Pearson BTEC Sample Set Assignment Brief

Single-Part Assessment

Unit 57 – Electrical and Electronic Principles

For use with:

Pearson BTEC International Level 3 qualifications in Engineering

Certificate (Optional)/Subsidiary Diploma (Optional)/Foundation Diploma/Diploma/Extended Diploma

Advised supervised hours	2 hours

For completion by the centre

Qualification (select as appropriate)	Certificate/Subsidiary Diploma/Foundation Diploma/Diploma/ Extended Diploma
Assessment date	

Pearson BTEC

Instructions to tutors and/or invigilators

The Pearson Set Assignment will be assessed internally by the centre, using the unit assessment criteria given in the qualification specification. The Set Assignment will be sampled by the Standards Verifier as part of the annual standards verification centre visit.

Conditions of supervision

The Pearson Set Assignment should be undertaken in conditions that assure the authenticity of outcome. This may require supervision.

We advise that the Pearson Set Assignment be completed in sessions that come to a total of 2 hours. The Pearson Set Assignment should not be shared with learners prior to the start of the assessment period. Teachers/tutors are responsible for security of the Pearson Set Assignment and materials.

Outcomes for submission

Learners may submit handwritten or word-processed evidence. Drawings and diagrams must be completed in pencil.

Learners will need to have access to a non-programmable calculator that does not have the facility for symbolic algebraic manipulation or allow the storage and retrieval of mathematical formulae.

Learners will need access to the Information Booklet of Formulae and Constants.

Learners must submit their own, independent work as detailed in the Set Assignment. Each learner must complete an authentication sheet.

Instructions to Learners

Read the Set Assignment carefully.

You will be asked to carry out specific activities using the information provided. You will be given a specific time period to complete the assignment.

You will be asked to carry out specific written activities and calculations using information provided.

You must work independently at all times and must not share your work with other learners. You must complete an authentication sheet and submit this along with your work.

You should show all of your working when completing calculations.

Set Assignment

You must complete ALL activities.

ACTIVITY 1

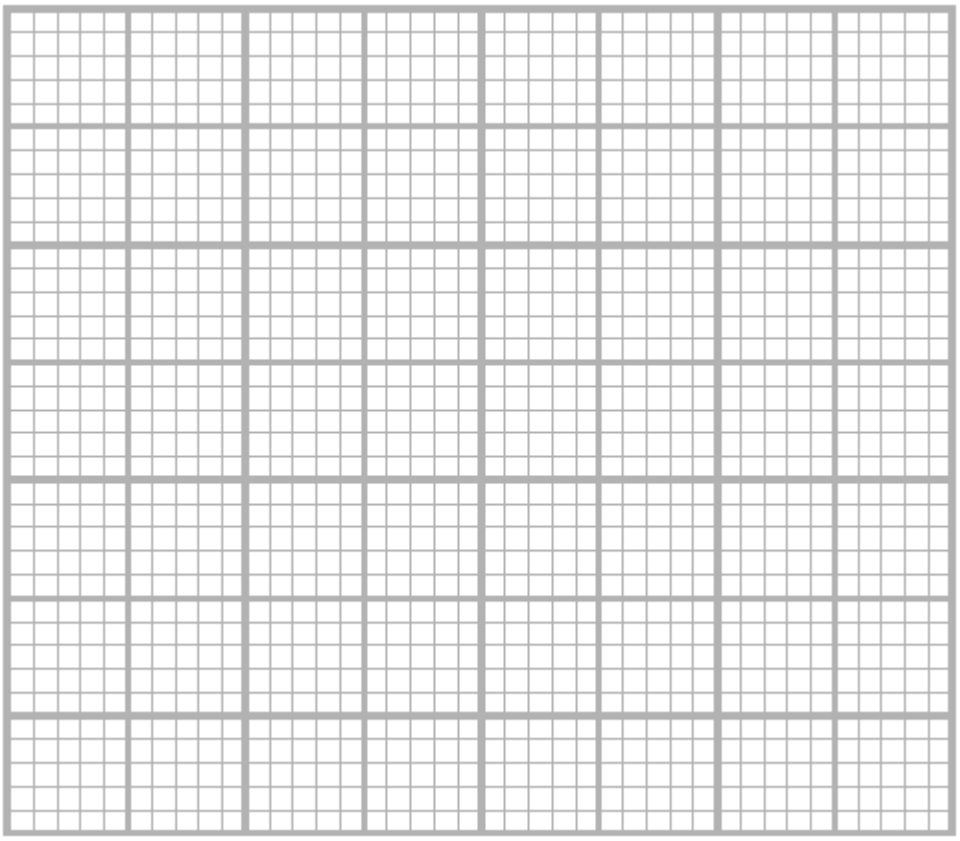
1. An engineer has completed two tests on two conductors.

The results of the tests are represented by the following expressions:

$V = 15R + 5$

$V = 12R + 8$

where V is the voltage and R is the resistance.



(a) Plot the results of both tests on the graph paper for values of R between 0 and 4 ohms. Use appropriate scales and axes.

(b) Use the graph to identify when the voltage will be identical for the same resistance value.

An engineering technician has measured the resistances of 25 resistors.

The values are shown below:

59, 65, 61, 62, 53, 55, 60, 70, 64, 56, 58, 58, 62, 62, 68, 65, 56, 59, 68, 61, 67, 62, 56, 60, 54

(c) Calculate the mean, median and mode values of the resistors.

The technician then groups the data into four ranges:

51–55; 56–60; 61–65; 66–70

(d) Produce a frequency chart for the data and then present the data as a histogram.

2. Use the laws of logarithms and indices to solve the following for the unknown values:

(a) $\log 24 = \log z + 2\log 2$

(b) $\ln(6/x) = 3\ln 4$

(c) $\log x = \log 12 - 2\log 2 + \log 3$

(d) $\ln 6^{x+3} = 7.2$

(e) $\ln 4^{2x+5} = 4.7$

(f) The percentage increase of an amplifier is represented by the equation:

$PI(\%) = (y^2 t)^2$

Solve the equation to find the value of y when the percentage increase is 64% and the value of t = 2.

3. Two AC voltage waveforms are represented by:

$V_1 = 100\sin(100\omega t)$ volts

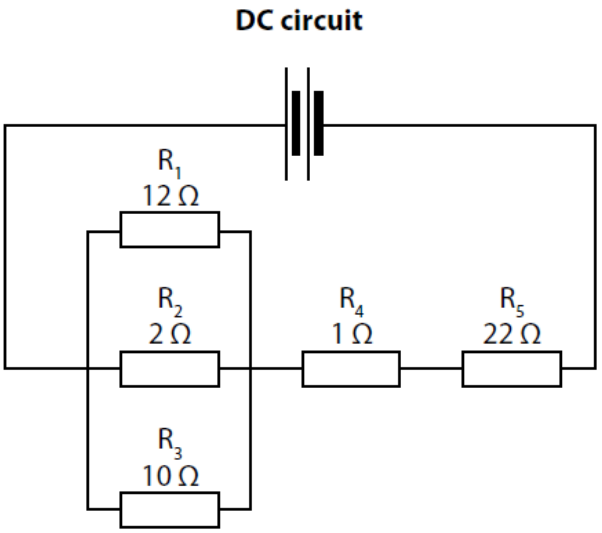
$V_2 = 200\sin(100\omega t - \pi/6)$ volts

Draw a phasor diagram to represent the two waveforms and find the resultant value.

This activity covers learning aim A and assessment/grading criteria: A.P1, A.P2, A.P3, A.M1, A.D1

ACTIVITY 2

1. The diagram shows a DC resistor network. The network is supplied by a 12 V battery.

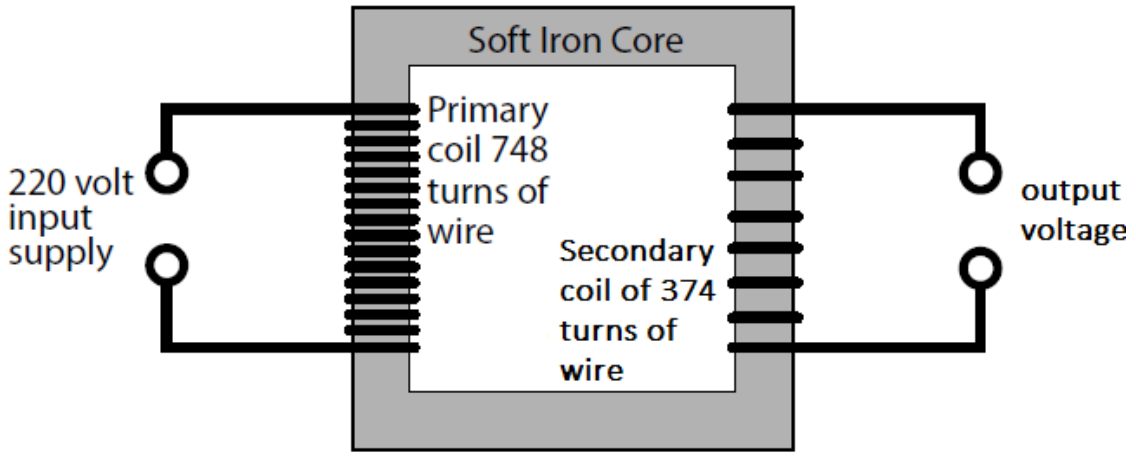


Using the information in the network diagram, calculate:

(a) the current flowing through resistor R5

(b) the overall power dissipated in the network.

2. A transformer is used to provide an AC supply to a piece of portable equipment.



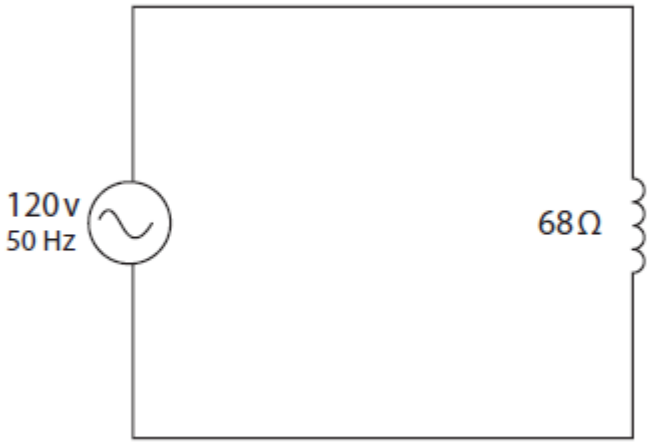
(a) Calculate the peak value of the input supply.

(b) Calculate the output voltage from the transformer and then draw a waveform to represent the output voltage over two cycles.

You should indicate the amplitude and the time period on the waveform.

(c) A technician checks the operation of the transformer. The calculations show that the transformer is 93% efficient. Use this information to calculate the actual output voltage from the secondary coil.

3. An electrical engineer has connected a coil to a 120 V AC supply at a frequency of 50 Hz.



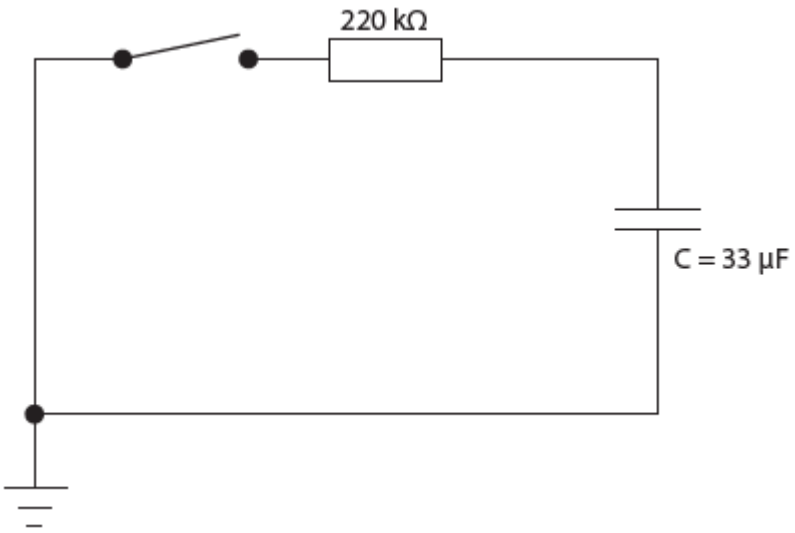
0.75 C of charge passes through the coil in 5 minutes.

(a) Calculate the current passing through the coil.

The coil has an internal resistance of 68 ohms.

(b) Calculate the inductance of the coil.

The diagram shows a fully charged capacitor that is discharged through the resistor when the switch is closed.

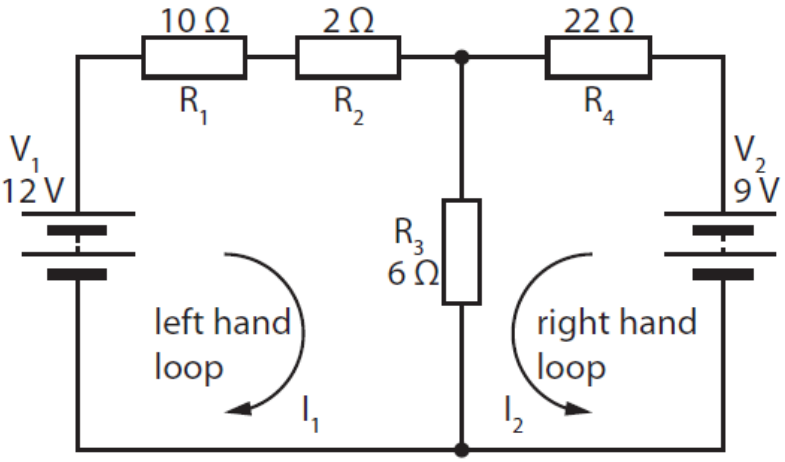


(c) Calculate the time constant of the capacitor.

When the capacitor is fully charged and t = 0, the voltage across it is 16 V.

(d) Calculate the voltage across the capacitor after 12 seconds.

4. The diagram shows a resistor network with two power supplies.



V_1 is supplied from a variable power supply that is supplied with a current of 1.1 amps.

(a) Calculate the power drawn by the power supply.

(b) Calculate the current flowing through resistor R_3.

(c) The supply voltage V_2 is increased to 15 V. Explain how this would affect the current flowing through resistor R_3.

This activity covers learning aims B, C and D and assessment/grading criteria: B.P4, B.P5, C.P6, C.P7, C.P8, D.P9, B.M2, C.M3, D.M4, BCD.D2

Pearson BTEC Level 3 International Qualifications in Engineering

Engineering

Unit 57: Electrical and Electronic Principles

Source Booklet of Formulae and Constants

Formulae and Constants

Maths

Laws of Indices

$a^m \times a^n = a^{m+n}$

$\frac{a^m}{a^n} = a^{m-n}$

$(a^m)^n = a^{mxn}$

Laws of Logarithms

$\log AB = \log A + \log B$

$\log \frac{A}{B} = \log A - \log B$

$\log A^n = n \log A$

Statistics

Arithmetic mean $\bar{x} = \frac{\Sigma x}{n}$

Median $\frac{(n+1)}{2}$ n^{th} term, where terms are arranged smallest to largest

Physical constants

Permittivity of free space – $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m

Permeability of free space – $\mu_0 = 4\pi \times 10^{-7}$ H/m

Angular parameters

Frequency

$$f = \frac{1}{time\ period}$$

Radians to degrees conversion $\theta_{(degrees)} = \frac{360\ \theta_{(radians)}}{2\ \pi}$ where 2π radians = 360°

Degrees to radians conversion $\theta_{(radians)} = \frac{2\ \pi\ \theta_{(degrees)}}{360}$

Static and DC electricity theory

Current/electron flow	$I = \frac{q}{t}$
Coulomb's law	$F = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2}$
Resistance	$R = \frac{pl}{A}$
Resistance: temperature coefficient	$\frac{\Delta R}{R_0} = \alpha \Delta T$
Ohm's Law DC circuit	$I = \frac{V}{R}$
Total for resistors in series	$R_T = R_1 + R_2 + R_3 \ldots$
Total for resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$
Power	$P = IV, \quad P = I^2 R, \quad P = \frac{V^2}{R}$
Electrical Efficiency	$Efficiency\ (\eta) = \frac{P_{out}}{P_{in}}$
Kirchhoff's Current Law	$I = I_1 + I_2 + I_3 \ldots$
Kirchhoff's Voltage Law	$V = V_1 + V_2 + V_3 \ldots$ or $\sum PD = \sum IR$

Capacitance

Capacitance	$C = \frac{\varepsilon A}{d}$
Time constant	$\tau = RC$
Charge stored	$Q = CV$
Energy stored in a capacitor	$W = \frac{1}{2} CV^2$
Capacitors in series	$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \ldots$
Capacitors in parallel	$C_T = C_1 + C_2 + C_3 \ldots$
Voltage decay on a capacitor discharging	$V_c = V_s e^{(\frac{-t}{\tau})}$
	Where V_c = capacitor voltage and V_s = supply voltage

Magnetism and Electromagnetism

Electric Field Strength	$E = \frac{F}{q}$ or $E = \frac{V}{d}$ for uniform electric fields
Magnetic Flux Density	$B = \frac{\phi}{A}$
Magnetomotive Force	$F_m = NI$
Magnetic field strength or magnetising force	$H = \frac{NI}{l}$
Permeability	$\frac{B}{H} = \mu_0 \mu_r$
Reluctance	$S = \frac{F_m}{\phi}$
Induced EMF	$E = Blv, \quad E = -N \frac{d\phi}{dt} = -L \frac{di}{dt}$
Energy stored in an inductor	$W = \frac{1}{2} LI^2$
Inductance of a coil	$L = N \frac{\phi}{I}$
Transformer equation	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$

Single phase alternating current theory

Time period	$T = \frac{1}{f}$
Capacitive reactance	$X_c = \frac{1}{2\pi fC}$
Inductive reactance	$X_L = 2\pi fL$
Ohm's Law AC circuits	$I = \frac{V}{Z}$ (when voltage and current are in phase)
Root mean square voltage	$r.m.s.\ voltage = \frac{peak\ voltage}{\sqrt{2}}$
Total impedance of an inductor in series with a resistance	$Z = \sqrt{X_L^2 + R^2}$
Total impedance of a capacitor in series with a resistance	$Z = \sqrt{X_c^2 + R^2}$
Waveform average value	$Average\ value = \frac{2}{\pi} \times maximum\ value$
Form factor of a waveform	$Form\ factor = \frac{r.m.s.\ value}{average\ value}$

Marker Sheet – Routine/non-routine requirements

This Marker Sheet should be used in conjunction with Unit 57. This sheet indicates whether a learner solution should be using routine or non-routine methods. These terms and their application are explained in the Unit 57 *Essential Information for Assessment Decisions* section.

ACTIVITY 1

Question		Type
1	(a)	Non-routine
	(b)	Non-routine
	(c)	No-routine
	(d)	Non-routine
	(e)	Non-routine
2	(a)to(e)	Routine
	(f)	Non-routine
3	(a)	Non-routine

ACTIVITY 2

Question		Type
1	(a)	Routine
	(b)	Routine
2	(a)	Routine
	(b)	Non-routine
	(c)	Routine
3	(a)	Routine
	(b)	Routine
	(c)	Non-routine
	(d)	Non-routine
4	(a)	Routine
	(b)	Routine
	(c)	Non-routine