2023 VCE VET Engineering Studies external assessment report

General comments

The 2023 Engineering Studies examination assessed the following units of competency:

* MEMPE006A Undertake a basic engineering project
* VU22333 Perform intermediate engineering computations.

All questions in the 2023 VCE VET Engineering Studies exam were attempted by the majority of students.

Overall, safety was a topic answered well, and students appear to have good understanding of third-angle projection when sketching.

While calculations were handled well, students should focus more on ensuring they are using the correct units. As an example, generally all dimensions in the exam are given in millimetres (mm), but some questions require the answer to be in metres. In these cases, it would be easier to convert dimensions to metres before adding or multiplying so as not to end up with large numbers in mm where it’s easier to make conversion errors.

Other areas for improvement:

* Students need to take into account all the information included in a question, including the details in drawings, in order to avoid incorrect assumptions about the required responses. For example, in Question 10, the type/thickness of the different materials was sometimes not taken into consideration, leading to more general responses that did not correctly answer the question.
* Students need to read the questions more carefully and take note of what is required. An example is Question 27, where some design details were required. Almost all students identified that a rolling element was required, but most did not have any or enough detail on the practical aspect of how the rolling element is held in or any details of materials used.
* Correct drawing convention is an area requiring major improvement. There appears to be little knowledge of correct dimensioning techniques, use of centre lines etc.
* Another area requiring attention is correct terminology of basic engineering tools. There was a large number of incorrectly named basic items such as scribers, vee blocks and basic parts of a lathe.

Specific information

The statistics in this report may be subject to rounding, resulting in a total of more or less than 100 per cent.

Question 1a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 5 | 37 | 59 | 1.5 |

Any two of:

* no damage to cord
* drill bit tightened
* tag test date
* damage to body/casing.

This question was answered well by most students. Generic answers such as ‘make sure drill functions safely’ were not accepted.

Question 1b.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 16 | 84 | 0.8 |

One of the following:

* plate could spin and cut hand
* cut hand on sheet metal
* drill slips and cuts hand.

The question was well answered.

Question 1c.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 51 | 49 | 0.5 |

Clamp sheet metal onto piece of timber (or similar).

Some students responded with ‘holding in vise’, which is not practical for sheet metal.

Question 2a.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 33 | 67 | 0.7 |

Two of the following:

* lathe
* milling machine
* pedestal drill.

A majority of students answered this question well.

Question 2b.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 10 | 90 | 0.9 |

Gloves could get caught in the spinning parts and drag the hand in.

The question was answered well by most students.

Question 3a.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 57 | 41 | 3 | 0.5 |

|  |  |
| --- | --- |
| Tool | Name of tool |
|  | twist drill |
|  | countersink |
| Engineering cutting tool known as counterbore | counterboring tool |
|  | step drill |

Many students did not know the correct names for tools. Some responses indicated students did not know the purpose of the tools.

Question 3b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 31 | 53 | 16 | 0.8 |

|  |  |
| --- | --- |
| Hole | Use |
|  | D |
|  | A & C |
|  | A & B |
|  | A |

For the counterbore and countersink, some students did not include the twist drill as part of the answer. This is possibly due to not reading the question carefully.

Question 4

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 8 | 52 | 39 | 1.3 |

Any two of the following:

* two-person lift
* don’t bend back
* check the path is clear
* check condition of box (sharp objects, stable)
* hold load close to body.

Most students answered this question well. Generic answers such as ‘lift safely’ were not accepted.

Question 5

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 12 | 19 | 69 | 1.6 |

|  |  |
| --- | --- |
| Item | Process |
| 1000 flat washers | stamping |
| gate | fabrication |
| aluminium post | extrusion |
| plumb bob | machining |

This question was well answered.

Question 6

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 0 | 2 | 33 | 65 | 2.6 |

|  |  |
| --- | --- |
| Safety Signage And Your Workplace. - WHS Consulting | No naked flames / No fires |
| Hearing Protection Sign | Hearing protection must be worn. |
| Safety Signage And Your Workplace. - WHS Consulting | First aid room / First aid cabinet |

The question was answered well by most students.

Question 7a.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 62 | 38 | 0.4 |

pedestal grinder / off-hand grinder

Many students did not know the correct name of the piece of equipment. Incorrect responses included ‘grinding stones’ and ‘bench grinder’.

Question 7b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 28 | 52 | 20 | 0.9 |

Two of the following:

* position of rest correct (not too far from wheels)
* no damage to grinding wheels
* guards in place / not loose.

Many students came up with one correct response but struggled with a second response.

Question 8

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 41 | 59 | 0.6 |

3200 / 77 = 41 pieces

This question was answered correctly by most students. Some students failed to consider the thickness of the saw blade.

Question 9a.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 24 | 76 | 0.8 |

TPI: teeth per inch

This question was answered correctly by most students.

Question 9b.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 58 | 42 | 0.4 |

hacksaw blade: 32 TPI

Reason: More teeth in contact with sheet metal / easier to cut / doesn’t jam (or similar).

Some students failed to make the connection between the thickness of sheet metal and spacing of teeth.

Question 9c.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 15 | 39 | 46 | 1.3 |

* correct direction of blade
* correct tension on blade / tight

Some responses such as ‘pick the correct blade’ suggest that students did not read the question carefully.

Question 10

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Average |
| % | 4 | 8 | 28 | 24 | 23 | 11 | 2 | 3.0 |

Any two joining methods for each material.

|  |  |
| --- | --- |
| Materials to be joined | Joining methods |
| A diagram of a piece of paper  Description automatically generated | * pop rivet * TIG welding / welding * self-tapping screws * adhesive |
| A diagram of a box  Description automatically generated | * welding * spray transfer * bolts (drill and tap) * screws (drill and tap) |
|  | * adhesive * pop rivets * screws (drill and tap) |

Students needed to pay more attention to details in this question, such as thicknesses and types of materials.

Question 11

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 52 | 48 | 0.5 |

The most common cause is that the cutting tool is not on centre height.

Many students used incorrect terminology in their response.

Question 12a.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 12 | 88 | 0.9 |

165 − 90 = 75mm

This question was answered correctly by most students.

Question 12b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 43 | 13 | 44 | 1.0 |

A math equations and numbers

Description automatically generated with medium confidenceA common error was using the incorrect trigonometric ratio.

Question 13

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | 4 | 5 | Average |
| % | 1 | 13 | 57 | 19 | 7 | 2 | 2.3 |

|  |  |  |
| --- | --- | --- |
| Tool | Name | Common use |
|  | scriber | marking lines |
|  | parallel strip | keeping work piece parallel in vise / supporting work in vise |
|  | vee block | holding round bar |
|  | centre punch | centre punching holes before drilling |
|  | end mill | milling slots / milling flat surfaces |

Many students were not able to use the correct terminology for these tools. Some answers indicated that students were not familiar with some of these tools, in particular the parallel strips and vee block.

Question 14

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | 4 | 5 | Average |
| % | 6 | 11 | 10 | 23 | 36 | 15 | 3.2 |

Common errors included:

* incorrect position of views
* re-drawing some views in isometric
* missing centre lines
* broken lines.

Graphical user interface

Description automatically generated with medium confidenceQuestion 15

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | 4 | Average |
| % | 12 | 7 | 18 | 49 | 14 | 2.5 |

Few students used correct drawing convention such as correct extension lines and arrows.

Question 16

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | 4 | 5 | Average |
| % | 42 | 11 | 13 | 12 | 13 | 9 | 1.7 |

|  |  |
| --- | --- |
| Shape | Name |
|  | SHS / square hollow section  square tube |
|  | angle iron |
|  | tube / round tube / pipe |
|  | RHS / rectangular hollow section  rectangular tube |
|  | solid round bar  round bar |

Very few students knew the correct names of these standard metal shapes. Some students misread the question and just put down the basic shape such as ‘circle’ / ‘square’.

Question 17a.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 38 | 62 | 0.6 |

10 × 5 = 50 discs

The question was answered correctly by most students. A common error was to calculate the area of one circle and divide this into the total sheet metal area.

Question 17b.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 36 | 35 | 8 | 20 | 1.1 |

Disc area:

πr2 × 50 3.142 × 552 × 50

9504.55 × 50 = 475,227.5 mm2

Plate area:

1200 × 600 = 720,000 mm2

Scrap:

720,000 - 475,227.5 = 244,772.5

244,772.5 / 720,000 = 0.3399 = 34%

Many students correctly calculated the area of the sheet metal, but then struggled to complete the percentage.

Question 18a.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 13 | 29 | 35 | 23 | 1.7 |

|  |  |  |
| --- | --- | --- |
| Part | Name | Main function |
| A | chuck | Holds work. |
| B | tool post | Holds tool. |
| C | tailstock | Holds centre / drills / supports long work. |

Most students seemed familiar with the chuck, but few correctly named the tailstock and tool post.

Question 18b.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 29 | 21 | 31 | 18 | 1.4 |

|  |  |
| --- | --- |
| Part | Function |
| D | cross slide / moves tool for depth of cut / facing off (Y axis) |
| E | engage auto feed / feed lever |
| F | carriage handwheel / moves tool along work / along bed / towards chuck (X axis) |

Few students could adequately describe the functions. Some gave answers that were not specific enough, such as ‘moves cutter’.

Question 19

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | 4 | Average |
| % | 3 | 10 | 26 | 55 | 6 | 2.5 |

|  |  |  |
| --- | --- | --- |
| Part | Machine | Work-holding method |
| Graphical user interface  Description automatically generated | lathe | three-jaw chuck and centre / between centres |
| Graphical user interface  Description automatically generated | drill | vise |
| Graphical user interface  Description automatically generated | lathe | four-jaw chuck |
| Graphical user interface  Description automatically generated | milling machine | bolted to table / using clamps |

This question was answered well overall. Some students put down vise for milling the slot in the 350 × 250, without considering the size.

Question 20

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | 4 | Average |
| % | 27 | 11 | 17 | 19 | 25 | 2.0 |

overall area: 2.4 × 1.6 = 3.84

circle area = π × 0.22 = 0.126

rectangle = 0.7 × 0.6 = 0.42

triangle = (0.6 × 0.6) / 2 = 0.18

area = 3.84 - (0.126 + 0.42 + 0.18)

3.84 - 0.726 = 3.114 m2

With this type of question, students would benefit from systematically laying out the working out, and converting the sizes to metres before beginning to calculate. This would avoid mistakes in converting large numbers at the end.

Question 21

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 58 | 15 | 3 | 24 | 0.9 |

(700 × 2) + (400 × 2) = 2200

π × 100 = 314.2

perimeter = 2200 + 314.2 = 2514.2 mm

The most common error was not subtracting the radii from the lengths.

Question 22

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 26 | 12 | 62 | 1.4 |

A =

A =

A =

A = 116.62

A

100

60

This question was answered correctly by many students.

Question 23a.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 5 | 17 | 30 | 48 | 2.2 |

|  |  |
| --- | --- |
| Step | Operation |
| 1 | Square off ends to 140 mm length. |
| 2 | Mark out. |
| 3 | Drill both holes. |
| 4 | Tap both holes. |
| 5 | Cut out excess material from corners. |
| 6 | Mill corners to size. |
| 7 | De-burr. |

Drilling and tapping after milling were also accepted.

Basic impractical mistakes made were tapping holes before drilling, and milling corners before cutting excess.

Question 23b.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | Average |
| % | 5 | 43 | 52 | 1.5 |

Four of the following:

* scriber
* rule
* protractor
* hammer
* centre punch
* square
* vernier height gauge.

While the majority of students answered this question well, some students included answers which are not marking out tools (e.g. drill), possibly not reading the question correctly.

Question 23c.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 44 | 56 | 0.6 |

One of the following:

* break the chip
* prevent tap from breaking

Many students answered this question correctly.

Question 23di.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 50 | 50 | 0.5 |

major diameter

Question 23dii.

|  |  |  |  |
| --- | --- | --- | --- |
| Marks | 0 | 1 | Average |
| % | 43 | 57 | 0.6 |

pitch

This question in two parts was answered correctly by approximately 50% of students, showing a lack of understating of basic engineering terms.

Question 24

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 41 | 11 | 11 | 37 | 1.4 |

1.8 × 1.2 x 0.9 = 1.944

(1.8 × 1.2 x 0.4) / 2 = 0.432

volume = 1.944 + 0.432 = 2.376 m3

Common errors included calculating the area instead of the volume, and incorrectly calculating the sloped area.

Question 25

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 20 | 43 | 24 | 12 | 1.3 |

Diagram

Description automatically generated

Common errors in students’ answers were missing tabs, or not showing all the required dimensions.

Question 26

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | Average |
| % | 42 | 34 | 15 | 9 | 0.9 |

|  |  |  |
| --- | --- | --- |
| Bearing | Name | Load |
| Bearings isolated on white background 3D | ball bearing |  |
| 3D illustration of ball thrust bearing. White isolated background | thrust bearing |  |
| 3D illustration of tapered roller bearing on white background | tapered roller bearing |  |

Few students used correct terminology when naming bearings.

A diagram of a machine

Description automatically generatedQuestion 27

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Marks | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Average |
| % | 31 | 16 | 23 | 13 | 9 | 6 | 2 | 1.8 |

Students seem to not have read this question fully and noted what details were required. Details such as material type, sizes and basic descriptions were often left out.

Students would benefit from using the dot points in the question as a check list for their response.