Induction Booklet

OCR Cambridge Technical - Engineering

This booklet is to be completed over the summer and handed in on your first Engineering lesson.

Engineering notation

SI prefixes

Sometimes physical quantities are very large or very small and it is useful to use engineering notation to make them easier to read. e.g. 24 mm, 72 km, 500 mV, 480 MW

As an Engineer it is important that you become skilled at handling both standard form and prefixes. You are expected to be able to use the prefixes shown below and need to make sure you learn them.

Prefix	Symbol	Value	Equivalent in Powers of ten
tera	T	1000000000000	10^{12}
giga	G	1000000000	10^{9}
mega	M	1000000	10^{6}
kilo	k	1000	10^{3}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	µ	0.000001	10^{-6}
nano	n	0.000000001	10^{-9}
pico	p	0.000000000001	10^{-12}

Conversion of units using SI prefixes and standard form

If you are struggling with this exercise watch the following guidance - https://www.youtube.com/watch?v=3TG-SeyyVdw There is a link to this video on the Moodle page.

Give your answer to questions **1-4 in standard form**.

1. Convert the following voltages to V:
   6 kV
   34 MV
   328 mV
   893 µV

2. Convert the following lengths to m:
   364 mm
   98 cm
   459 nm
   28.7 µm

3. Convert the following energies to J:
   23 mJ
   439 GJ
   2.5 pJ
   34 TJ

4. Convert the following powers to W:
   359 MW
   962 mW
   785 nW
   285 µW

5. Convert the following frequencies to GHz:
   34 mHz
   34 µHz
   34 MHz
   34 Hz

6. Convert the following currents to mA:
   23×10^{-4} A
   247 µA
   857×10^{-5} A
   25 µA

7. Convert the following powers to MW:
   2650 GW
   2240 kW
   260 mW
   379 TW

Maths in engineering

Manipulating equations in Engineering is important, no matter what branch you take. All rely on equations that have some sort of an unknown. Different situations have different unknowns, meaning being able to rearrange and solve equations is a key skill in any engineering role.

Algebra

(1) $x + 9 = 15$

x=_____ [1]

(2) $13 - y = 4$

y=_____ [1]

(3) $6t - 3 = 39$

t=_____ [2]

(4) $\frac{x}{3} + 6 = 11$

x=_____ [2]

(5) $\frac{9 + d}{4} = 2$

d=_____ [2]

(6) $2(5 - g)=6$

g=_____ [3]

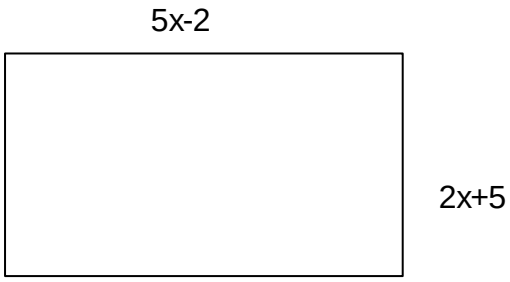
(7) $5x + 2 = 3x - 4$

x=_____ [3]

(8) $3(2b - 1) = 4b+5$

b=_____ [4]

(9)



(a) Write an expression in terms of x for the perimeter and simplify your expression.

_____ [4]

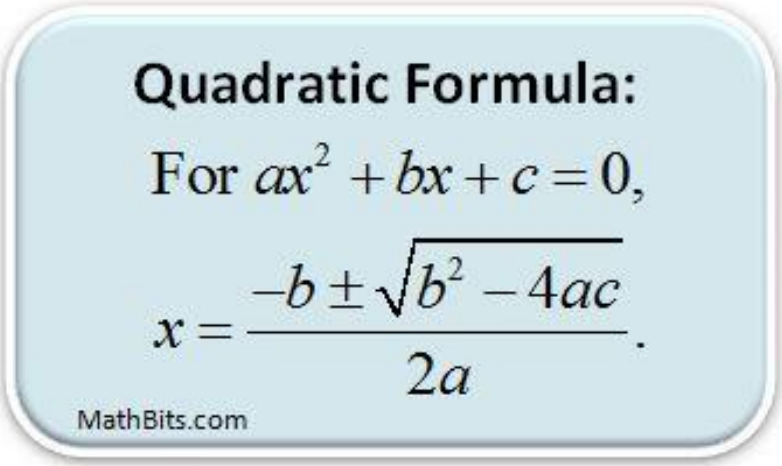
(b) If the perimeter is 48, work out x.

x= _____ [3]

Quadratics

We will be going into quadratics as they play an integral part of engineering maths. The following questions require you to use the quadratic formulae to solve for answers.

If you are struggling with it watch this :
https://www.youtube.com/watch?v=s80J2dAUUyI



A: Only a few negative terms

1) $x^2 + 8x + 2 = 0$

2) $x^2 + 6x + 3 = 0$

3) $x^2 – 12x + 4 = 0$

4) $x^2 - 10x + 5 = 0$

B: Negatives and coefficient of x^2 bigger than 1

5) $2x^2 + x – 8 = 0$

6) $3x^2 + 5x + 1 = 0$

7) $x^2 – x – 10 = 0$

8) $5x^2 + 2x – 1 = 0$

C: Extension – Functional questions

9) A rectangular lawn is 2 m longer than it is wide.
The area of the lawn is 21 m^2. The gardener wants to edge the lawn with edging strips, which are sold in lengths of 1.5 m. How many will she need to buy?

Hint: Draw a diagram. Write area equation and solve values of x.

Physics in Engineering

Now physics in basically maths in real life situations the following uses you skills of maths to solve real problems. Not only will you have to rearrange equations but read data from graphs and interpret what to do with it. The following are some classic equations we come across in engineering and some questions involving them.

Weight = mass x acceleration due to gravity	W = mg

1. Calculate the weight of an object with a mass of 50 kg on Earth where the acceleration due to gravity is 9.8 m/s/s.

2. Calculate the weight if an object of 60 kg is accelerated at 9.8 m/s/s.

3. Work out the mass if an object is accelerated at 9.8m/s/s and has a weight of 98N.

4. Calculate the mass of a person accelerated at 9.8m/s/s with a weight of 700N.

5. Calculate the acceleration due to gravity on the moon if the mass is 10kg and the weight is 16N

Force = mass x acceleration	F = ma

1. Calculate the force required to accelerate a mass of 50 kg at 3 m/s/s.

2. Calculate the force if an object of 100 kg is accelerated at 1.8 m/s/s.

3. Work out the mass if an object is accelerated at 2m/s/s by a force of 50N.

4. Calculate the mass of a person accelerated at 9.8m/s/s by a force of 70N.

5. Calculate the acceleration if the mass is 100kg and the force is 10N

Voltage = Current x Resistance	V = IR

1. Calculate the voltage if the current in a circuit is 3A and the resistance is 120Ω.

2. Calculate the voltage if the current is 2.2A and the resistance is 50Ω

3. Work out the current if the voltage is 120V and the resistance is 240Ω

4. Calculate the current if the voltage is 9V and the resistance is 450Ω

5. Calculate the resistance if the voltage is 200V and the current is 2.5A.

Power = Current x Voltage	P = IV

1. Calculate the power if the current in a circuit is 3A and the voltage is 12V.

2. Calculate the power if the voltage is 220V and the c urrent is 5A

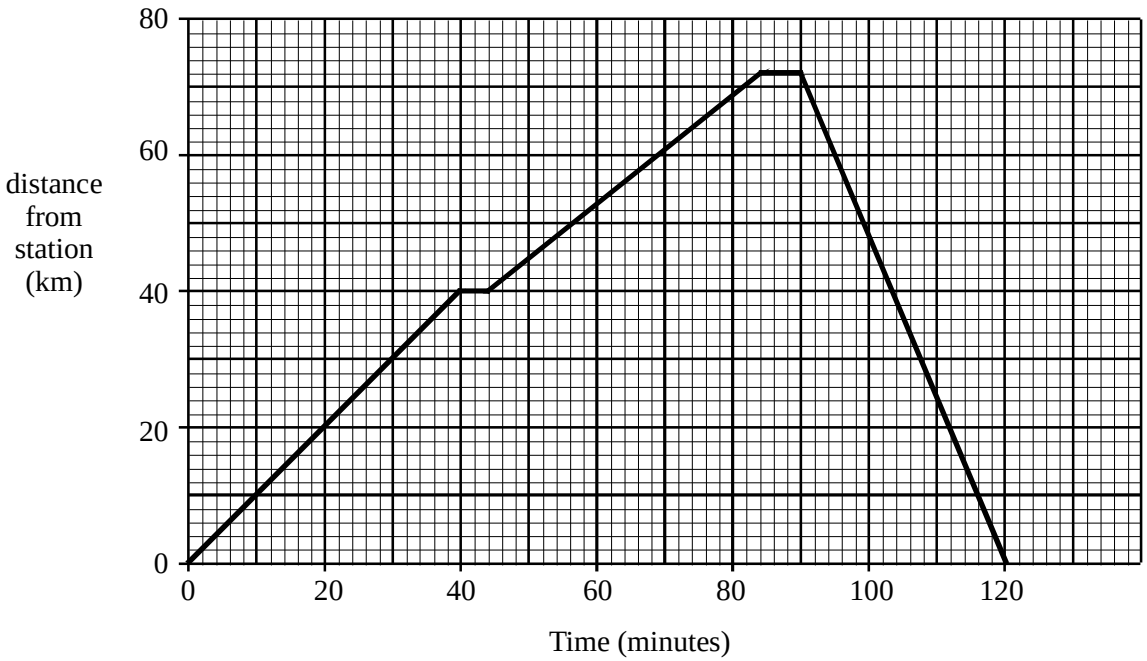
3. Work out the current if the power is 120W and the voltage is 240V

4. Calculate the current if the voltage is 9V and the power is 45W

5. Calculate the voltage if the power is 20W and the current is 0.2A.

Data from graphs

1) The diagram shows the travel graph of a train.



(a) Find the greatest speed at which the train travelled.
Give your answer in km/h.

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(3)

(b) Calculate the average speed for the whole journey in km/h.

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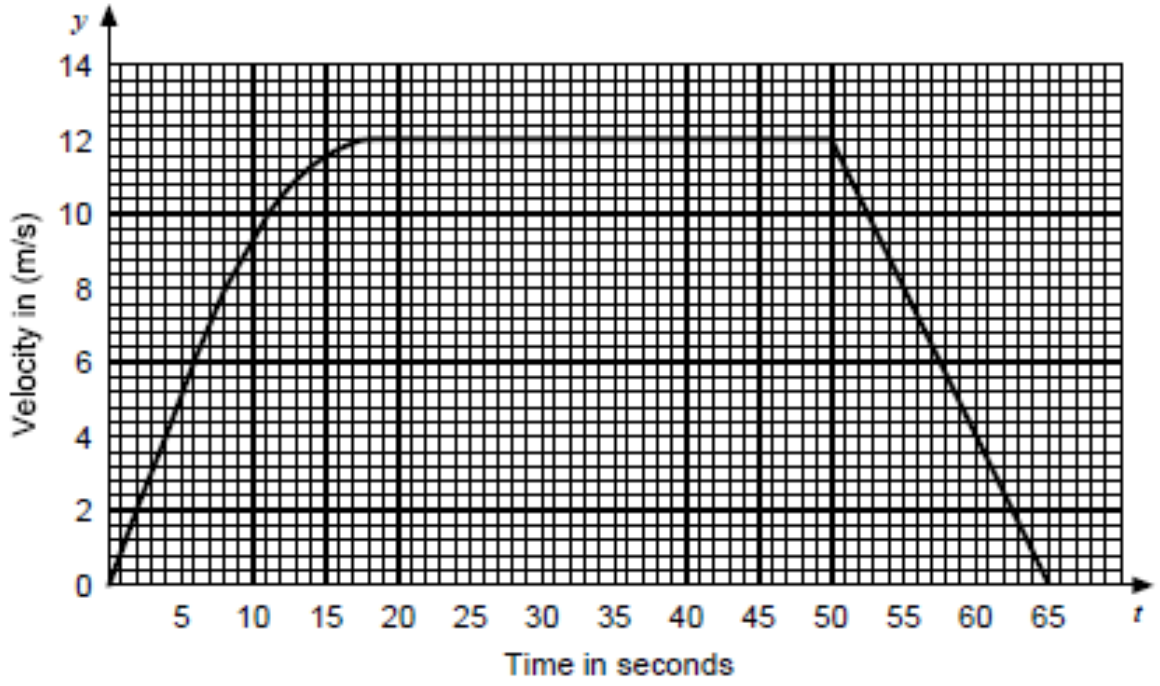
1. A car travels between two sets of traffic lights.
The diagram represents the velocity/time graph of the car.



The car leaves the first set of traffic lights.

(a)Use the graph to find the velocity of the car after 15 seconds.

..... (1)

(b)Calculate an estimate for the acceleration of the car, in m/s^2, after 10 seconds.

..... (2)

Use the equation v = u + at to find acceleration.
Hint you know a v at 15 seconds and a u at 10…….