Brockenhurst College

Getting Ahead – Pre-course Work

#ThinkBrock

Engineering Level 3 Extended Diploma

Welcome to Level 3 Engineering. In preparation for the start of the course, please complete these tasks and have them with you to hand in during your first week of college in September.

These tasks should take you approximately thirteen hours to complete and are designed to give you an introduction to the subject, and the expectations we have for you to complete at least 13 hours of independent study per week

Instructions:

Answer all 6 questions – the last question 7 is the longest and will take more time than the others. This question is optional in this case. You should also complete the quiz at the end.

If you need more space, then you may add further pages, but make sure it is clear which questions the additional work relates to.

You may research to help you with your answers, but the work submitted must be your own, and be written in your own words.

Deadline:

This work must be completed to the best of your ability and submitted on the 5th & 6th September (Induction Day) in the big blue submission box (under "Julian Knott") outside the Engineering staffroom in B4.

Your teachers can show you where this is on Induction Day

Your Name: _____

Q1.
In electrical/electronic work, we often use Ohm's law: $\boldsymbol{voltage = current \times resistance}$ to help calculate different values in circuits. Without using the terms themselves in your answers, explain briefly what each of these three terms means:

Voltage: _____
_____
_____
_____

Current: _____

_____

_____

_____

_____

Resistance: _____

_____

_____

_____

Q2.

Use the formula, $velocity = \frac{distance}{time}$ to solve the following problems:

a) A car travels 500 m in 20 seconds. What is its average velocity?

b) A motorcycle travels at a constant 35 m/s for 30 seconds. What distance will it travel?

c) How long would it take a person to walk 2500 m if they travel at 2 m/s?

Q3.

The following text describes features that enable hybrid cars to be more efficient than conventional cars.

Read the text and answer the questions that follow.

> The addition of a battery-powered electric motor increases the fuel efficiency of hybrids in a number of ways.
>
> Like the switch that turns off your refrigerator's light bulb when the door is closed, "idle-off" is a feature that turns off your car's conventional engine when the vehicle is stopped, saving fuel. The battery provides energy for the air conditioner and accessories while the vehicle idles at stoplights or in traffic, and the electric motor can start the vehicle moving again. If needed, the conventional engine will re-engage to provide more power for acceleration.
>
> "Regenerative braking" is another fuel-saving feature. Conventional cars rely entirely on friction brakes to slow down, dissipating the vehicle's kinetic energy as heat. Regenerative braking allows some of that energy to be captured, turned into electricity, and stored in the batteries. This stored electricity can later be used to run the motor and accelerate the vehicle.
>
> Having an electric motor also allows for more efficient engine design. This "power assist" feature helps reduce demands on a hybrid's gasoline engine, which in turn

can be downsized and more efficiently operated. The gasoline engine produces less power, but when combined with electric motors, the system's total power can equal or exceed that of a conventional vehicle.

The most efficient hybrids utilize "electric-only drive," allowing the vehicle to drive entirely on electricity and use less fuel. In hybrids that can't be plugged-in, electric-only drive is typically only utilized at low speeds and startup, enabling the gas or diesel-powered engine to operate at higher speeds, where it's most efficient. Most plug-in hybrids—which tend to have larger batteries and motors—can drive entirely on electricity at relatively high speeds for extended distances (typically 10 to 30 miles).

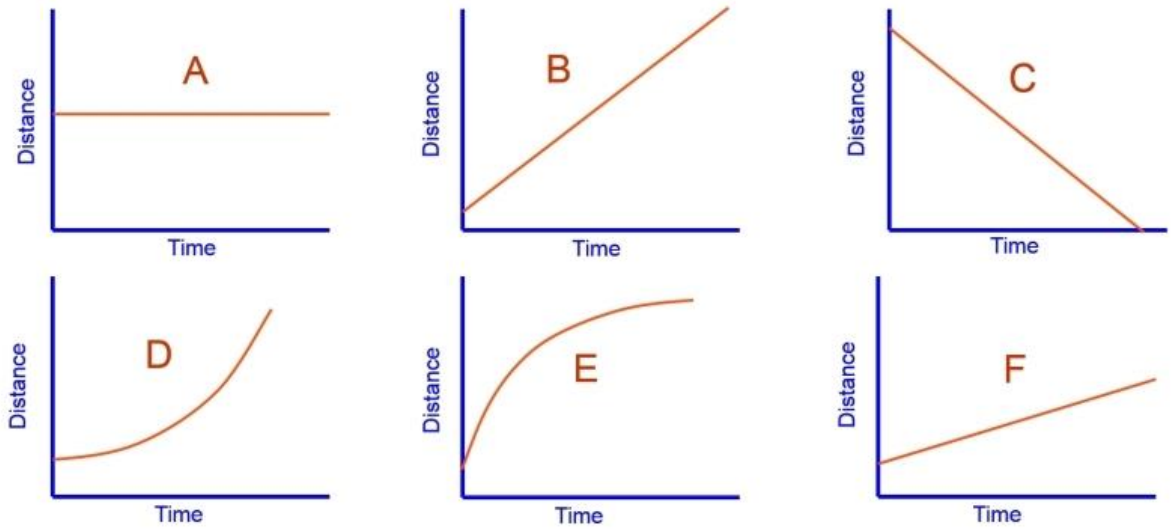
Taken from: *https://www.ucsusa.org/clean-vehicles/electric-vehicles/how-do-hybrids-work#.XDEzzVz7SUk*

a) What are the names of the four features described in the text that improve the efficiency of hybrid car.

b) How does "regenerative braking" make a hybrid more efficient?

c) In your own words, explain why having an electric motor enables the engine to be more efficient.

Q4.
Look the following six Displacement vs Time graphs and choose the appropriate graph for each motion:



Answer the questions below:
Which of the graphs A – F, or none, best suits the following motions (circle your answer):

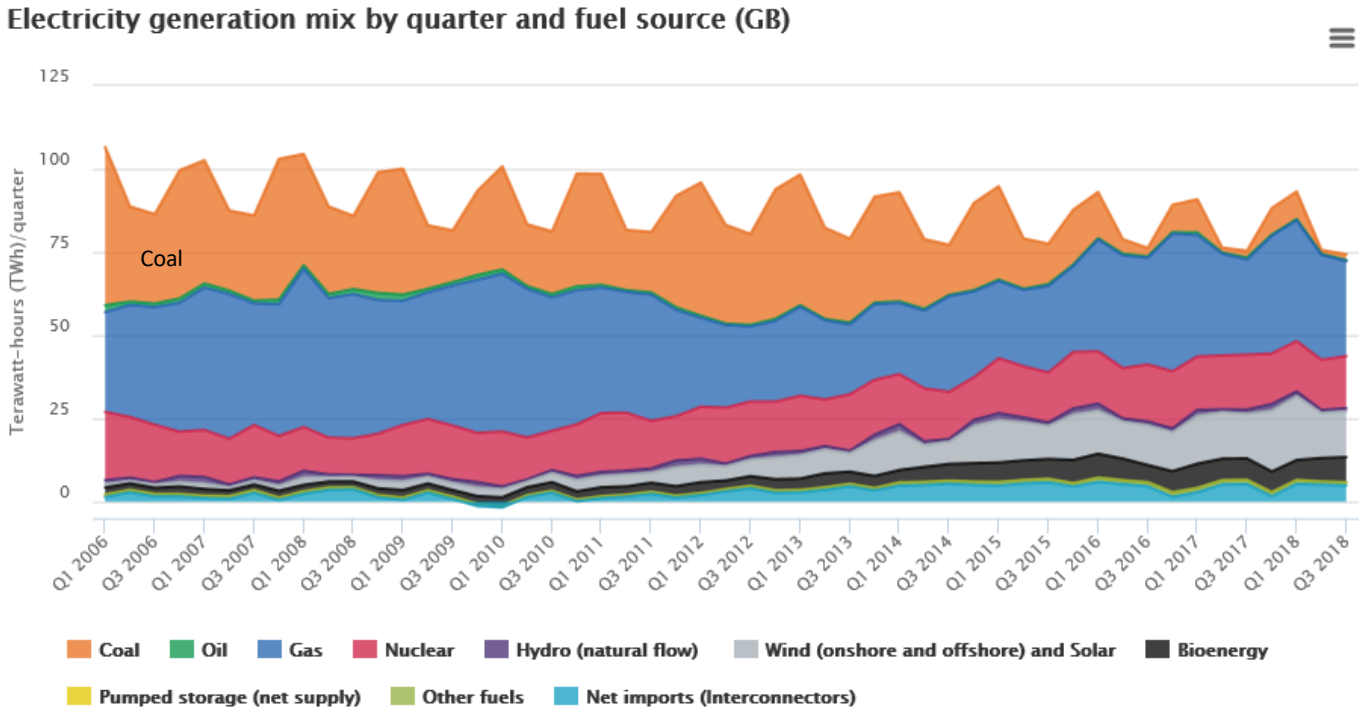
a) Not moving A B C D E F
None

b) Travelling at constant speed A B C D E F
None

c) Slowing down A B C D E F
None

d) Speeding up A B C D E F
None

Q5.
Look carefully at the chart and answer the questions that follow:



Taken from: https://www.ofgem.gov.uk/news-blog/our-blog/what-drives-great-britain-s-electricity-generation-mix

a) Describe in your own words, as clearly as you can, what this graph is all about.

b) How often is this information updated?

c) Estimate the amount of electrical energy generated each year.

d) Why do you think that the top line goes up and down so much?

e) Identify 3 general trends that you can see in the data.

Q6.
The table below shows some of the property values of a range of different materials.

MATERIAL	Type	Cost per kg ($)	Density (kg/m^3)	Elastic Modulus (GN/m^2)	Shear Modulus (GN/m^2)	Poisson's Ratio	Yield Stress (MN/m^2)	Ultimate Tensile Strength (MN/m^2)	Breaking Strain (%)	Fracture Toughness	Thermal Expansion x 10^{-6} /°C
Alumina (Al_2O_3)	ceramic	1.90	3.9	390	125	0.26	4800	35	0.0	4.4	8.1
Aluminum alloy (7075-T6)	metal	1.80	2.7	70	28	0.34	500	570	12	28	33
Brass (70Cu,30Zn, annealed)	metal	2.20	8.4	130	39	0.33	75	325	70.0	80	20
Cermets (Co/WC)	composite	78.60	11.5	470	200	0.30	650	1200	2.5	13	5.8
CFRP Laminate (graphite)	composite	110.00	1.5	1.5	53	0.28	200	550	2.0	38	12
Concrete	ceramic	0.05	2.5	48	20	0.20	25	3.0	0.0	0.75	11
Copper alloys	metal	2.25	8.3	135	50	0.35	510	720	0.3	94	18
Epoxy thermoset	polymer	5.50	1.2	3.5	1.4	0.25	45	45	4.0	0.50	60
GFRP Laminate (glass)	composite	3.90	1.8	26	10	0.28	125	530	2.0	40	19
Glass (soda)	ceramic	1.35	2.5	65	26	0.23	3500	35	0.0	0.71	8.8
Granite	ceramic	3.15	2.6	66	26	0.25	2500	60	0.1	1.5	6.5
Lead alloys	metal	1.20	11.1	16	5.5	0.45	33	42	60	40	29
Nickel alloys	metal	6.10	8.5	180	70	0.31	900	1200	30	93	13
Polyamide (nylon)	polymer	4.30	1.1	3.0	0.76	0.42	40	55	5.0	3.0	103

Polybutadiene elastomer	polymer	1.20	0.91	0.0016	0.0005	0.50	2.1	2.1	500	0.087	140
Polycarbonate	polymer	4.90	1.2	2.7	0.97	0.42	70	77	60	2.6	70
Polyester thermoset	polymer	3.00	1.3	3.5	1.4	0.25	50	0.7	2.0	0.70	150
Polyethylene (HDPE)	polymer	1.00	0.95	0.7	0.31	0.42	25	33	90	3.5	225
Polypropylene	polymer	1.10	0.89	0.9	0.42	0.42	35	45	90	3.0	85
Polyvinyl chloride (rigid PVC)	polymer	1.50	1.4	1.5	0.6	0.42	53	60	50	0.54	75
Silicon Carbide (SiC)	ceramic	36.00	2.8	450	190	0.15	9800	35	0.0	4.2	4.2
Spruce (parallel to grain)	natural	1.00	0.60	9	0.8	0.30	48	50	10	2.5	4
Steel, high strength 4340	metal	0.25	7.8	210	76	0.29	1240	1550	2.5	100	14
Steel, mild 1020	metal	0.50	7.8	210	76	0.29	200	380	25	140	14
Steel, stainless austenitic 304	metal	2.70	7.8	210	76	0.28	240	590	60	50	17
Titanium alloy (6Al4V)	metal	16.25	4.5	100	39	0.36	910	950	15	85	9.4
Tungsten Carbide (WC)	ceramic	50.00	15.5	550	270	0.21	6800	35	0.0	3.7	5.8

a) Using data from the table, give one advantage and one disadvantage of using CFRP laminate for car body panels.

Advantage: _____

_____

_____

Disadvantage: _____

b) The table only includes some of the property data of the materials. What other data would also be helpful when choosing materials to be used as engine components? State the material property and also explain why it would be useful.

Property: _____

Why useful? _____

c) Compare some of the properties of aluminium alloy and GFRP laminate for making remote control aircraft.

_____

_____

_____

_____

_____

_____

Q7. (Optional)
Choose a topic related to Engineering that you are particularly interested in.
Write a report explaining what you are interested in (including any technical aspects) and why you find it interesting.
This report should be between 400-500 words, typed and stapled to the back of this assignment.

Q8 Quiz

1.What type of material is bronze?

a. A ferrous metal
b. A non-ferrous metal
c. A metal alloy
d. A ceramic material

2. Which of the following is a useful characteristic of ceramic materials?

a. They deform plastically before failure
b. They can be machined easily
c. They are brittle
d. They have excellent resistance to heat

3. An engineering application requires a material that is an electrical insulator, is lightweight and formed easily. Which group would be a good choice to look for a suitable material?

a. Ferrous metals
b. Non-ferrous metals
c. Polymers
d. Ceramics

4. Which of these is used to make Plastic?

a. Wood
b. Metal
c. Oil
d. Sand

5. In Which of these is Calcium carbonate not found?

a. Titanium
b. Limestone
c. Eggshell
d. Coral

6. Which element is used, with iron, to make steel?

a. Bronze

b. Carbon
c. Aluminium
d. Chromium

7. What material is made up of cement and water?

a. Gypsum
b. Concrete
c. Steel
d. Styrofoam

8. Which of these elements will eventually become diamond?

a. Sulphur
b. Nitrogen
c. Carbon
d. Thalium

9. Who was the self-taught American chemist who developed vulcanized rubber – Mr.?

a. Goodyear
b. Dunlop
c. Avon
d. Michelin

10. Which of these is not an ingrediant used to glaze ceramics

a. Ferric oxide
b. Cobalt
c. Brass
d. Iron oxide

11. The name of which material is translated from the Italian for "baked earth"?

a. Clay
b. China
c. Pottery
d. Terracotta

12. What brand name was given in 1908 for borosilicate glass?

a. Boron
b. Pyrex
c. Laminate
d. Pilkington

13. Quarried on the Isle of Portland, Dorset, what type of rock is Portland stone?

a. Limestone
b. Brick
c. Blue Circle
d. Anthracite

14. The Leaning Tower of Pisa is constructed of which material?

a. Limestone
b. Wood
c. Concrete
d. Marble

Brockenhurst College

Getting Ahead – Pre-course Work

#ThinkBrock

Getting Equipped

You will need the following:

- A ring binder
- Dividers
- Pens, hi-lighters, pencils
- Notebook/notepad
- Calculator