Ideal transformer: $P_{in} = P_{out}$, $V_p I_p = V_s I_s$

a. Calculate the output voltage
b. The input current is 0.1A. Calculate the output current. $12 \times 0.1 = 12 \times I_s$, $I_s = 2A$

2. 30 Joules of energy is transferred by a Battery when it produces 1A for 20 seconds. What is the voltage of the battery? $V = \frac{E}{It} = \frac{30}{1 \times 20} = 1.5V$
3. You have a 10 Ohm and a 15 Ohm resistor.
   a. What combined resistances can they have in parallel, in series? 6Ω, 25Ω
   b. Calculate the current that would flow if the 15 Ohm resistor is connected to a 1.5V battery $I = V/R = 1.5/15 = 0.1A$

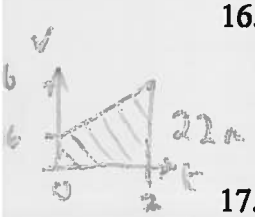
$\frac{1}{R} = \frac{1}{10} + \frac{1}{15} = \frac{5}{30} + \frac{2}{30}$

4. If a battery can deliver 360 coulombs of charge how long can it be used to run a device that has a normal operating current of 0.1 Amps? $t = Q/I = 360/0.1 = 3600s = 1hr$
5. If a device is labelled 2400W, 230V what fuse might be used in the plug? 13A

$I = \frac{P}{V} = \frac{2400}{230} = 10.4A$

6. Light entering a medium of refractive index 1.35 at an angle of incidence 45 degrees will refract by how many degrees? $\sin(45) = 0.707$
   n = sin(i) / sin(r) $\sin r = 0.707/1.35$, $r = 32$ degrees ∴ 13 degrees refraction
7. What is the critical angle for a material with a refractive index of 1.4? **sin (c) = 1/n** $\sin^{-1}(\frac{1}{1.4}) = 45.6°$
8. A wave of wavelength 33m has a time period of 0.1s. What is its speed? $f = 1/T = 10Hz$, $v = f\lambda = 10 \times 33 = 330 m/s$
9. Work is done whenever energy is transferred. Calculate the work done / energy transfer in the following situations.
   a. A 50N horizontal force is used to drag a bag 10m across a floor. 500J
   b. A 40kg mass is lifted by 5m. $40 \times 10 \times 5 = 2000J$
   c. A 40kg mass falls and reaches a speed of 10m/s. (how far did it fall?) $\frac{1}{2} \times 40 \times 10^2 = 2000J$ (5m)
10. If a pump pumps water to the top of a hill and uses 5000J of electrical energy.
    a. If the pump is 75% efficient how much energy has the water gained? 3750J
    b. How much waste energy is dispersed into the surroundings? 1250J

    The hill is 30m above the pump and the density of water is 1000kg/m^3
    c. How much pressure is there due to the water at the pump? $1000 \times 30 \times 10 = 3 \times 10^5 Pa$
    d. What must be added to get the total pressure at the pump? Atmospheric P ($\approx 1 \times 10^5 Pa$)
11. Ethanol boils at 351K. Is this above or below the boiling point of water? 78°C - Below
12. The SHC of water is 4.2 kJ/kgK. What does this mean? It takes 4.2kJ to heat 1kg of water by 1°
13. If the latent heat of fusion of vaporization of water is 2260 kJ/kg how much energy is needed to evaporate 10g of water? $2260 \times 0.01kg = 22.6kJ$
14. If a cylinder of gas had a volume of 20cm^3 is compressed to a 5cm^3 what has happened to its pressure? Multiplied by 4 (if temperature constant)
15. Copper has a density of about 9000 kg/m^3 and is worth £4 per kilo scrap value. How much will a cube of side 10cm be worth? $V = 0.1^3 = 0.001 m^3$, $m = 9kg$, £36
16. A 5kg toy car travelling at 6m/s has a thrust of 30N and friction equalling 5N acting on it for 2 seconds.
    a. How fast will it accelerate during the two seconds? $a = \frac{F}{m} = \frac{25}{5} = 5 m/s^2$
    b. How fast will it be travelling at the end of the two seconds? 16 m/s
    c. How far will it have travelled in the 2 seconds? av. vel = time = 11 × 2 = 22m



17. A spring is used to lift one end of a 10kg plank. The spring stretches by 4cm.
    a. What is the weight of the plank? 100N
    b. If the plank is uniform where is its centre of mass? CENTRE OF IT
    c. If the plank is 1m long how much moment is the weight generating? $100 \times 0.5 = 50 Nm$
    d. How much force must the spring be lifting the plank with? Moments balance, $F \times 1m = 50Nm$, $F = 50N$
    e. What is the spring constant of the spring? $k = \frac{F}{x} = \frac{50}{0.04} = 1250 N/m$

Part one – equation recall	Equation	Units
1. Defining equation for speed	s or $V = d/t$	m
2. Defining equation for acceleration	$(V-u)/t$	m/s^2
3. If you know the mass, how do you work out the weight?	$W = mg$	N
4. Equation for density	$\rho = m/V$	kg/m^3
5. Newton's 2nd law, which links force and acceleration	$F = ma$	N
6. Equation for Hooke's law for springs	$F = kx$	N
7. Equation to calculate out the moment of a force	Moment = fd	Nm
8. Equation for work done	$W = Fd$	J
9. Equation for kinetic energy	$E_k = \frac{1}{2} m v^2$	J
10. Equation for potential energy	$E_p = mgh$	J
11. Equation for power	$P = E/t$	W
12. General equation for efficiency	useful/total	–
13. Defining equation for pressure	$p = F/A$	N/m^2, Pa
14. Equation for pressure in a liquid	$P = \rho g h$	N/m^2
15. Defining equation for specific heat capacity	$C = E/m\Delta T$	J/kgK
16. Defining equation for latent heat capacity	$L = E/m$	J/kg
17. Wave speed equation	$V = f\lambda$	m/s
18. Defining equation for refractive index	$n = \frac{\text{speed in vac.}}{\text{speed in medium}}$	–
19. Defining equation for Current	$I = Q/t$	A
20. Defining equation for Resistance	$R = V/I$	Ω
21. Combine resistance of three resistors all in	Series $R_1 + R_2 + R_3$	Parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
22. Electrical Power	$P = VI$	W
23. Electrical Energy	$E = VIt$	J
24. Transformer coils and voltage ratio	$N_p/N_s = V_p/V_s$	–
25. Relationship between frequency and time period	$f = 1/T$	Hz
26. Relationship between refractive index and angle for a wave entering a medium	$n = \frac{\sin(i)}{\sin(r)}$	–
27. Relationship between refractive index and angle for a wave leaving a medium	$n = \frac{\sin(r)}{\sin(i)}$	–
28. Relationship between refractive index and critical angle for a wave attempting to leave a medium	$n = \frac{1}{\sin(c)}$	–

Part two – equation use:

1. In an ideal transformer the input voltage is 240V. There are 20 times more coils on the input side compared to the output side of the transformer.

Output voltage a) $V_s = \frac{240}{20} = 12\,V$

$\frac{N_p}{N_s} = 20 = \frac{V_p}{V_s} = \frac{240}{V_s}$