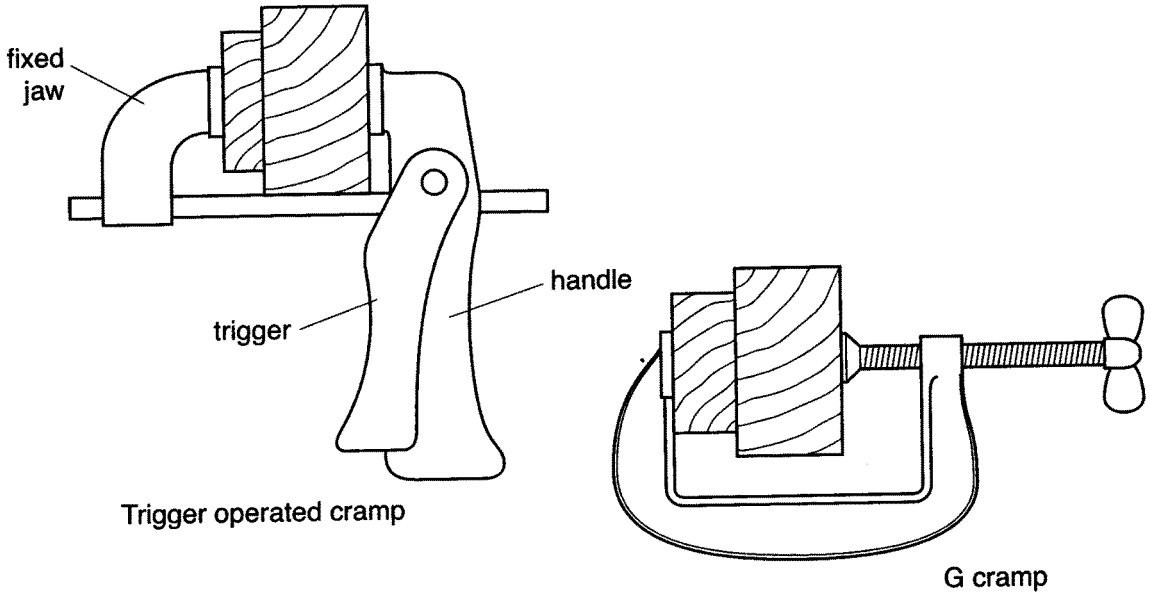


Fig. 2

(a) With reference to mechanical features, give **two** advantages that the trigger operated cramp has over the G cramp.

Advantage 1 _____

_____ [1]

Advantage 2 _____

_____ [1]

(b) Use sketches to show a modification to the jaws of the trigger operated cramp to securely hold round bars.

[2]

(c) Explain how polymorph could have been used in developing the design of the handle of the trigger operated cramp.

_____

_____ [2]

(d) Fig. 3 shows the trigger operated cramp in use as a spreading tool. This can be achieved by removing the fixed jaw and replacing it at the other end of the bar.

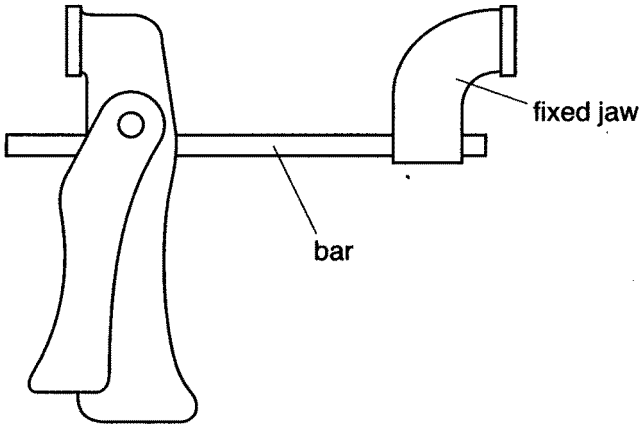


Fig. 3

Use sketches and notes to show how the fixed jaw can be:

- secured at either end of the bar;
- easily removed without the use of additional tools.

[4]

[TOTAL 10]

3 Fig. 4 shows a disc brake system used on a mountain bike in cross-country events.

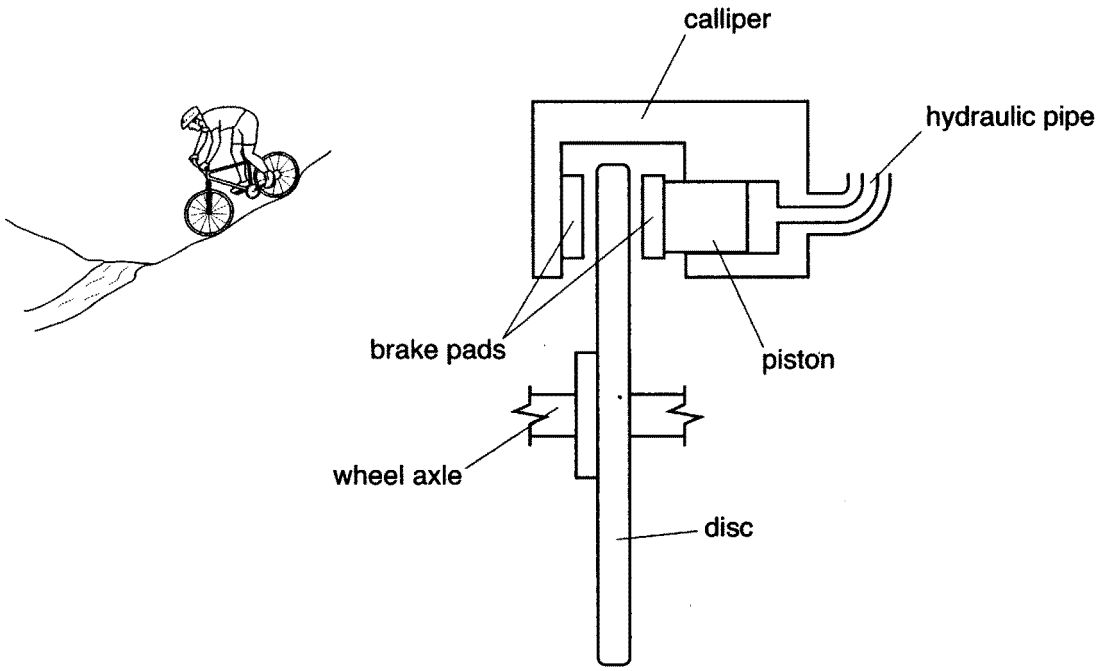


Fig. 4

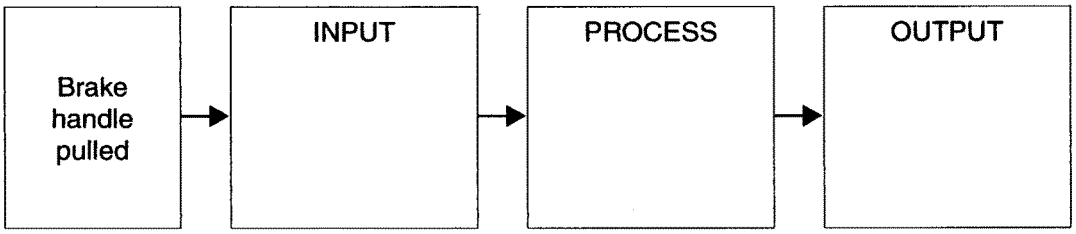
(a) Explain why mountain bikers choose to use disc brakes instead of rim brakes.

_____

_____

_____ [2]

(b) Complete the block diagram to describe how the disc brake system shown in Fig. 4 operates.



[3]

(c) State the energy conversion that takes place when the brake pads grip the disc.

_____ [1]

Fig. 5 shows the adjustment screw on a cable operated braking system.

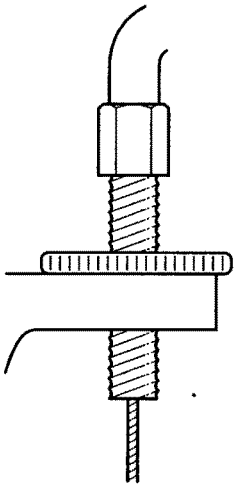


Fig. 5

(d) Describe the operation of the adjustment mechanism shown in Fig. 5.

_____

_____ [2]

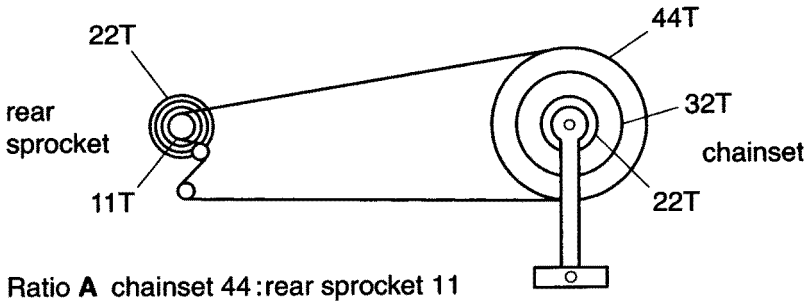
(e) Explain the need for lubrication in cable operated braking systems.

_____

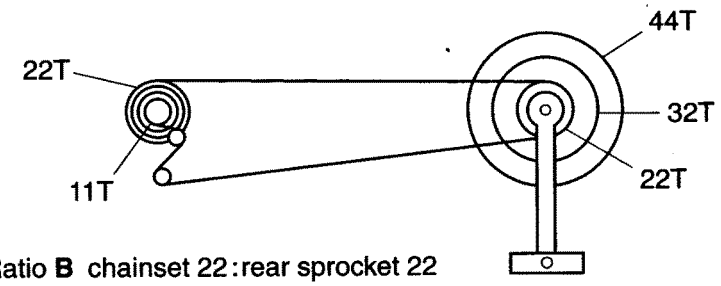
_____ [2]

[TOTAL 10]

4 Fig. 6 gives details of a chain and sprocket gear system on a bicycle.



Ratio **A** chainset 44 : rear sprocket 11



Ratio **B** chainset 22 : rear sprocket 22

Fig. 6

(a) While racing, the rider aims to turn the crank at a constant pace of 50 rpm whether riding up or downhill.

(i) Calculate the speed of the rear sprocket when the rider selects ratio **A** or ratio **B**.

Ratio **A** _____

_____

_____ [2]

Ratio **B** _____

_____

_____ [2]

(ii) Calculate the road speed achieved when using a diameter 700 mm wheel rotating at 100 rpm.

_____

_____

_____

Answer _____ metres per minute [2]

Fig. 7 shows two views of part of a chain and sprocket gear system.

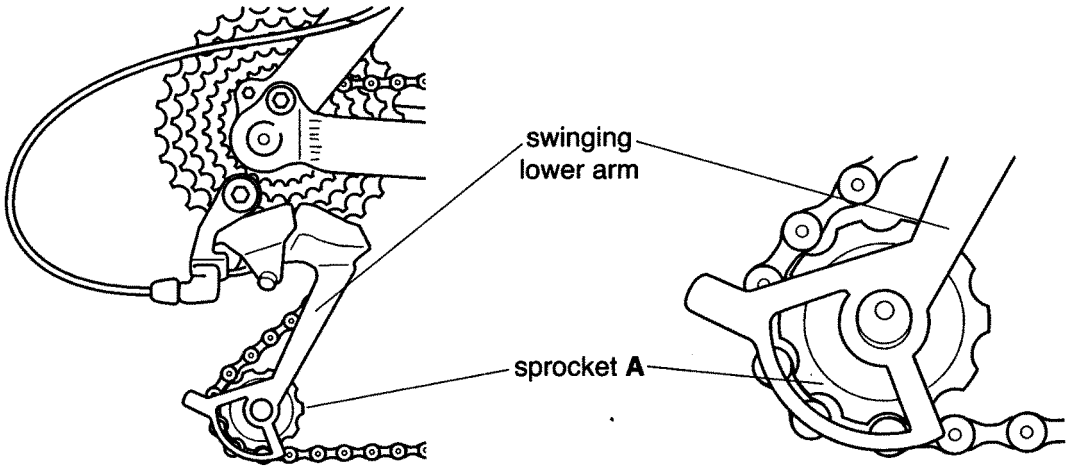


Fig. 7

(b) Explain the purpose of the swinging lower arm and sprocket **A** assembly in the system.

_____

_____

_____ [2]

(c) Fig. 8 shows the gear change lever assembly.

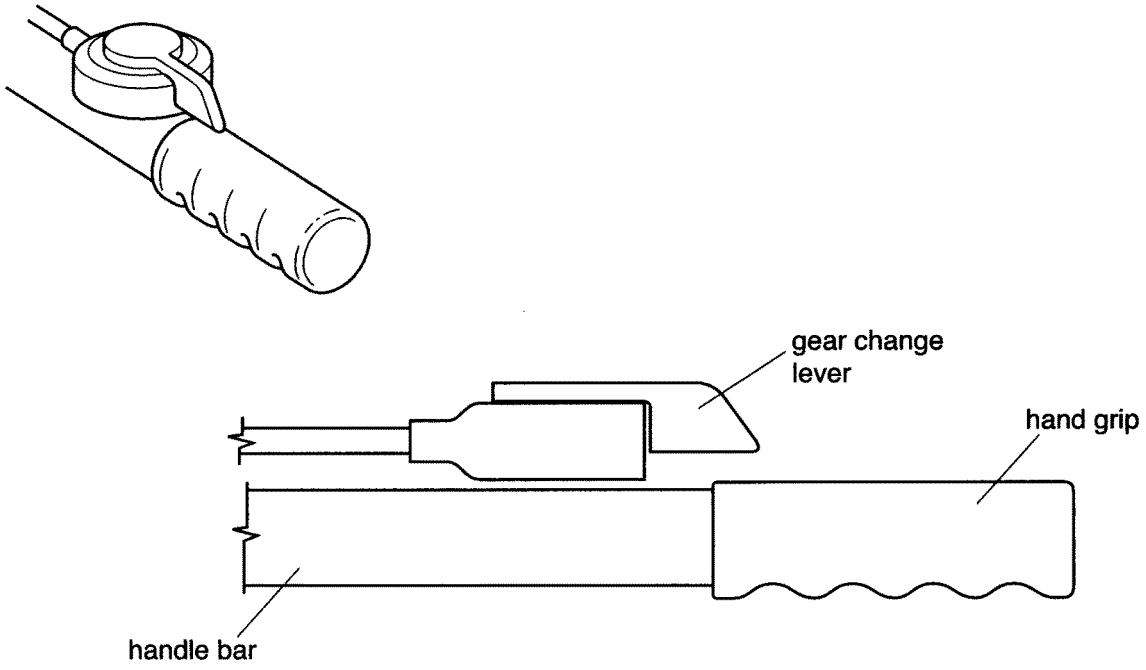


Fig. 8

Draw on Fig. 8 a means of attaching the gear change lever assembly securely to the handlebar. [2]

[TOTAL 10]

5 Fig. 9 shows a mini drill and incomplete stand used during the production of printed circuit boards.

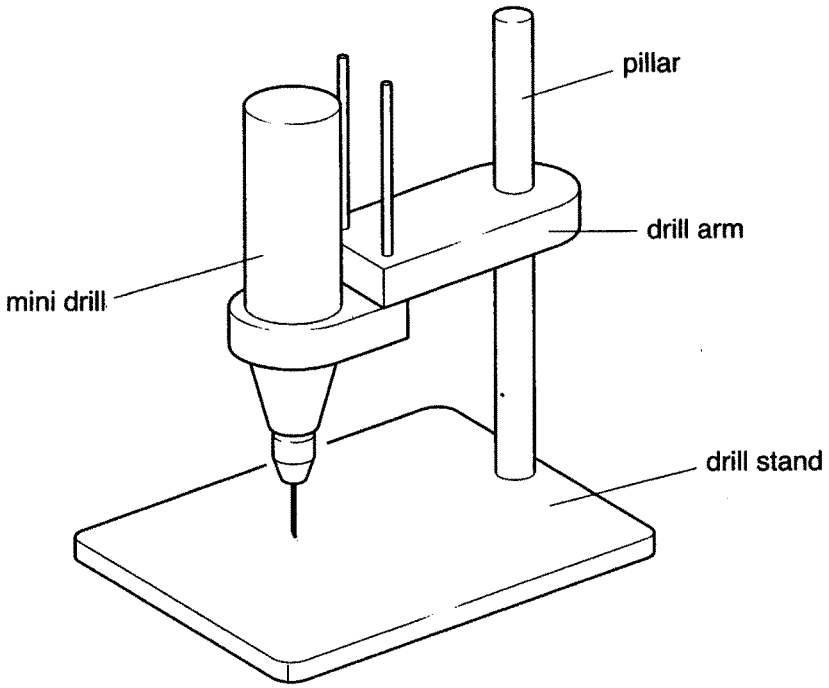
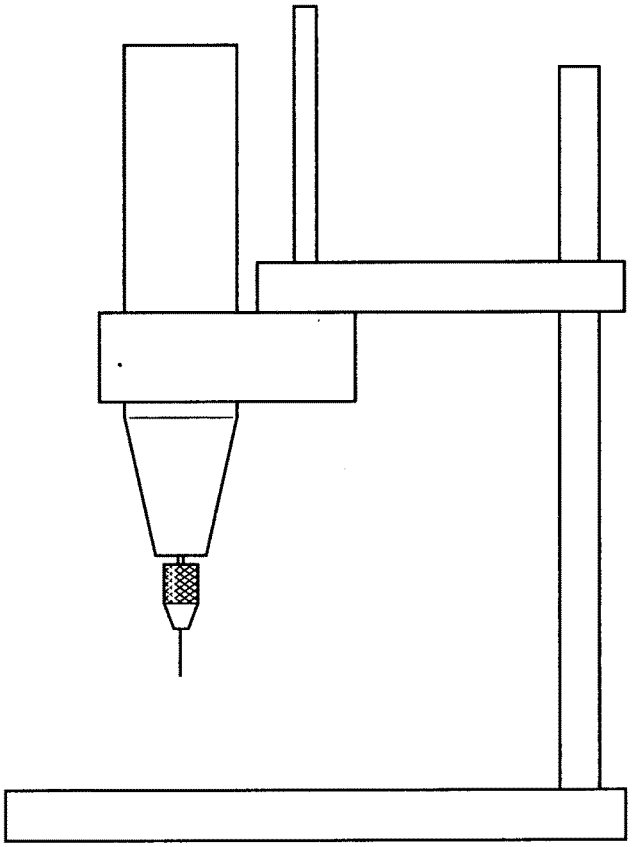


Fig. 9

(a) Use sketches and notes to show how the drill arm could be securely attached to the pillar allowing for height adjustment.

[3]

(b) Draw on Fig. 10 a simple lever operated system for lowering the mini drill. When the lever is released the mini drill must return to its raised position.



[5]

Fig. 10

(c) Explain how the length of the lever affects fine control when lowering the drill.

_____

_____

_____ [2]

[TOTAL 10]

[PAPER TOTAL 50]