MARKING GUIDE OF PHYSICS II ND TERM EXAMINATION FOR S4

Section A: This section is compulsory (70 marks).

1. Iv.Communication /1
2. i.$R = v^2 (\sin 2\theta)/g$ /1
3. (ii) parabola /1
4. D. 5.0×10^4 /1
5. C /1
6. **A)**i) energy ;it is an ability of doing work. Enery is scalar quantity and its s .u is joule**(1mark)**

   ii) work ;it is the product of force and distance moved in the direction of force.

   $W=F\times S$ **(1mark)**

   iii) power; Is the rate of doing work. $P=W/t$ **(1mark)**

   b)

Solution: $m = 10$ kg, $h = 2$ m, $t = 4$ s, $g = 10$ m^{-2}, $P = ?$

Using the formula Power $= \dfrac{F\times s}{t}$

$= \dfrac{mgs}{t}$

$= \dfrac{10\times 10\times 2}{4} = \mathbf{50\ W}$

7. a)Renewable energy sources: These are energy sources which cannot be exhausted on a human time scale. They can be used over and over again. A renewable energy source can be said to be permanent because it can be replenished as it is used. **(1mark)**

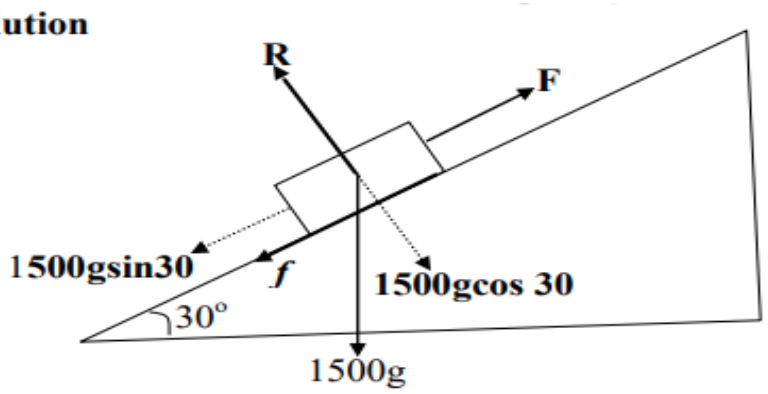
Examples include: Geothermal power, wind, wave, tides, the sun/solar, biomass fuel/ biofuels and hydroelectric power.

Non-renewable energy resources: The natural resources which cannot be regenerated along with their exploitation are known as non -renewable resources. These are energy sources which once used cannot be replaced in a short time. They get exhausted. A non–renewable energy source is one that is considered to be a temporary source that is depleted when it is used. **(1mark)**

Examples of non-renewable sources of energy include: - Fossil fuels (oil, coal and natural gas.) - Nuclear fuels.

b)

Solution



(a) Resultant force = F – (mgsin30 + f)

ma = F – (1500gsin30 + μR)

Since the velocity is uniform, a = 0

0 = F – (1500gsin30 +580)

F = 7937.5N

But power, P = F. v = 7937.5 × 5

P = 39687.5W

(b) P_{max} = F. v_{max}

$v_{max} = \frac{P_{max}}{F} = \frac{75\times10^3}{7937.5} = \mathbf{9.45ms^{-1}}$

c) Advantage (6marks)

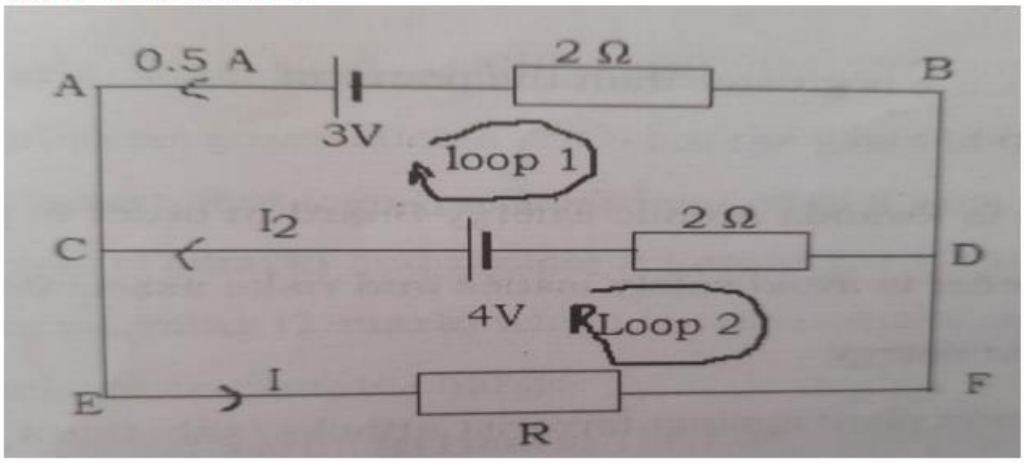
- No green house gas emissions
- No significant pollution during operation;
- High efficiency and low running costs. Etc…

8. 1.d **(1mark)** 2.a **(1mark)** 3.b **(1mark)** 4.c **(1mark)**

9. a)Kirchhoff's first law states that; The sum of the currents entering a junction in a circuit is always equal to the sum of the currents leaving the junction. **(1mark)**

Kirchhoff's second law states that; In any closed loop, the algebraic sum of all potential drops is equal to the algebraic sum of all the e.m.fs **(1mark)**

Kirchhoff's laws



a) Loop 1: gives us $-3 + 2 \times 0.5 - 2I_2 + 4 = 0$ **(1 mark)**

$I_2 = 1A$ **(1 mark)**

b) Loop 2: $-4 + 1 \times 2 + IR = 0$ **(1 mark)**

$IR = V_R = 2V$ **(1 mark)**

c) Junction C: $I = 0.5A + 1A = 1.5A$ **(1 mark)**

10. a) i) **Projectile**: is anything that is given an initial velocity from a point and left to move on its own under the influence of its own mass alone in the presence of a constant force field such as gravitational field. In this case, air resistance is negligible. **(1mark)** ii)**Projectile motion**;motion which occurs vertically and horizontally at the same time(simultaneously) **(1mark)**

iii) Angle of projection: This is the angle between the direction of projection and the horizontal **(1mark)**

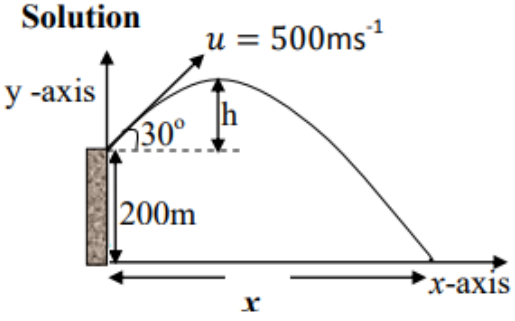
iv)Maximum height : This is the distance between the highest point reached and the horizontal plane through the point of projection. **(1mark)**

v) Range: This is the distance from the initial position to the final position of the projectile on the horizontal plane through the point of projection **(1mark)**

vi) Time of flight: This is the time taken by the particle (projectile) to move from its initial position to the final position along its path **(1mark)**

b)

Solution



(i) Considering vertical motion

using S= ut + $\frac{1}{2}at^2$; S = −200m (since it ends below the point of projection, resultant displacement is −200m) , u_y = u sinθ, time taken = T, $a = -g$

$$-200 = (u \sin\theta)T - \frac{1}{2}gT^2$$

$$-200 = (500 \sin 30)T - \frac{1}{2}(9.81)T^2$$

T = 51.76s

(ii) Considering horizontal motion

$x = (u\cos\theta)t$ $\quad \{S= ut + \frac{1}{2}at^2, a = 0\}$

$x = (500\cos 30)51.76 = 22412.74m$

(iii) Using $v^2 = u^2 + 2aS$; at maximum height v= 0, S = h , $a = -g$, u_y = usinθ

$\Longrightarrow 0^2 = (u\sin\theta)^2 + 2(-g)(h)$

$h = \frac{500^2 sin^2\, 30}{2\times 9.81} = 3185.5m$

Required distance = 200 + 3185.5 = **3385.5m**

11.(6marks)

Comparison of the lens camera and the human eye

	Eye	**Lens Camera**
Type of lens	converging	converging
Method of focusing	Change of lens shape: Thicker for near objects and thinner for far objects	Lens moves away from the film for near objects and near to film for far objects.
Light control	- Iris - sensitivity of retina	- Diaphragm - Exposure time or shutter speed. - Sensitivity of the film

12. a) i) momentum of a moving particle: The linear momentum of a body is the product of the body's mass and its velocity. Mathematically, it is expressed as: Momentum = Mass ×Velocity In symbols; P = mv **(1mark)**

ii) collision : , the sudden, forceful coming together in direct contact of two bodies, such as, for example, two billiard balls, a golf club and a ball, a

hammer and a nail head, two railroad cars when being coupled together, or a falling object and a floor. **(1mark)**

iii) impulse: we can define impulse as the product of force and time or the change in momentum of the body which is acted on by the force **(1mark)**

b) one application of momentum in daily life **(1mark)**

Rocket propulsion, Jet engine, Recoiling of a gun when a bullet is fired , The lawn sprayer/ water sprinkler.

c)Difference between elastic collision from inelastic collision **(2marks)**

The collisions can be summarized in the table below:

Elastic or perfectly elastic collisions	**Inelastic collision**
- Kinetic energy is conserved. - Linear momentum is conserved. - Bodies separate after collision e.g. collisions of gas molecules.	- Kinetic energy is not conserved. - Linear momentum is conserved. - Bodies separate after collision e.g. a ball bouncing from a floor.

d) **(5marks)**

Solution



Before collision After collision

From conservation of momentum $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Since momentum is a vector quantity we have to take into account the direction velocity given.

Considering all velocities to the right (→) to be positive;

$(3 \times 6) + 5 \times (-5) = 3(-v) + 5 \times (-1)$

$$v = \frac{2}{3} ms^{-1}$$

Kinetic energy before collision $= \frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2$

$$= \frac{1}{2} \times 3 \times 6^2 + \frac{1}{2} \times 5 \times (-5)^2 = \mathbf{116.5J}$$

Kinetic energy after collision $= \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

$$= \frac{1}{2} \times 3 \times \left(\frac{2}{3}\right)^2 + \frac{1}{2} \times 5 \times (-1)^2 = \mathbf{3.2J}$$

Loss in energy = K.E before collision – K.E after collision

$= 116.5 - 3.2 = \mathbf{113.3\ J}$

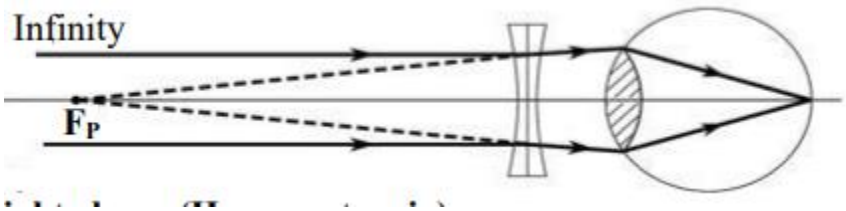
Percentage loss in energy $= \frac{113.3}{116.5} \times 100 = \mathbf{97.3\%}$

13. Any two ways that can be used to reduce Great forces that are produced during collision **:** using seat belt, shock absorber in good position , air bags and head restraints **(2marks)**

14.a) i. Short Sightedness (Myopia) **(1mark)**

ii) Short sightedness is corrected by using a suitable diverging lens (concave lens). The diverging lens diverges the light rays such that they appear to come from the (uncorrected) far point of the eye.

(2marks)

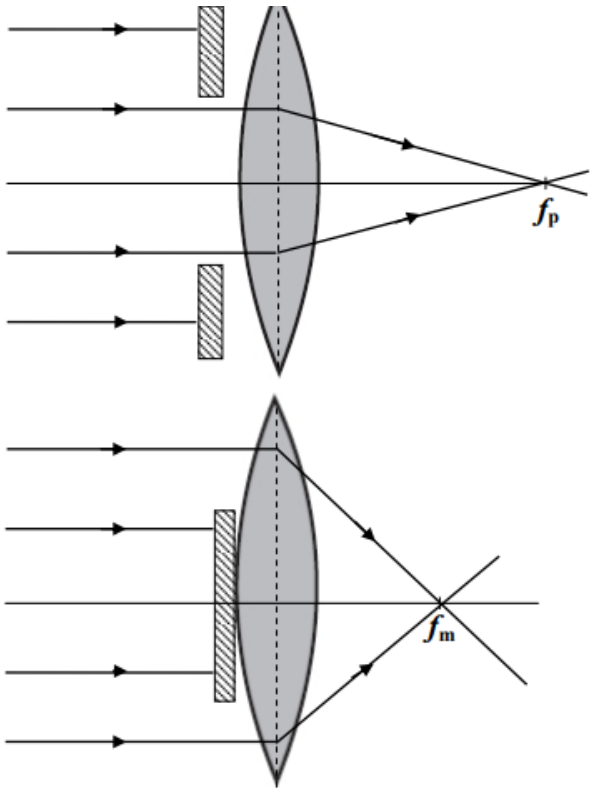


15. Any two diffects of lens and explain how it can be corrected. **(2marks)**

- Spherical aberration

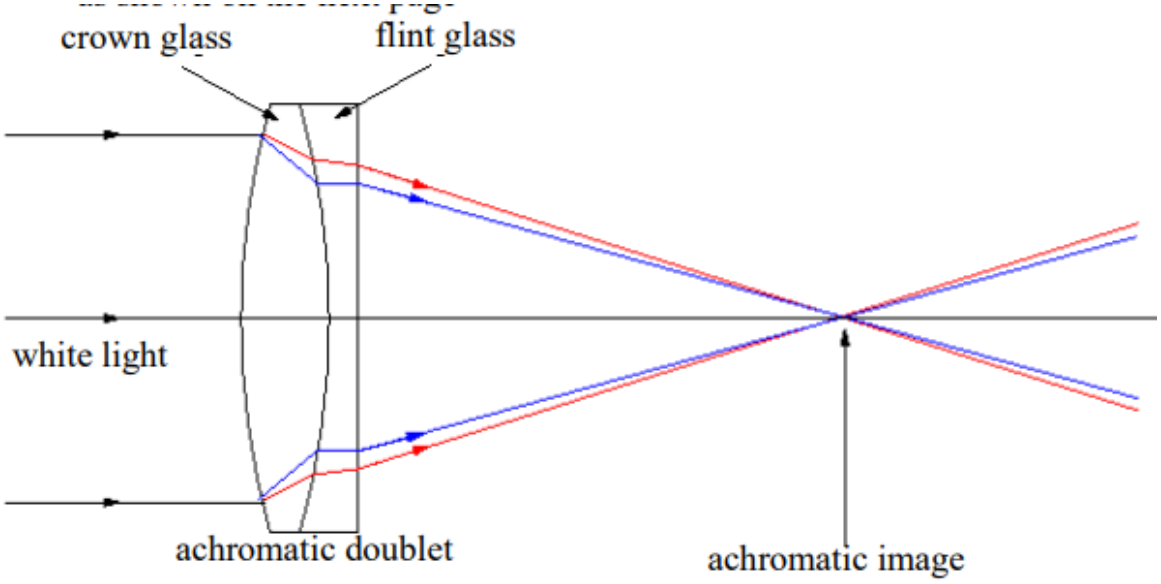
- Chromatic aberration (occurs only in lens)

Correction of spherical aberration (Spherical aberration may be reduced by surrounding the lens with an opaque disc having a hole in the middle so that light is incident on the middle of the lens or using an opaque disc to cover the middle part of the lens. Both cases have been illustrated below.



☞ *The disadvantage of this method is that light intensity (amount of light energy passing through the lens) is cut down so the brightness of the image is reduced.*

Correction of chromatic aberration :Chromatic aberration can be corrected by using an achromatic doublet. This consists of a biconvex lens made of crown glass and a concave lens made from flint glass.



SECTION B : (30Marks)

16.

a) The position of the image created by the first lens

$$\frac{1}{f_1} = \frac{1}{p_1} + \frac{1}{p'_1} \quad \textbf{(1 mark)}$$

$$\frac{1}{p'_1} = \frac{1}{8} - \frac{1}{24} = \frac{3-1}{24} = \frac{1}{12}$$

$$p'_1 = 12\ cm \ \textbf{(1 mark)}$$

b) Position of the final image

We use the image produced by the first lens as the object for the lens. The first thing we need to determine is the object distance for the second lens. If the image is $12\ cm$ from the first lens, and the second lens is $18\ cm$ from the first lens, then the image is only $6\ cm$ $(18\ cm - 12\ cm)$

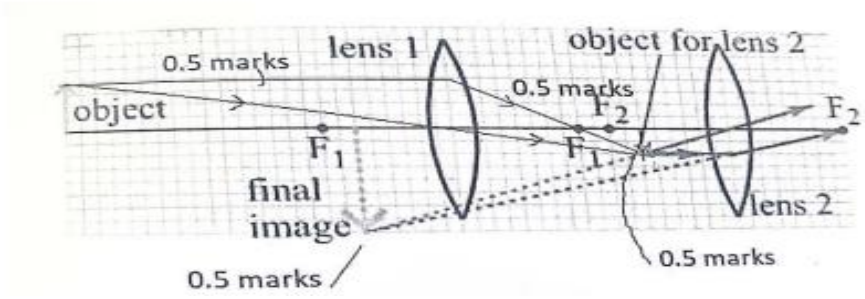
$p_2 = 6\ cm$ **(1 mark)** from the second lens (and is now the object for that lens)

$$\frac{1}{p'_2} = \frac{1}{8} - \frac{1}{6} = \frac{3-4}{24} = \frac{-1}{24} \quad then$$

$$p'_2 = -24\ cm \ \textbf{(1 mark)}$$

The final image is at $24\ cm$ from the second lens.

c)



d) The overall magnification of this two – lens system $M = m_1 \times m_2$ (**1 mark**) where m_1 and m_2 are respectively magnification of the first lens and second lens.

$$M = -\frac{12}{24} \times -\left(\frac{-24}{6}\right) = -2 \text{ (1 mark)}$$

$m_1 = -0.5$ which, with an object height of $4.0\ cm$, gives a height of $-2.0\ cm$ (height of intermediate image).

$m_2 = 4$ which, with an object height of $-2.0\ cm$, gives an image height of $-8.0\ cm$ (height of the final image).

$$M = \frac{Height\ of\ the\ final\ image}{Height\ of\ the\ object} = \frac{-8}{4} = -2$$

e) Diagram shows that the final image is magnified (**1 mark**), inverted (**1 mark**), virtual

You may analyze the overall magnification $M = -2$

The final image is twice as large as the original object, with the minus sign telling us that the image is inverted compared to the original object.

17.a)

Conditions for a rigid body to be in equilibrium

The following are the conditions for a body to be in equilibrium when under the action of a number of parallel forces.

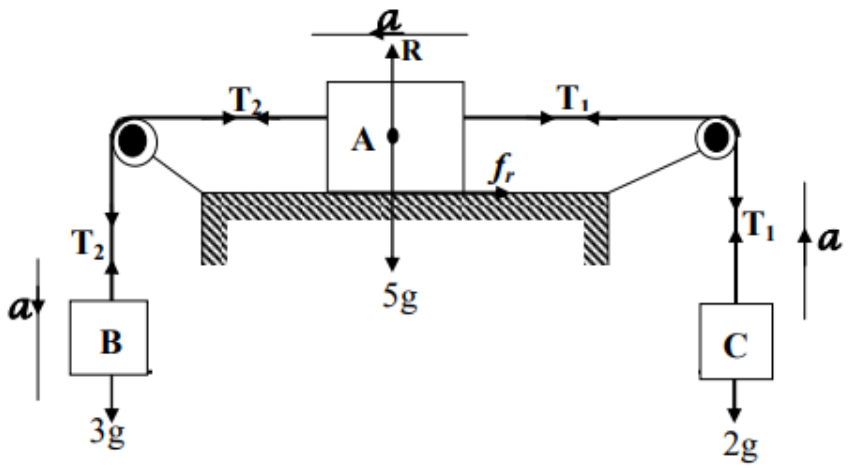
(i) *The sum of forces acting in one direction is equal to the sum of forces acting in the opposite direction. I.e.* ***the net resultant force on the body is zero****.*

☞ *These forces must balance; otherwise they would cause* ***translational motion.***

(ii) *When a body is in equilibrium, the sum of clockwise moments about any point is equal to the sum of anti-clockwise moments about the same point. I.****e. the net resultant moment is zero.***

☞ *There should be no resultant moment otherwise this would cause* ***rotational motion.***

b) Begin by identifying the direction of motion of the whole system by looking at the given masses **(8marks)**



Recall that $f_r = \mu_k R$
also observe that,
R = 5g
and $\mu_k = \frac{1}{7}$

(i)

Consider motion of block A:

$T_2 - T_1 - f_r$ = net resultant force on A [net force F= ma]

$T_2 - T_1 - \mu_k R = m_A a$

$T_2 - T_1 - \frac{5g}{7} = 5a$ ..... (i)

Consider motion of block B:

$3g - T_2$ = net resultant force on B

$3g - T_2 = m_B a$

$3g - T_2 = 3a$ ..... (ii)

Consider motion of block C:

$T_1 - 2g$ = net resultant force on C

$T_1 - 2g = m_C a$

$T_1 - 2g = 2a$..... (iii)

Eqn (i) + eqn (ii) + eqn (iii) gives;

$5a + 3a + 2a = g - \frac{5g}{7}$

$70\ a = 2g = 2 \times 9.81$

Hence **$a = 0.28$ m s^{-2}**

> ☞ You might have wondered why there are two arrows representing the tension in the strings above. Consider blocks A and B for example. The *tension* in the string is *pulling* block A (so the arrow is forward/ downwards) but *slowing* block B (so the arrow is backwards/ upwards). Of course the same force that slows one object down is also pulling the other forward, so both forces are the same.

(ii) Substituting for a in (ii) and (iii) gives, **$T_1 = 20.18$N** and **$T_2 = 28.6$N**

18.

The sun

The sun is the source of energy for all our energy resources **except** *geothermal*, *nuclear* and *tidal*.

The sun radiates energy because of **nuclear fusion** reactions deep inside it. Its output is equivalent to that from 3×10^{26} electric hot plates. Just a tiny fraction of this reaches the earth. In the sun, energy is created through a process called nuclear fusion; *hydrogen nuclei are pushed together/combine to form helium atom.*

Therefore the sun is therefore the origin of most of our energy resources for example;

- Solar energy is the direct conversion of sunlight using panels or collectors or solar cells.
- Energy in plants is as a result of sunlight falling on their leaves. They use it to turn water and carbon dioxide into food in the process called photosynthesis.Therefore Biomass energy is stored sunlight energy contained in plants
- Animals eat plants to get the energy stored in them.
- The fossil fuels (*coal*, *oil* and *natural gas*) were formed from the remains of plants and tiny creatures which lived many millions of years ago. The fuels extracted from oil include; petrol, diesel, jet fuel, paraffin, central heating oil, bottled gas.
- Weather systems are driven by energy from the sun. Heated air rising above the equator causes belts of wind around the earth. Winds carry water vapour from oceans and bring rain and snow. Hence wave energy, hydroelectric energy and wind energy all have their origin from the sun as the source.

Hence most of these renewable energies depend on the sun in one way or another.

19.introduction: 1mark

Body including the following points and others related to the topic atleast 4points+ explanations: (4×2marks= 8marks)

The Energy sector in Rwanda is still facing the following challenges;

- Access to electricity remains low and in particular so low in the rural areas.
- Costs of new connections are still beyond the reach of most households in Rwanda.
- Generally there is a lack of entrepreneurial capacity in the country and this hampers small commercial electricity projects.
- The increasing population will result in a higher demand for cooking energy which is a big threat.
- There is a lack of enough trained and skilled energy experts in the energy sector.
- The local poor are not well informed about energy and related end –use practices and options.
- The government wants a reduction of the consumption of biomass (firewood/ charcoal) but there are only few alternatives such as kerosene and liquefied petroleum gas (LPG). However, these are more expensive while electricity is no real option due to the high costs and low connection rate.

Conclusion(with short summary,advices and recomendations) (1mark)

20.)(i)Electromotive force is energy per unit electric charge that is

Imparted by an energy source**(0.5mark)** such as electric generator

Or the work done on a unit of electric charge or the energy

Thereby gained per unit electric charge

(ii)Resistance of the conductor is the opposition to the flow of

Electrical current through a conductor **(0.5mark)**

You can also accept the potential difference across the

Conductor divided by the electric current through it

b)(i)The 2 Ω and 4 Ω resistors are in series

R_1 = 2Ω+4 Ω**(1 mark)**

=6 Ω**(1mark)**

The 3 Ω, 6Ω and 1 Ω resistors are in series

R_2 =3 Ω+6Ω+1Ω

=10Ω**(1mark)**

The resistors having the resistances R_1 and R_2 are in parallel

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}$$ **(1mark)**

$$\frac{1}{R}=\frac{1}{10}+\frac{1}{6}=\frac{3+5}{30}=\frac{8}{30}$$

The equivalent resistance R =3.75Ω **(1mark)**

(ii)The internal resistance E=(R+r)I

$$r=\frac{E}{I}-R$$

$$r=\frac{6}{1.5}\Omega-3.75\Omega=0.25\Omega$$ **(0.5mark)**

(iii)The terminal voltage V=RI

=1.5 Ax3.75 Ω=5.625V **(0.5mark)**

(iv)Ammeter **(0.5mark)**

(v)The reading is I=1.5 A **(1mark)**

(vi) 1)the current $I_1=\frac{V}{R_1}$ **(1mark)**