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Science is about
knowing; engineering
is about doing.

Henry Petroski Engineer

Year 10

Add
department
logo here

Engineering
(603/7006/3)

Content Area 2

Applied Science & Mathematics in Engineering

Name		
Group		
Teacher		
Assessment	Date	Grade

- energy:
 - efficiency $\text{efficiency (\%)} = (\text{useful energy out} \div \text{total energy in}) \times 100$
 - power $P = E \div t$ power = energy $\div$ time
 - work done $W = F \times d$ work done = force $\times$ distance
- force and motion:
 - speed $s = d \div t$ speed = distance $\div$ time
 - acceleration $a = (v - u) \div t$ acceleration = change in velocity $\div$ time
 - force $F = m \times a$ force = mass $\times$ acceleration
 - moment of force $m = F \times d$ moment = force $\times$ perpendicular distance from pivot
 - momentum $p = m \times v$ momentum = mass $\times$ velocity
 - pressure $p = F \div A$ pressure = force $\div$ area
- mass:
 - weight $w = m \times g$ weight = mass $\times$ gravity
 - density $d = m \div v$ density = mass $\div$ volume
- electrical:
 - power $P = V \times I$ power = voltage $\times$ current
 - voltage $V = I \times R$ voltage = current $\times$ resistance
 - current $I = P \div V$ current = power $\div$ voltage
 - resistance $R = V \div I$ resistance = voltage $\div$ current
- geometric:
 - area – square length of side²
 - area – rectangle length of side 1 $\times$ length of side 2
 - area – triangle (length of base $\times$ height of triangle) $\div 2$
 - area – circle $\pi \times \text{radius}^2$
 - volume – cube length of side³
 - volume – pyramid $(1/3) \times (\text{base area}) \times \text{height of pyramid}$
 - volume – cylinder $\pi \times \text{radius}^2 \times \text{height of cylinder}$



Knowledge recall

Date:



1

2

3

Activate

Why an international system?

Demonstrate

Complete the questions below

1. Recall the SI units and symbols

Dimension	Unit	Symbol
Mass		
Distance		
Time		
Current		
Amount of Substance		
Temperature		
Light Intensity		

2. List the 5 multiples (prefix) of the base unit for distance (length)

3. Recall the engineering discipline responsible for this product then list and justify the different SI units required.

Engineering discipline

SI Units

Justification

4. Why are standard units of measurement important in all aspects of engineering?



Complete the diagnostic, multiple choice questions of the following page.

Upgrade*Circle the correct answer for each question.*

1. Which one of the following SI units would be used to measure an amount of substance?

- a. Milliamp
- b. Millicandela
- c. Milligram
- d. Millimole

2. Which one of the following units of measurement is not an SI base unit?

- a. Ampere
- b. Candela
- c. Inch
- d. Second

3. Which one of the following is measured in candela?

- a. Amount of substance
- b. Electrical current
- c. Luminous intensity
- d. Thermodynamic temperature

4. Which one of the following is measured in kelvin?

- a. Amount of a substance
- b. Electrical current
- c. Microcandela
- d. Thermodynamic temperature

5. Which of the following involves a transfer from one body to another?

- a. Acceleration
- b. Moment of force
- c. Resistance
- d. Work done

6. Which one of the following units is one thousandth of an amp?

- a. Kiloamp
- b. Microamp
- c. Milliamp
- d. Millivolt

7. Which one of the following is a unit of measurement for luminous intensity?

- a. Centimetre
- b. Millicandela
- c. Milligram
- d. Nanomole

8. Which one of the following does a milliamp measure?

- a. Circuits
- b. Current
- c. Time
- d. Volts

9. Which one of the following is equivalent to 1 kiloamp?

- a. 1 amp
- b. 10 amps
- c. 100 amps
- d. 1000 amps

10. Which one of the following does is equal to 1 000 000 microcandelas?

- a. 1 millicandela
- b. 100 millicandelas
- c. 1 candela
- d. 10 candela

11. Which one of the following does a kilogram measure?

- a. Area
- b. Density
- c. Mass
- d. Volume

12. Which one of the following is equal to 18 milliseconds?

- a. 1.8 seconds
- b. 0.18 seconds
- c. 0.018 seconds
- d. 0.0018 seconds

13. Which one of the following is equal to one millionth of a metre?

- a. Centimetre
- b. Kilometre
- c. Micrometre
- d. Millimetre

14. What is a km a measure of?

- a. Current
- b. Length
- c. Mass
- d. Volume

15. Which of these is not an imperial measurement?

- a. Inch
- b. Centimetre
- c. Feet
- d. Yard



Knowledge recall

Date:



1

2

3

Activate

SI Unit group task. Scenario discussion notes.

Demonstrate

Recall the skills for each discipline then tables

Discipline	Applications of SI units		
Mechanical			
Electrical & Electronic			
Aerospace			
Telecommunications			

Chemical

Civil

Automotive

Biomedical

Software

Think and link—complete the matching task

Mass	Amount of substance	Electric current	Temperature	Length (Distance)	Time	Luminous intensity
Kelvin, K	Mole, mol	Candela, cd	Kilogram, kg	Ampere, A	Second, s	Metre, m



Knowledge recall

Date:



1

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Activate

Revision notes and practise questions

Demonstrate

Use the equations in your booklet and a calculator to answer the questions below.

1. A client wants to know the **efficiency** of their conveyor belt system.

Calculate the efficiency of the conveyor belt system using the following data:

Total energy consumption = 50 watts/hour

Useful energy out = 42.5 watts/hour

Show your working. [2 marks]

2. A train uses 100 000 joules of energy to move in one hour.

Calculate the average **power** used by the train in one second.

Show your working. [2 marks]

3. Engineers are testing a motorcycle. It produces 372 W of usable power for every 400 W of input during the charging process. Calculate the motorcycle's **efficiency**.

Show your working. [2 marks]

4. The motorcycle and rider require a force of 350 N to move.

Calculate the **work done** to move them 0.6km

Show your working. [2 marks]



A buffing machine uses 230 volts and the current is 11 amps. Calculate the **power** of the buffing machine. Show your working. [2 marks]



Knowledge recall

Date:



1

2

3

Activate

Revision notes and practise questions

Demonstrate

Use the equations in your booklet and a calculator to answer the questions below.

1. What is a km a measure of? [1 mark] A Current B Length C Mass D Volume

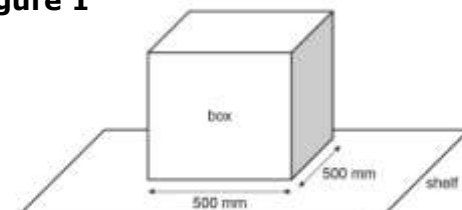
2. A flight from London to New York takes 8 hours and covers a distance of 5540 km. Calculate the **speed** that the aircraft must be travelling at. Give your answer in km/h. Show your working. [2 marks]

3. Calculate the average **speed** of a car that travels 200 kilometres in 4 hours. Show your working. [2 marks]

4. An engineer is tightening a bolt on the front wheel of an electric motorcycle. The engineer applies 45 N of force at a distance of 400 mm from the bolt. Calculate the **moment of force** being applied to the bolt. Show your working. [2 marks]

5. Figure 1 shows a box with a base measuring 500 mm by 500 mm on a shelf. The box applies a force of 175 N over its base. Calculate the **pressure** applied to the shelf shown in Figure 1. Show your working. [2 marks]

Figure 1



A 25500 g electric scooter is used in a crash test to test its safety. It accelerates into a brick wall at 8 metres per second. Calculate its **force** in Newtons. Show your working. [2 marks]



Knowledge recall

Date:



1

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Activate

Revision notes and practise questions

Demonstrate

Use the equations in your booklet and a calculator to answer the questions below.

1. State two SI units for the measurement of mass. 1. _____ 2. _____

2. A disc sander has a mass of 15 290 grams.

Calculate the disc sander's **weight** to the nearest whole number. Gravity = 9.81 ms^{-2}

2. A paving slab has a mass of 73kg and dimensions 40mm × 500mm × 850mm.

Calculate the **density** (in kg m^{-3}) of the material from which the paving slab is made.

Show your working. [2 marks]

3. Calculate the **density** of a metal if its mass is 15kg and volume is 0.25 m^3

Show your working. [2 marks]

4. Figure 2 shows an aluminium component.

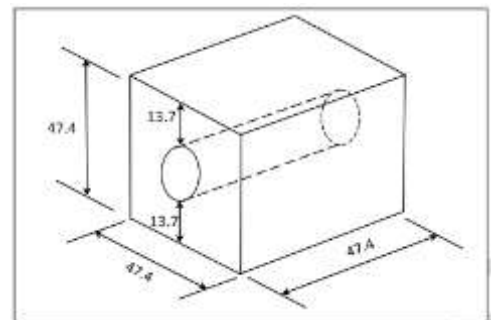
Calculate the total **density** of the aluminium component with the cylindrical hole cut through it.

Mass of the product = 247.37g

Value of $n = 3.14$

All dimensions are in mm. Show your working. [5 marks]

Figure 2





Which one of the following does a kilogram measure? A. Area B. Density C. Mass D. Volume



Knowledge recall

Date:



1

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3

Activate

Key word definitions.

Voltage is _____

Current is _____

Resistance is _____

Power is _____

Demonstrate

Complete the questions below.

1. Calculate the **voltage** in the following circuits:

$I = 2A$	$R = 10 \text{ Ohms}$	$V =$
$I = 5A$	$R = 2 \text{ Ohms}$	$V =$
$I = 100A$	$R = 2.3 \text{ Ohms}$	$V =$

2. Calculate the **current** in the following:

$V = 10V$	$R = 2 \text{ Ohms}$	$I =$
$V = 120V$	$R = 40 \text{ Ohms}$	$I =$
$V = 230V$	$R = 5 \text{ Ohms}$	$I =$

3. Calculate the **resistance** in the following:

$V = 230V$	$I = 10A$	$R =$
$V = 12V$	$I = 1.5A$	$R =$
$V = 60V$	$I = 2A$	$R =$

4. Calculate the **missing values**.

$I = 5 \text{ Amps}$	$R =$	$V = 12 \text{ V}$
$I =$	$R = 4 \text{ Ohm}$	$V = 20 \text{ V}$
$I = 7 \text{ Amps}$	$R = 0.3 \text{ Ohm}$	$V =$
$I = 2 \text{ Amps}$	$R =$	$V = 3V$
$I =$	$R = 220 \text{ Ohm}$	$V = 24V$

5. A household kettle heats water using an electrical heater that is connected to a 240 volt mains supply. The power of the heater is 1.5 kW (1500 watts). Calculate the **current** going through the kettle.

Show your working out.

6. An 18 V cordless drill uses 750 mAh of current. Calculate its **resistance** in Ohms.

Show your working out.

7a. A hair dryer has a power rating of 920W. It is operated from the mains supply. (You should know that the mains supply is 230V). Calculate the **current** in the hair dryer when operating.

Show your working out.

7b. Calculate the **resistance** of the hair dryer.



When switched on, a mains powered grilling machine has a current of 3.1A in it. Calculate the **power** of the machine.



Knowledge recall

Date:



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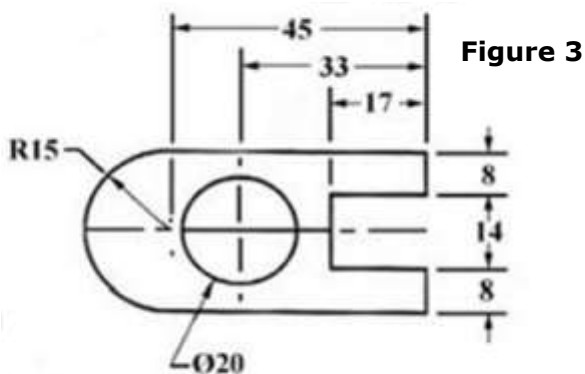
3

Demonstrate

Complete the questions below using the formula provided. Unless otherwise stated, all dimensions are in mm.

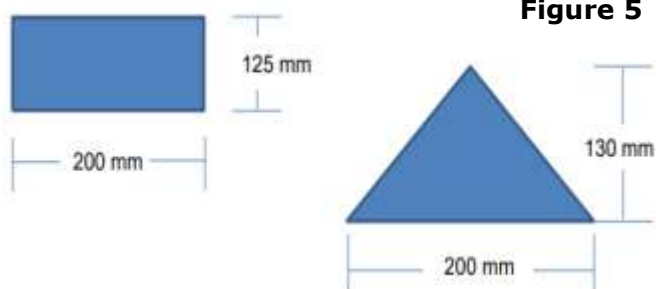
1. Calculate the **length** and **width** of the product shown in figure 3.

Show your working. [4 marks]



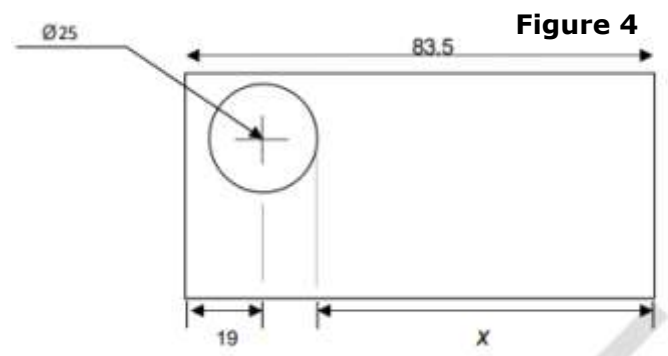
2. You are a sheet metal worker. You have been asked to produce a circular component out of 1cm stainless steel with a radius of 7cm.

Calculate the surface **area** of the component. Give your answer to one decimal place (1dp)



3. Figure 4 shows a component with a hole through it. Calculate the missing dimension x.

Show your working.



4. Figure 5 (bottom left) shows two components to be cut from the same square sheet of material, that has an area of 40 000 mm².

Calculate if both shapes in Figure 5 can be cut from the same square sheet.

Show your working. [3 marks]



Name two SI units of measurement commonly used in mechanical engineering. _____



Knowledge recall

Date:

1

2

3



Demonstrate

Complete the questions below using the formula provided. Unless otherwise stated, all dimensions are in mm.

1. Find the **volume** of the cuboids:

a. $l = 10, b = 20, h = 5. V =$ _____

b. $l = 18, b = 6, h = 20. V =$ _____

c. $l = 42, b = 52, h = 22. V =$ _____

2. Calculate the **volume** of figure 7.

Show your working. [3 marks]

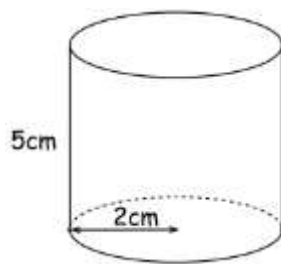


Figure 7

3. Calculate the **volume** of figure 8.

Show your working. [3 marks]

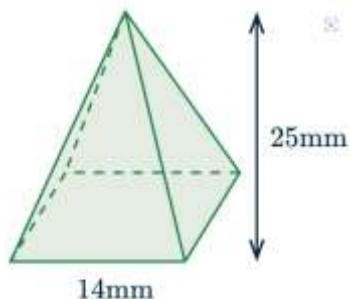


Figure 8

4. Figure 9 shows an aluminium component.

Calculate the total **volume** of the aluminium

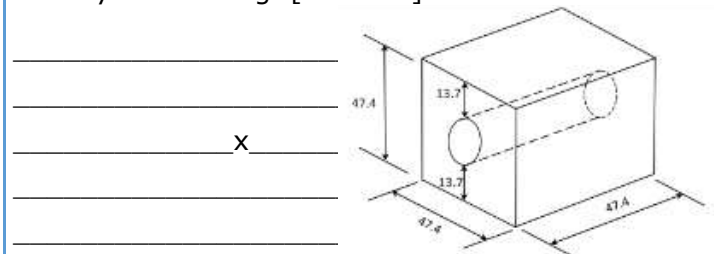
component with the cylindrical hole cut through it.

Mass of the product = 247.37g

Value of $\pi = 3.14$

Show your working. [5 marks]

Figure 9



5. An engineer is fabricating a new kitchen

extraction hood as shown in Figure 10. It is a

combination of a cuboid shape with a pyramid top.

Calculate the total **volume** of the shape.

All dimensions are in cm.

Show your working. [4 marks]

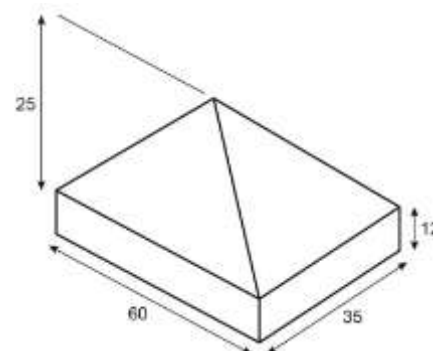


Figure 9



Name two SI units of measurement commonly used in civil engineering. _____



SI units of measurement

Upgrade

How secure is your knowledge? Writing strategies to support you with this question include:

1. Because, but, so, 2. Appositives, 3. Question words (WWWWH), and 4. the use of academic writing stems.

1. It is important to use SI units and equations in engineering to make sure that applications function and are safe to operate. Explain the ways that SI units and equations have been applied to aerospace engineering.

[9 marks]

[illegible]

Upgrade

How secure is your knowledge? Writing strategies to support you with this question include:

1. Because, but, so, 2. Appositives, 3. Question words (WWWWH), and 4. the use of academic writing stems.

1. Figure 4 shows a modern car.

Figure 1



Modern cars are usually manufactured and assembled from component parts using a network of specialist manufacturers around the world. Car components are usually made according to the international system of units (SI).

Discuss how SI units may have been used in engineering a modern car.

[9 marks]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Upgrade

How secure is your knowledge? Writing strategies to support you with this question include:

1. Because, but, so, 2. Appositives, 3. Question words (WWWWH), and 4. the use of academic writing stems.

1. The food and drink business is a global area of chemical engineering which has helped to shape the modern world.

Evaluate the uses of equations in food and drink manufacturing.

[9 marks]

[illegible]

Stick your assessment paper here.

This will be needed to identify MAD opportunities and for knowledge recall prior to your exam in Year 11.