**Victorian Certificate of Education
2009**

STUDENT NUMBER

Letter

Figures

Words

VCE VET ENGINEERING STUDIES CERTIFICATE III

Written examination

Wednesday 18 November 2009

**Reading time: 9.00 am to 9.15 am (15 minutes)
Writing time: 9.15 am to 10.45 am (1 hour 30 minutes)**

QUESTION AND ANSWER BOOK

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
A	15	15	15
B	3	3	15
C	12	12	30
D	3	3	40
			Total 100

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, a protractor, a set square and aids for curve sketching.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- A scientific calculator is allowed in this examination.

Materials supplied
- Question and answer book of 30 pages with a formula sheet on page 30.
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – VBN 771 Apply electrotechnology principles in an engineering environment

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Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Question 1

A digital ohmmeter is being used to measure a component. The meter indicates 3.725k Ω.

This is equivalent to

A.   0.3725 Ω

B.   37.25 Ω

C.   372.5 Ω

D.   3725 Ω

Question 2

The voltage measured across a closed switch equals

A.   zero.

B.   the total supply voltage.

C.   half the supply voltage.

D.   double the supply voltage.

Question 3

Electrical power is measured in

A.   volts.

B.   watts.

C.   ohms.

D.   amperes.

Question 4

What can cause excessive voltage drop?

A.   using extra large-size wires

B.   too much insulation on the wires

C.   excessive resistance in part of the circuit

D.   an open circuit bypassing the load being tested

Question 5

One use for a piezoelectric device would be for

A.   temperature measurement.

B.   high-voltage insulators.

C.   gas ignition systems.

D.   voltage amplifiers.

Question 6

If a fuse blows again after it has been replaced, the most likely cause is that

A.   resistance in the circuit is too high.

B.   an open circuit has occurred in a component.

C.   the earth connector has become disconnected.

D.   the current or amps through the circuit is too high.

Question 7

The factor that does **not** affect the resistance of a conductor is its

A.   length.

B.   voltage rating.

C.   type of material.

D.   cross-sectional area.

Question 8

A resistor with a **gold** tolerance band has an accuracy of

A.   1%

B.   2%

C.   5%

D.   10%

Question 9

Components that are connected in parallel form

A.   several branches for current flow.

B.   a single path for current flow.

C.   a voltage divider.

D.   an open circuit.

Question 10

A 12-volt battery is rated at 20 ampere hours.

This means that it can supply 2 amps for

A.   2 hours.

B.   10 hours.

C.   12 hours.

D.   20 hours.

Question 11
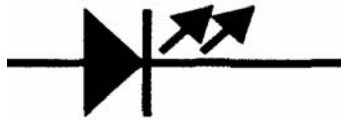
What is the name of this device?

A. transistor

B. capacitor

C. rectifier diode

D. light-emitting diode (LED)

Question 12

A safety switch installed on a switchboard will activate when

A. the current being drawn by the active and neutral is out of balance.

B. there is a short circuit between active and neutral.

C. there is an open circuit in the cable.

D. the circuit is overloaded.

Question 13

You are about to use a power drill and notice that the lead is damaged, exposing the wires.

What is the **most** appropriate action to take?

A. use another power drill

B. repair the lead before using

C. place insulation tape around the drill before using

D. tag the drill as faulty and report the fault to your supervisor

Question 14
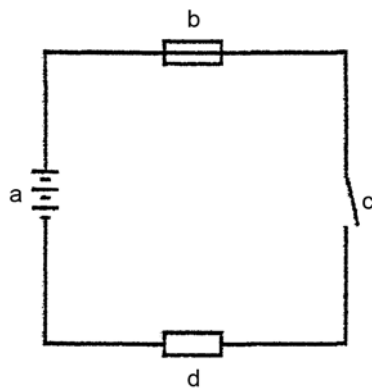
From the figure, select the letter that indicates a fuse.

A. a

B. b

C. c

D. d

Question 15
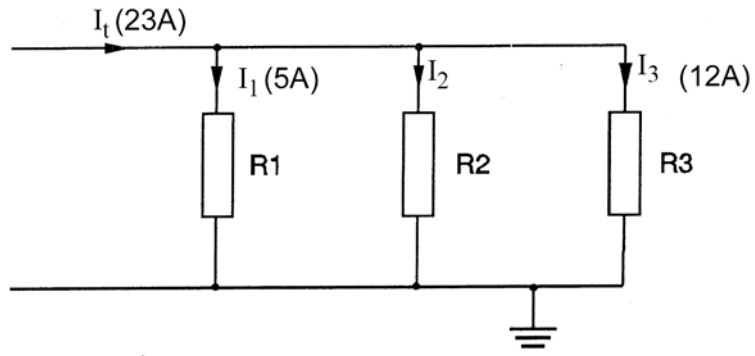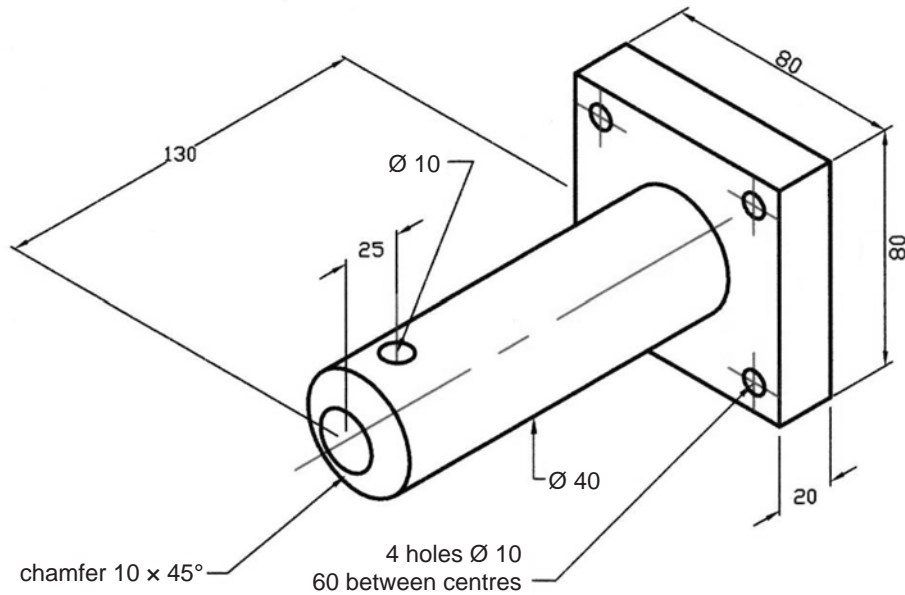

What is the current at I_2 for the circuit shown?

A.   6 amps
B.   12 amps
C.   23 amps
D.   40 amps

SECTION B – VBN 773 Produce engineering sketches and drawings

Instructions for Section B

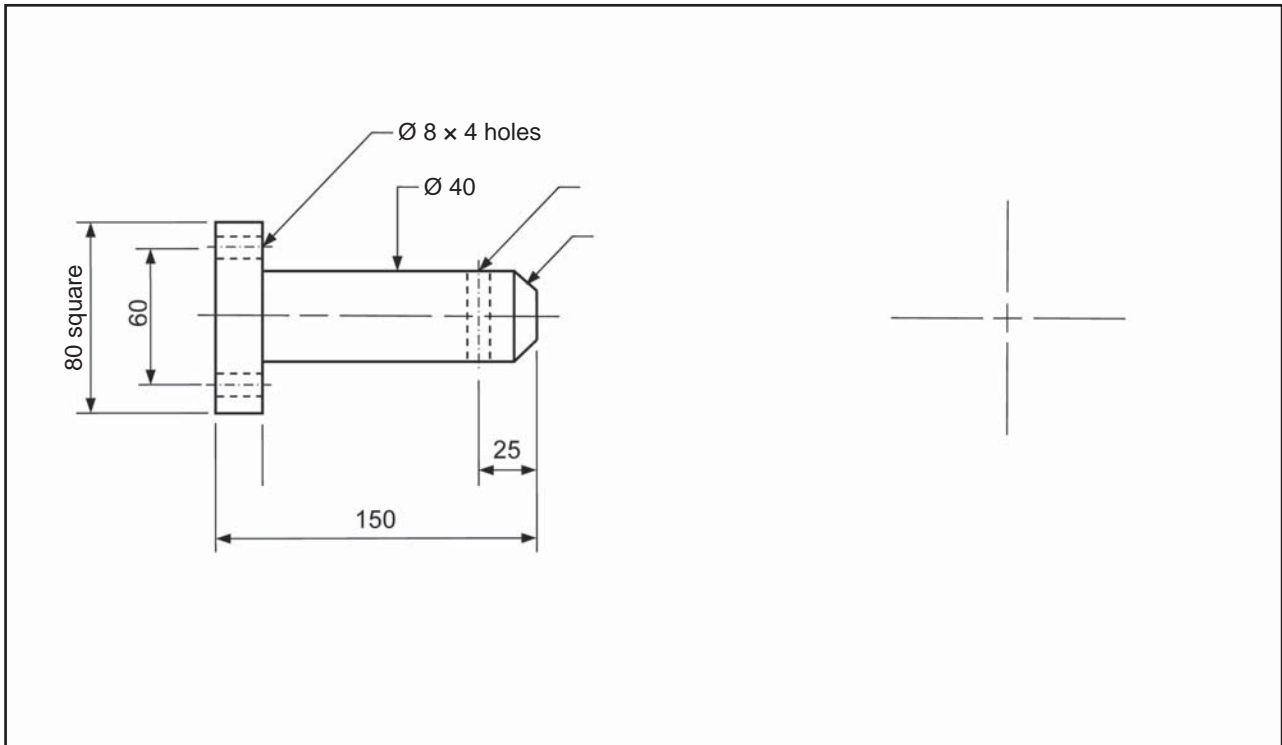Answer **all** questions in the spaces provided. All dimensions are in mm (millimetres).

Question 1

Figure 1 shows an isometric view of a pin.

Figure 1

On the sketch below, complete the orthogonal views of the pin shown in Figure 1.
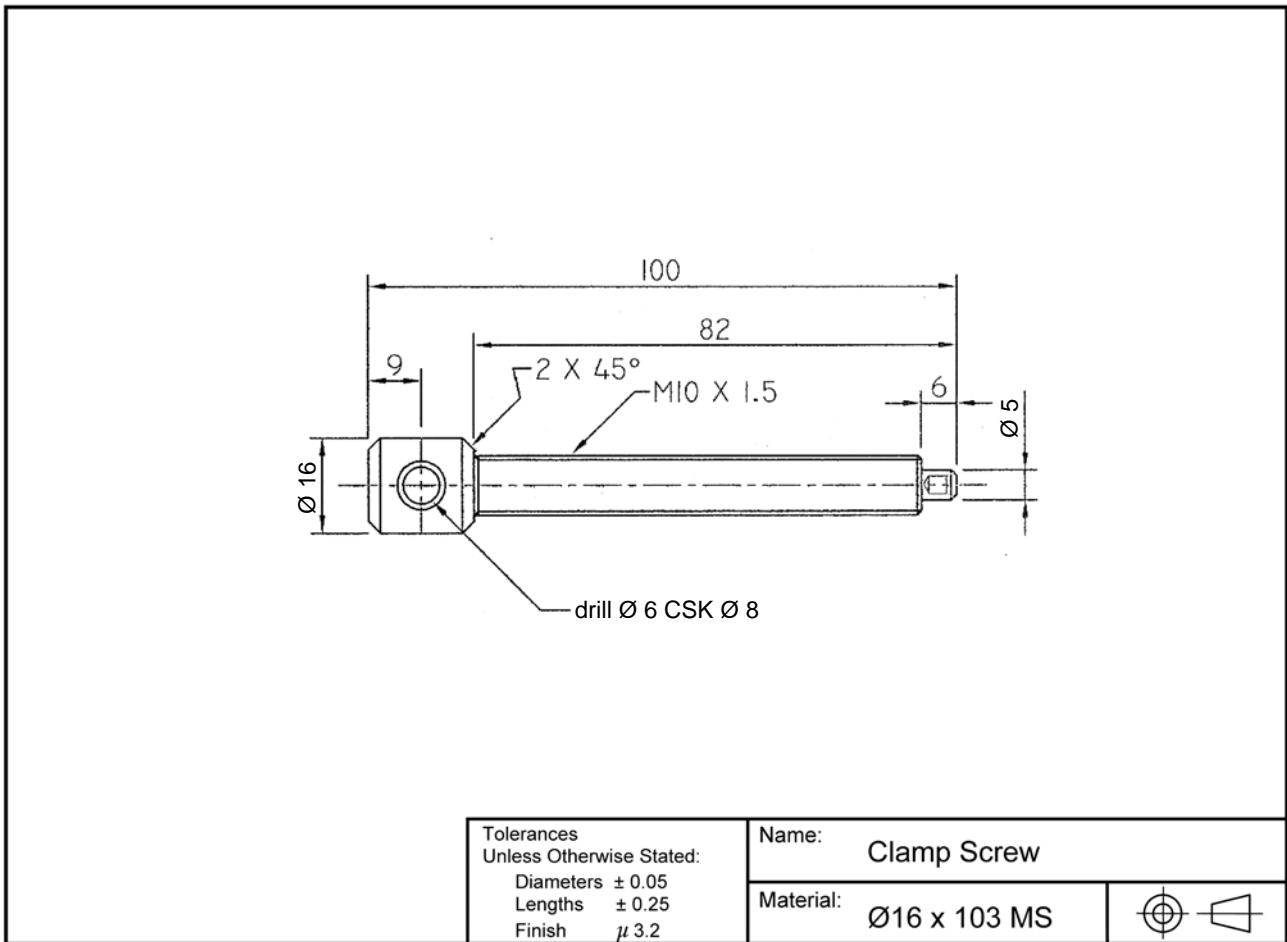
- use conventional drawing systems
- show views in third-angle projection
- show all hidden detail
- complete all missing dimensions

4 marks

Question 2

Figure 2 shows a detailed drawing of a clamp screw used in a G Clamp.

Figure 2

a.   What does CSK Ø 8 mean?

_____

1 mark

b.   What is the pitch of the M10 thread?

_____

1 mark

c.   How long is the head of the clamp screw?

_____

1 mark

d.   What are the maximum and minimum lengths the clamp screw can be made to?
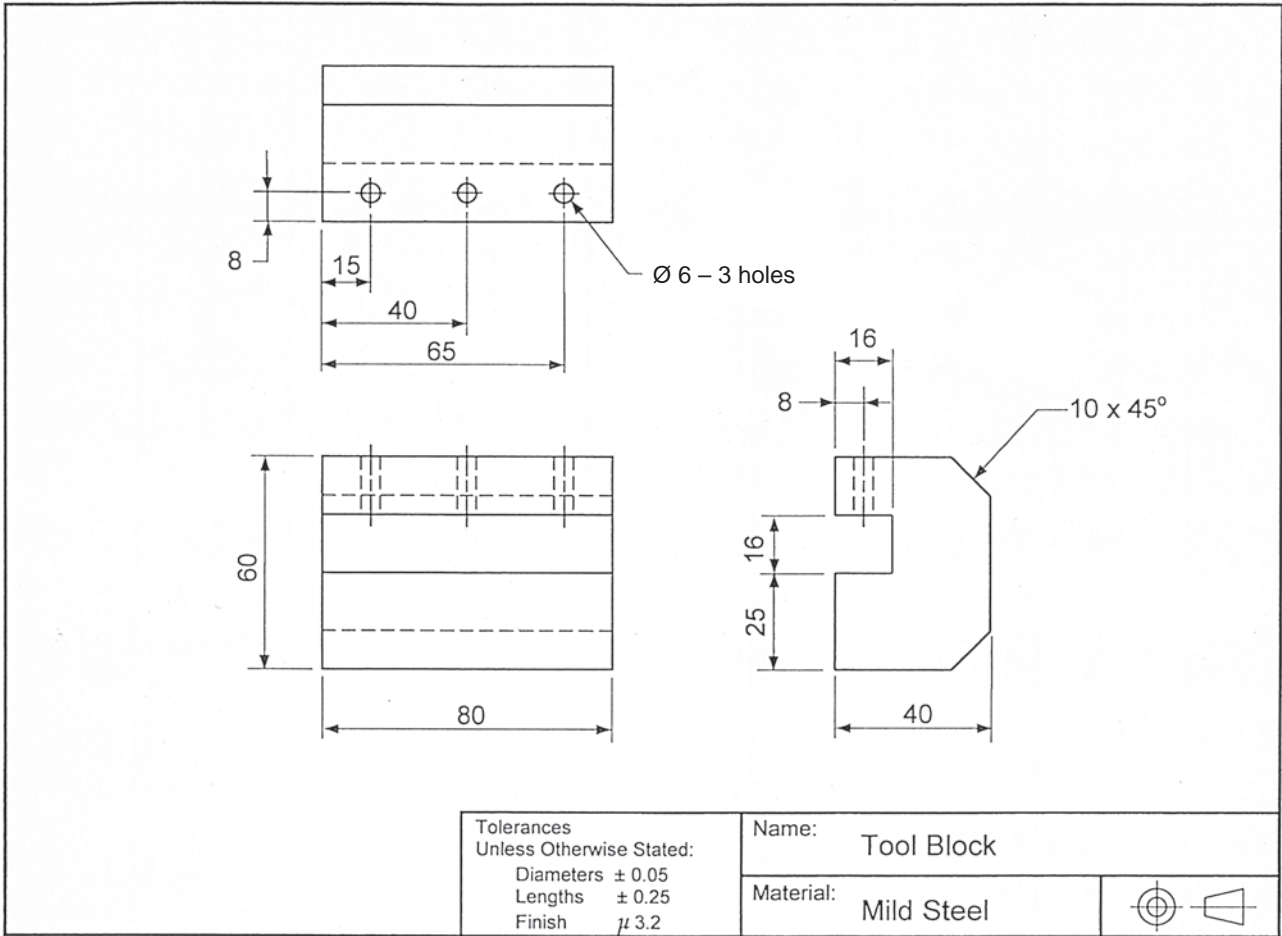
maximum _____   minimum _____

2 marks

e.   Complete the table below showing details of the material required to make the clamp screw.

| **Type of material**	
Material size	

2 marks

Question 3

Figure 3 shows an orthogonal drawing of a tool block.

Ø 6 – 3 holes

10 x 45°

Tolerances
Unless Otherwise Stated:
Diameters ± 0.05
Lengths ± 0.25
Finish μ 3.2

Name: Tool Block

Material: Mild Steel

Figure 3

In the space provided below, draw an isometric drawing of the tool block shown in Figure 3.
(**DO NOT DIMENSION THE DRAWING.**)

4 marks

Total 15 marks
END OF SECTION B
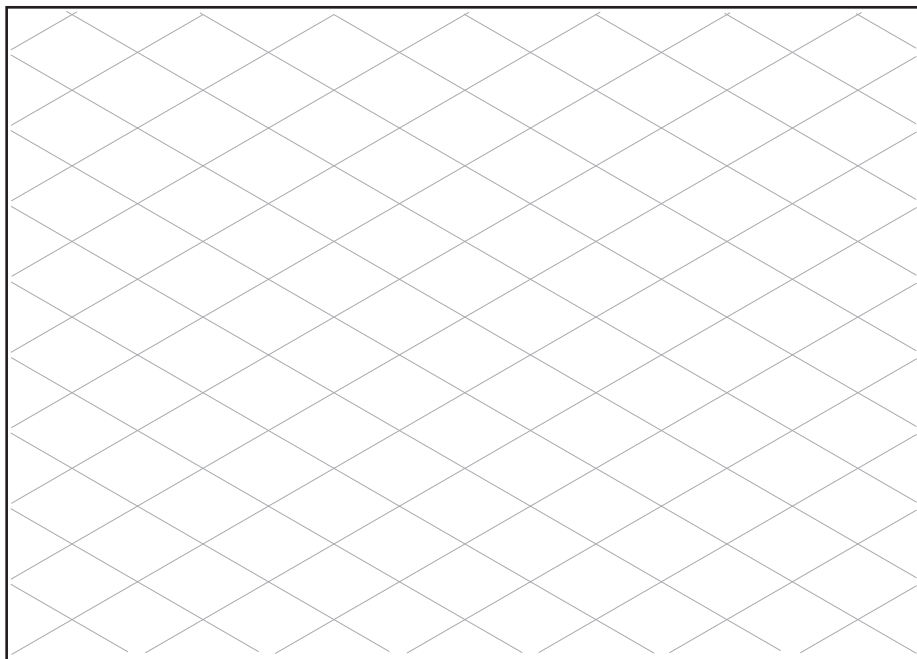
SECTION C – VBN 787 Apply mathematical principles to engineering designs

Instructions for Section C

Answer **all** questions in the spaces provided.

Where a question is worth more than one mark, you **must** show your working out.

Where applicable, answers must be given to two decimal places.

Unless otherwise indicated all measurements are in mm (millimetres).

Question 1

A part made out of steel weighs a total of 780 kg. The same part made from aluminium weighs 260 kg.
Calculate the percentage reduction in weight of the part from steel to aluminium.

2 marks

Question 2

The minor Ø (md) of an imperial thread is calculated by using the formula: md = MD – 2 depths

Where: MD = Major Diameter   Depth $= 0.64 \times \dfrac{1}{\text{TPI}}$

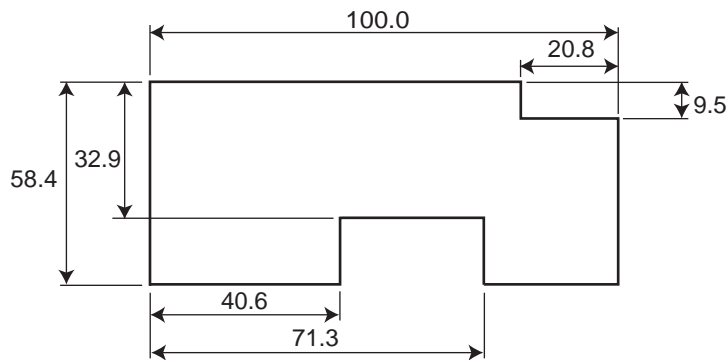Calculate the minor Ø of a $\frac{1}{2}$ **inch × 12 TPI** thread.

2 marks

Question 3

A 6 metre length of bar has a 1.5 metre piece cut off.

Calculate as a **fraction** the portion of the bar that was cut off.

1 mark

Question 4

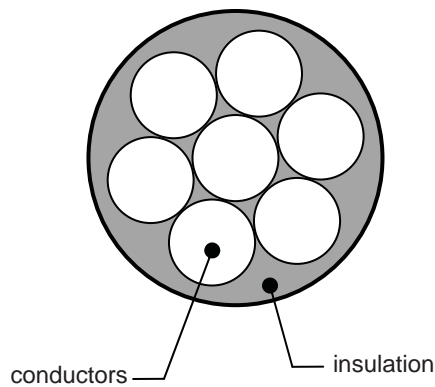Find the perimeter of the shape shown in Figure 1.

Figure 1

2 marks

Question 5

A power cable has 7 wire conductors each of which is Ø 0.8 mm, as shown in Figure 2.
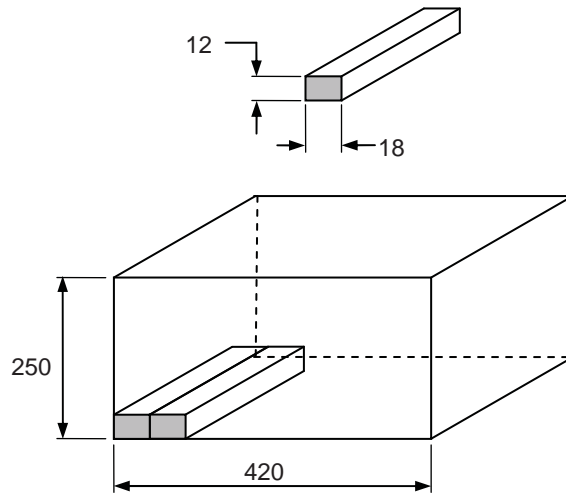

conductors — | — insulation

Figure 2

Calculate the total cross-sectional area of the conductors.

2 marks
SECTION C – continued

Question 6

Rectangular aluminium bars will be packed in a timber box measuring 420×250 mm as shown in Figure 3.
The timber box weighs 2.2 kg and each bar weighs 350 g.

Figure 3

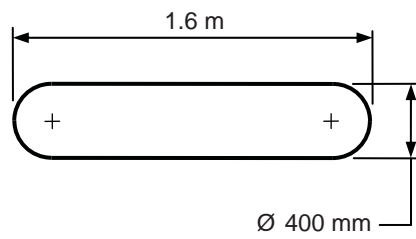**a.**   Calculate how many bars will fit in the box.

2 marks

b.   Calculate the total weight of the full box.

1 mark

Question 7

Calculate the surface area in m^2 of an LPG cylinder with spherical ends as shown in Figure 4.
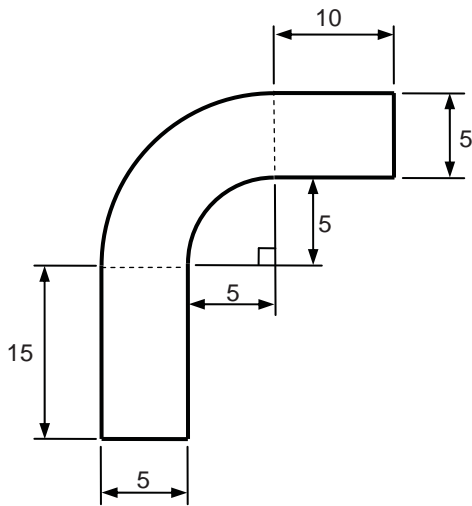

Figure 4

3 marks

Question 8

A 40 mm square is to be milled from a round bar.

What is the smallest diameter bar that you could use?

2 marks

Question 9

The area shown in Figure 5 is to be concreted. Sizes shown are in metres.

Figure 5

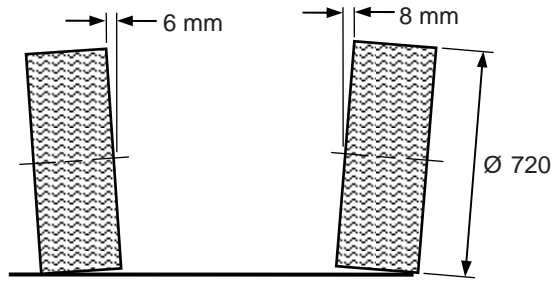**a.** Calculate the total area.

2 marks

b. Calculate the volume of concrete required for a thickness of 100 mm.

2 marks

Question 10

A front-end alignment check of two wheels on a truck shows that the right wheel 'toes out' by 8 mm and the left wheel 'toes out' by 6 mm as shown in Figure 6.

Figure 6

Calculate the included angle between the two front wheels.

3 marks

Question 11

The turnbuckle shown in Figure 7 will be used to tension a fence wire.

The turnbuckle has a left-hand thread on one eye, and a right-hand thread on the opposite eye. Both threads are M10 × 1.5.
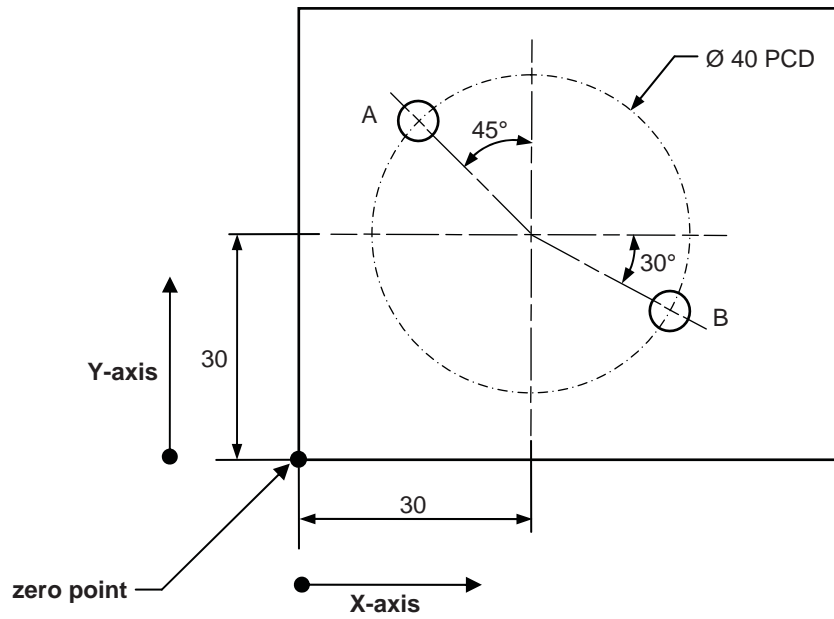

Figure 7

Calculate the distance the eyes will close if the body is given $3\frac{1}{2}$ turns (both eyes remain stationary).

2 marks

Question 12

Holes A and B need to be drilled in the component shown in Figure 8.

Ø 40 PCD

A

45°

30°

B

Y-axis

30

30

zero point

X-axis

Figure 8

Calculate the X–Y coordinates of holes A and B from the zero point.

| Hole	X	Y
A		
B		

4 marks

Total 30 marks

END OF SECTION C
TURN OVER

SECTION D – VBN 788 Design and prototype components and/or small structures using engineering design principles

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Instructions for Section D

Answer **all** questions in the spaces provided. All dimensions are in mm (millimetres).

Figure 1 shows a can crusher for aluminium cans. The connecting link between the handle and the crusher plate is not shown. When the handle is pushed down, the connecting link pushes the crusher plate down and this crushes the can.

column (16 x 16 tube)

handle arms (16 x 3 flat)

handle (16 x 16 tube)

400

connecting link (250–270 long)
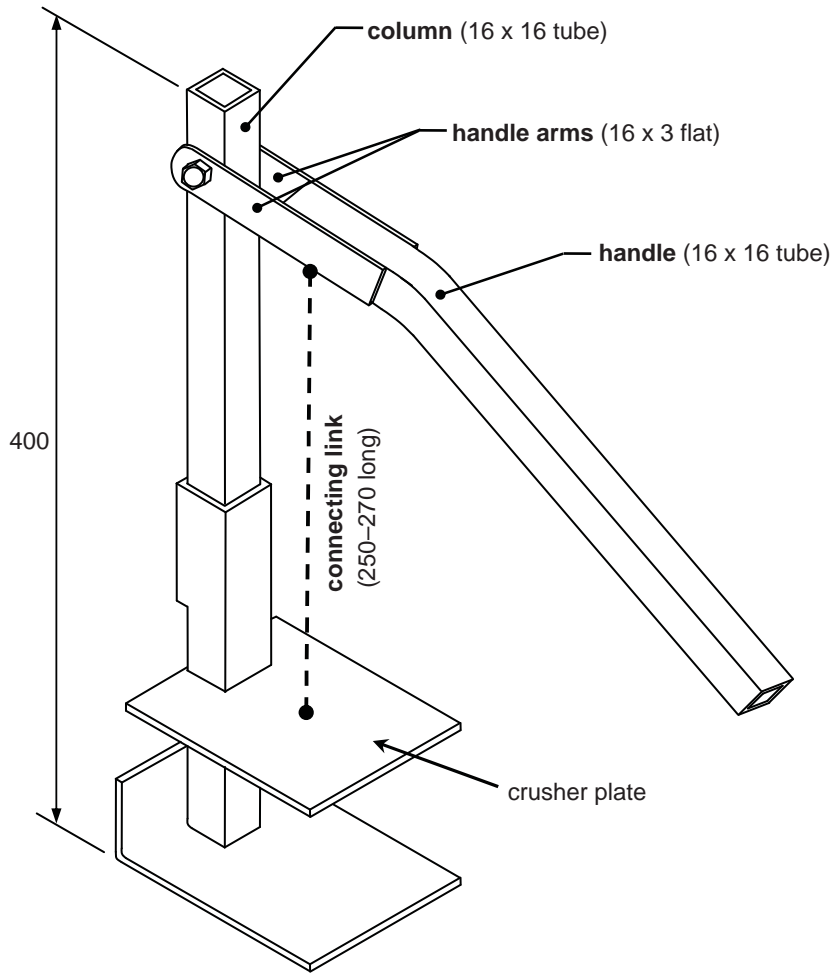
crusher plate

Figure 1

Question 1

You are required to design the **connecting link** between the handle and the crusher plate for the can crusher shown in Figure 1.

- The connecting link needs to connect the handle to the crusher plate so that the crusher plate moves up and down with the handle.
- The total length of the connecting link has to be adjustable between 250 and 270 mm.
- The bottom face of the crusher plate (which comes into contact with the can) needs to be flat and not have any protrusions.

Sketch your design of the connecting link below.

- Label all parts.
- Show basic dimensions and materials used.
- Include notes of how your design works if required.

10 marks

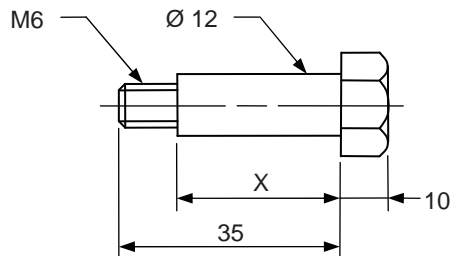**SECTION D** – continued
TURN OVER

Question 2

Figure 2 shows the top of the can crusher where the handle is attached to the column.

A bolt goes through a hole drilled in the handle arms and column, and is fastened by a plain nut.
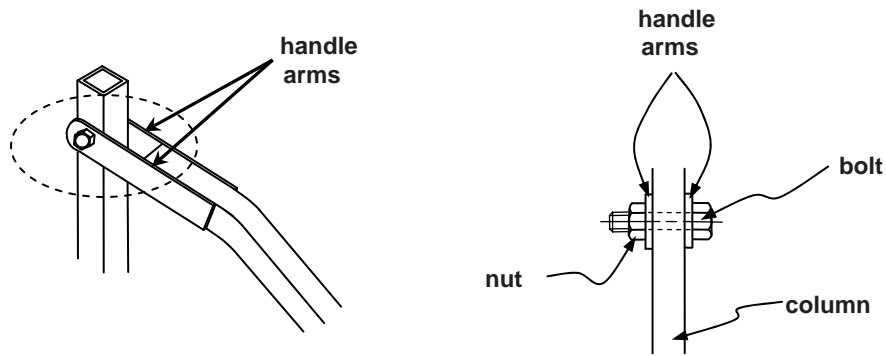
Figure 2

Figure 3 shows a shoulder screw that has been designed to replace the current plain nut and bolt shown in Figure 2.

Figure 3

a.   Describe two advantages of using the shoulder screw rather than the plain nut and bolt.

_____

_____

2 marks

b.   How long should dimension X be for the shoulder screw shown in Figure 3?

_____

1 mark

c. The shoulder screw shown in Figure 3 is being made from a piece of 18 mm hexagon bar which is 400 mm long. The shoulder screw will be machined then parted-off when finished.

Complete the operational plan below showing how the shoulder screw will be made.

Op. No.	Operation description	Work-holding method	Equipment/Cutters

6 marks

d. Some changes have been suggested to the design of the can crusher.

The first suggestion is to move the connecting link from point A and attach it further down the handle to point B.
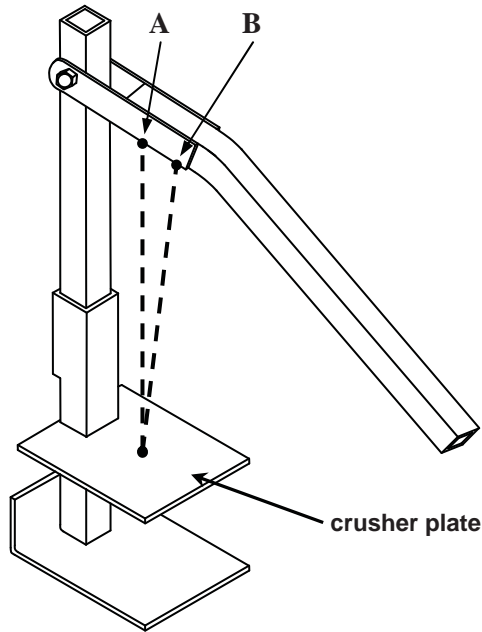
Figure 4

List two effects of moving the connecting link from A to B as shown in Figure 4.

_____

_____

_____

_____

_____

2 marks

e. The second suggestion is to shorten the handle by 150 mm.

What will happen if the handle is shortened?

_____

_____

_____

1 mark

f. What **thickness** of mild steel plate would be most suitable to make the **crusher plate**?

   A. 1.5 mm

   B. 2 mm

   C. 5 mm

   D. 12 mm

1 mark

g. Show on the sketch of the can crusher in Figure 5 (using arrows) all the places where applying lubricant would be an advantage.
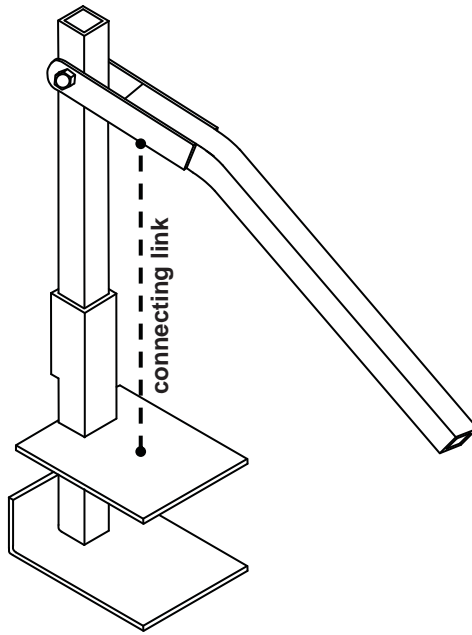

Figure 5

2 marks

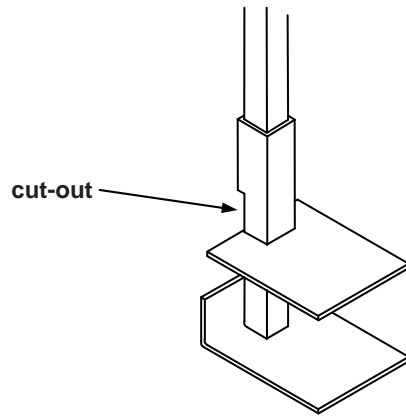**h.** Describe one safety hazard associated with using the can crusher.

_____

_____

1 mark

i.

Figure 6

What is the purpose of the cut-out (Figure 6) on the slider?

_____

_____

_____

1 mark

j.   When used, the can crusher kept tipping over.
Describe **two** ways to overcome this problem.
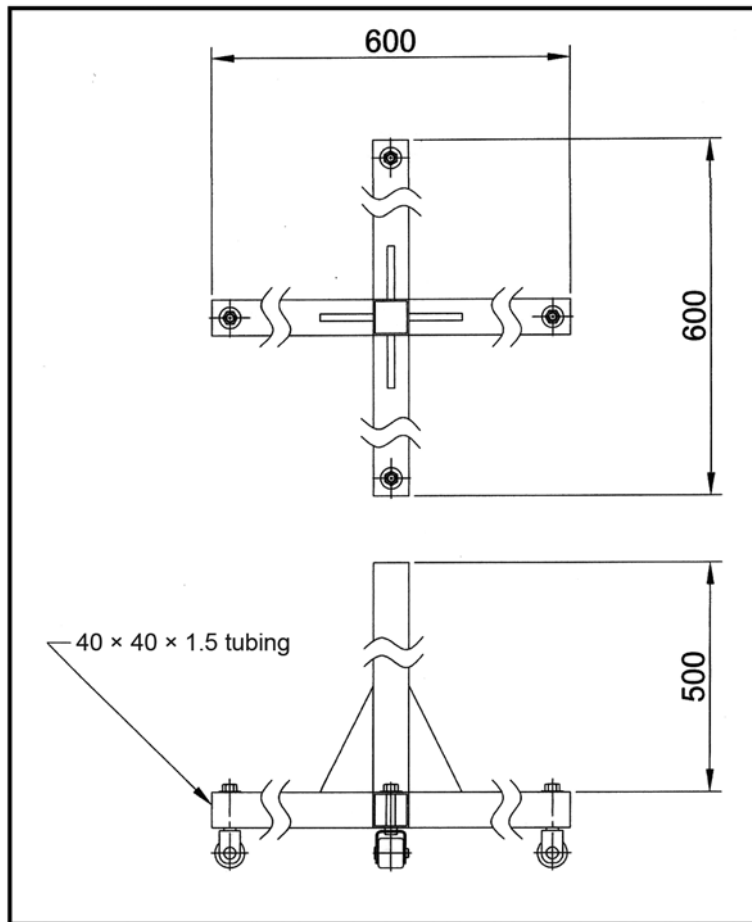
1. _____

_____

2. _____

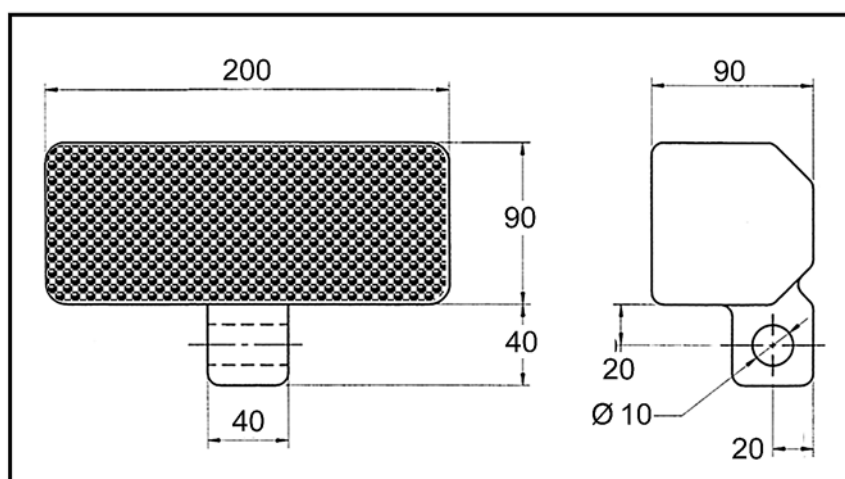_____

2 marks

CONTINUES OVER PAGE

Question 3

A mobile light stand to hold two halogen lights is being manufactured in the machine shop.

Figure 7 shows the base of the mobile light stand.

Figure 7

Figure 8 shows the dimensions of the halogen lights that will be held on the stand.

Figure 8

a.   Design and sketch a mounting system for the two halogen lights. This mounting system will connect to the base.

Your design must

- allow for adjustable height with a 400 mm range
- allow each light to swivel up and down
- show basic dimensions and materials used
- include notes of how your design works.

6 marks

b. The current design of the light stand base shown in Figure 7 has four legs. The light base is unstable on uneven ground.

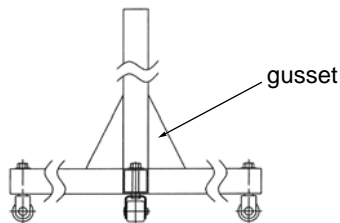How can the design be changed to make the base more stable?

_____

_____

1 mark

c. The light stand base has been designed with gussets between the upright and the legs (Figure 9).
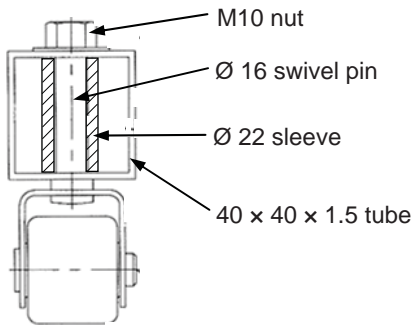

Figure 9

What is the purpose of these gussets?

_____

_____

1 mark

Figure 10 shows the wheel assembly of the light stand base.

Figure 10
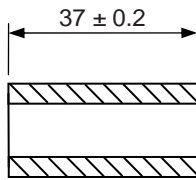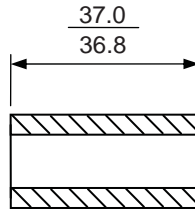
d. What is the purpose of the Ø 22 sleeve?

_____

_____

1 mark

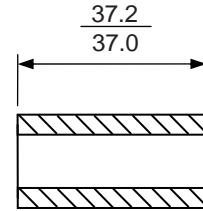**e.** The sketches below show the Ø 22 sleeve length with different tolerances.

A.   **B.**   **C.**

   i. Which of these tolerances best suits the application in Figure 10?

ii. Explain your answer.

_____

_____

1 + 1 = 2 marks

Total 40 marks

END OF SECTION D
TURN OVER

Data/formula sheet

Circumference of a circle = πD

Area of a circle = πr^2

Area of a triangle = $\frac{1}{2} \times$ base $\times$ height

Volume of a sphere = $\frac{4\pi r^3}{3}$

Area of a rectangle = $L \times W$

Volume of a square prism = $L \times W \times H$

Area of a circular ring = $\frac{\pi (D^2 - d^2)}{4}$

Volume of a cylinder = $\pi r^2 \times L$

Sin = $\frac{\text{opposite}}{\text{hypotenuse}}$

Cos = $\frac{\text{adjacent}}{\text{hypotenuse}}$

Tan = $\frac{\text{opposite}}{\text{adjacent}}$

Surface area of sphere = $4\pi r^2$

Area of cylinder = circumference $\times$ length

END OF QUESTION AND ANSWER BOOK