Q1. E **(2 marks)**
Q2. E **(2 marks)**
Q3. ii **(2 marks)**
Q4. iv **(2 marks)**
Q5. iv **(2 marks)**
Q6. i **(2 marks)**
Q7.iii **(2 marks)**
Q8. iii **(2 marks)**

Q9.

a) Use the equation for the equivalent resistance of a series circuit:
$R_{eq} = R_1 + R_2$ **(1marks)**
$R_{eq} = 3\Omega + 3\Omega = 6\Omega$ **(2 marks)**
b) Use the equation for the equivalent resistance of a pallalel circuit:
$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ **(2 marks)**
$\frac{1}{R_{eq}} = \frac{1}{1\Omega} + \frac{1}{2\Omega} + \frac{1}{3\Omega}$

$R_{eq} = 1\Omega$ **(2 marks)**
c) c. As more and more resistors are added in parallel to a circuit, the equivalent resistance of the circuit **decreases (1 marks)**
d) and the total current of the circuit **increases (1 marks)**

Q10.
Given data

$l = 400mm = 4 \times 10^{-1}m$

$m = 1.2 \times 10^{-3}Kg$

$T = 120\ N$ **(1mark)**

Asked

a) f_1 = f_3= **(1 mark)**

formula

$\boldsymbol{f_n = \frac{n}{2l}\sqrt{\frac{Tl}{m}}}$ **(1 mark)**

$\boldsymbol{a)f_1 = \frac{1}{2\times4\times10^{-1}}\sqrt{\frac{120\times4\times10^{-1}}{1.2\times10^{-3}}} =}$ **250 *Hz*** **(1. 5mark)**

b) $f_3 = 3f_1 = 3 \times 250 = 750\ Hz$ (**1**.5 **mark**s)

Q11.

a. Electromotive force (EMF) is equal to the terminal potential difference when **no** current flows. ... EMF (ϵ) is the amount of energy (E) provided by the battery to each coulomb of charge (Q) passing through. **(3 marks)**

b.The current is given by: $I = \frac{E}{R+r}$

,Where E is electromotive , R is load resistance ,r is internal resistance:

$I = \frac{12}{3+0.05} = 3.93A$ **(1 marks)**

we can calculate the voltage across the load resistance R

Terminal voltage:$V = IR$ **/** V=3.93×3 =11.8V **(1 marks)**

Q12.

a) The photoelectric effect is a phenomenon in which electrons are ejected from the surface of a metal when light is incident on it **(2 marks)**

b) Energy $E = \frac{hc}{\lambda}$ **(1 marks)**

Speed of light $C = 3x10^8\ {}^{m}/_{s}$

$1nm = 10^{-9}m$

$E = \frac{6.63x10^{-34}x310^8}{7.8X10^2x10^{-9}}$ **(1 marks)**

$E = 2.5510^{-19}J$ **(1 marks)**

Q13. .a) The factors affecting the periodic time of the simple pendulum;

- Length of string **(0.5 marks)**
- Angle from which pendulum is dropped **(0.5 marks)**
- Acceleration due to gravity **(0.5 marks)**
- Air resistance **(0.5 marks)**

b)the period of a simple pendulum $T_i = 2\pi\sqrt{\frac{l_i}{g}}$ **(0.5 marks)**

if the pendulum's length is doubled $T_f = 2\pi\sqrt{\frac{l_f}{g}}$

$l_f = 2l_{fi}$ **(0.5 marks)**

$T_f = 2\pi\sqrt{\frac{2l_i}{g}}$, $T_f = \sqrt{2T_i}$ The time period gets larger by 2 times **(0.5 marks)**

b. Changing the mass has no effect on the time period of a simple pendulum. **(1 marks)**

Q.14

15. Given that mass =2kg, g=10N/kg F=2kg×10N/kg=20N

From $F = Kx$ we find $x = \frac{F}{K}$ $x = \frac{20N}{5N_m}$ $x = 4m$ **(2 marks)**

Spring energy $E = \frac{1}{2}Kx^2$

$E = \frac{1}{2}5x4^2$=40J **(2 marks)**

Q.15

a) controlled and uncontrolled nuclear fission: **4.marks (0.5marks for each correct sentence)**

Controlled nuclear fission	**uncontrolled nuclear fission**
. Of the three neutrons, liberated during a fission reaction, only one triggers a new reaction and the others are simply captured	. A fission reaction which is allowed to proceed without any moderation (without removal of neutrons)
. One fission reaction leads to one new fission reaction, which leads to one more, and so on,	. more and more neutrons are given out and cause more fission reactions
. The system is in equilibrium.	. system is not in equilibrium
. it is used in nuclear power stations	. it is used in nuclear weapons
. The amount of heat required is controlled by raising and lowering the rods.	. releasing large amounts of energy

b) i) **Nuclear Meltdown**: is nuclear reactor accident that results in core damage from overheating. **0.5marks**. this occurs due to the lack of coolant that decreases the temperature of the reactor. The causes of a meltdown occur due to:

A: The loss of pressure control of the confined coolant may be caused by the failure of the pump or having resistance or blockage within the pipes. **(1mark)**

B: A physical loss of coolant, due to leakage or insufficient provision, causes a deficit of coolant to decrease the heat of the reactor. **(1mark)**

C: It is caused by an uncontrolled power excursion due to the failure of the moderator or the control that slows down the neutron during chain reaction. **0.5marks.** A sudden power surge will create a high and abrupt increase of the reactor's temperature, and will continue to increase due to system failure.

ii) **Nuclear (Radioactive) Wastes**: Nuclear wastes are radioactive materials that are produced after the nuclear reaction. **(1mark)** The wastes must be isolated from human contact for a very long time in order to prevent radiation. They can penetrate deep inside the human body where they can damage biological cells and thereby initiate a cancer. If they strike sex cells, they can cause genetic diseases in progeny.

c) advantages and disadvantages of fossil fuels: : **4.marks (0.5marks for each correct sentence)**

Advantages	disadvantages
Large quantities	Acid rain and air pollution
Well-distributed	Not so readily transported.
Yields far more energy than renewable sources.	Global warming
Easy transportation (pipelines/ tankers	Risk of explosions due to leakage
Use in cars, lorries, etc. Feedstock for organic chemical	Mining is dangerous.

SECTION B

Q16.

- The algebraic sum of the currents flowing at anode or junction in an electric circuit is zero. **(2mark)**
- The algebraic sum of the potentials in a closed loop is zero **(2mark**)

a. <u>From junction rule</u>

$I_1 + I_2 = I_3$ (1) **(1mark)**

<u>From loop rule</u>

$10 - 10I_1 - 40I_3 = 0$ (2) **(1mark)**

$20 - 20I_2 - 40I_3 = 0$ (3) **(1mark)**

The equation (1) in (2) and (3) gives

$10 - 10I_1 - 40I_1 - 40I_2 = 0$ (i)

$20 - 20I_2 - 40I_1 - 40I_2 = 0$ (ii)

$50I_1 + 40I_2 = 10$ × -4 (i)

$40I_1 + 60I_2 = 20$ × 5 (ii)

$-200I_1 - 160I_2 = -40$ (i)

$200I_1 + 300I_2 = 100$ (ii)

Adding (i) and (ii) we get $140I_2 = 60$

$I_2 = \frac{60}{140} = \frac{3}{7}A$ **(2mark)**

Replacing the value of I_2 in the equation (ii) we get: $40I_1 + \frac{180}{7} = 20$

$40I_1 = 20 - \frac{180}{7}$

$40I_1 = \frac{140-180}{7}$

$I_1 = -\frac{1}{7}A$ **(2mark)**

$\boldsymbol{I_3 = -\frac{1}{7}A + \frac{3}{7}A = \frac{2}{7}}$ A **(1mark)**

$V_{AB} = R_3 \times I_3 = 40\boldsymbol{\Omega} \times \frac{2}{7}\boldsymbol{A} = \frac{\boldsymbol{80}}{\boldsymbol{7}}\boldsymbol{A}$ **(3marks)**

Q.17

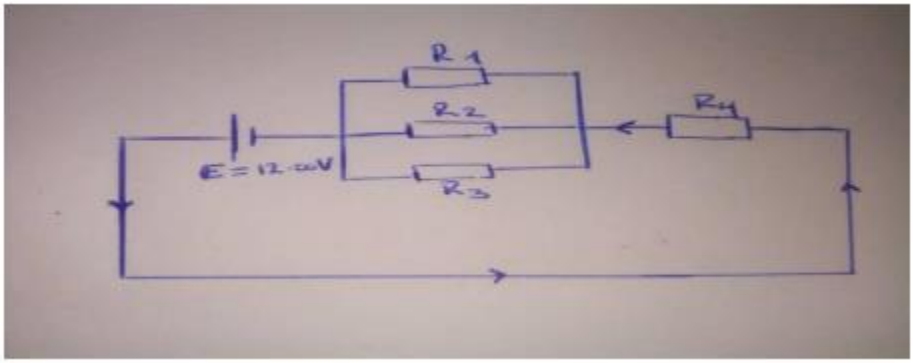
From $y(t) = Asin2\pi\left(\frac{T}{t} - \frac{x}{\lambda}\right)$ **/1mark**

Given $y(t) = Asin2\pi\left(\frac{T}{0.04} - \frac{x}{40}\right)$

a) Amplitude A= 2cm **(2mark)**
b) wavelength λ = 40cm **(2mark)**

c) period T= 0.04cm **(2mark)**
d) frequency f= 1/T= 25HZ **(2mark)**
e) angular frequency $\omega = 2\pi f = 157 rad/s$ **(2mark)**
f) angular wave number $K = \frac{2\pi}{\lambda} = 0.157$cm **(2mark)**
g) the speed wave v= λf=1000cm/s **(2mark)**

Q18.



/5marks

b. The equivalent resistance of the resistors in parallel

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_{eq}} = \frac{1}{2.00\Omega} + \frac{1}{3.00\Omega} + \frac{1}{6.00\Omega}$$

$R_{eq} = 1.00\Omega$ **(1 marks)**

Total resistance of circuit R_T = 1.00Ω + 11.00Ω , R_T =12.00 Ω

Total current $I = \frac{E}{R_T}$

$I = \frac{12.00}{12.00}$ (**1 marks**) $I = 1A$ **(1 marks)**

E

c. The potential difference V_4 across R4 is V_4 = 11.00 × 1.00 = 11.00V **(1 marks)**

The resistor across the parallel resistor network V = 12.00 − 11.00 = 1.00V

(1 marks)

The potential difference across R_1, R_2 and R_3 is the same 1 = V_2=V_3 = 1.00Ω **(1 marks)**

d. The current throughR_4 is equal to the total current $I = I_4$ = 1.00Ω **(1 marks)**

$I_1 = \frac{1}{2} = 0.50A$ **(1 marks)**

$I_2 = \frac{1}{3} = 0.33A$ **(1 marks)**

$I_3 = \frac{1}{6} = 0.17A$ **(1 marks)**

.Q.19

a) i) it is B **(1mark)**

ii) energy loss while they are in motion due to *frictional* or *viscous and heat generations* generally: **friction force** (air resistance) and **losses of energy (2 marks)**

iii) displacement and amplitude critically oscillation dies to zero in a short period of time and losses of energy. **(2mark one key ward)**

b) mass, m=0.5kg constant spring, k=8N/m and amplitude, A=10cm=0.1m the angular speed, $\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{8N}{0.5kgm}} = \frac{4rad}{s}$ **(1mark)**

$v_{max} = \omega A = \frac{0.1mx4rad}{s} = 0.4m/s$ **(2mark)** maximum acceleration, $a_{max} = \omega A^2 = \frac{0.1mx16}{s^2} = 1.6m/s^2$ **(2mark)**

c) when x=6cm=0.06m **(1 marks)**, the velocity, $v = \omega\sqrt{A^2 - x^2} = \pm 4\sqrt{(0.1)^2 - (0.06)^2} = 0.32m/s$ **(2mark)**

acceleration $a = \omega A^2 = \frac{16x\ 0.06}{s^2} m = 0.96m/s^2$ **(2mark)**

Q.20

a) Mass m=3.0g $3x10^{-3}$kg

Length l=30cm $30x10^{-2}$m

1st overtone $\mathbf{f_1}$=200Hz remember $\mathbf{f_1 = 2\ f_0}$ **(1mark)**

and $\boldsymbol{f_0 = \frac{v}{2l}}$

$$v = 2lxf_0$$

$$v = 2x0.3x100 = 60m/s$$

$v = \sqrt{\frac{F}{\mu}}$ **(1mark)**

$\mu = \frac{m}{l} =$ $\mu = \frac{3.0x10^{-3}}{30x10^{-2}}$ $\mu = 10^{-2}\ {}^{kg}/_{m}$ **(1mark)**

Thus

from

$$v = \sqrt{\frac{F}{\mu}}$$

$60 = \sqrt{\frac{F}{10^{-2}}}$ $F=36N$ **(1mark)**

b) Mass m=3.0g $3x10^{-3}$kg

Length l=60cm $60x10^{-2}$m

$\mathbf{f_0}$ =30and $\boldsymbol{f_0 = \frac{v}{2l}}$

$$v = 2lxf_0$$

$v = 2x0.6x30 = 36m/s$ **(1mark)**

$$v = \sqrt{\frac{F}{\mu}}$$

$\mu = \frac{m}{l}$ $\mu = \frac{3.0x10^{-3}}{60x10^{-2}} = \mu = 0.5x10^{-2}$ **(1mark)**

Thus
from

$$v = \sqrt{\frac{F}{\mu}}$$

$36 = \sqrt{\frac{F}{0.5x10^{-2}}}$ $F=64.8N$ **(1mark)**

c) $f = 240Hz$

$l = 40x10^{-2}$

Remember $f_{(n-1)} = nf_0$ **(1mark)**

N.B: the number of loops (n) is equal to the number of nodes minus one
i.e.n=5-1 n=4

from $f = nf_0$ and $\boldsymbol{f_0 = \frac{v}{2l}}$ hence $\boldsymbol{v = \frac{2lf}{n}}$ **(1mark)**

i.e. $\boldsymbol{v = \frac{2x4010^{-2}x240}{4}}$

$v = 48m/s$ **(1mark)**