YEAR 11 PHYSICS SEMESTER 2 TEST 1.

CONSTANTS: Latent heat of fusion (water) = $3{\cdot}35 \times 10^{5}$ J kg^{-1}
Latent heat of vapourization (water) = $2{\cdot}25 \times 10^{6}$ J kg^{-1}.

1. Liquid sodium is used to transfer heat in some nuclear reactors. What is the main method of heat transfer in the reactor and why is the liquid sodium used in preference to water? (3)

2. Distinguish between heat and temperature. (2)

3. How much heat is absorbed by a 2·80 kg brick sitting in the sun while its temperature rises from 18·0°C to 28·0°C? (Specific heat of the brick is $7{\cdot}50 \times 10^{2}$ J kg^{-1} K^{-1}). (3)

4. A lump of lead is dropped from a height of 50·0 m. If 60·0% of the energy it has on impact is converted into heat, calculate the temperature rise of the lead. (Specific heat of lead is $1{\cdot}30 \times 10^{2}$ J kg^{-1} K^{-1}). (4)

5. A 50·0 g copper calorimeter contains 85·0 g of water at 16·0°C. 6·00 g of ice is added, and the contents stirred until all the ice has melted. What will be the final temperature of the mixture? (4)
(Specific heat of water is $4{\cdot}18 \times 10^{3}$ J kg^{-1} K^{-1}).
" " " copper " $3{\cdot}90 \times 10^{2}$ J kg^{-1} K^{-1}

6. Explain why salt is thrown onto icy roads to clear them. (2)

7. Draw a heating curve for water, from −2·00°C to 105°C. (3)

8. 1·00 kg of steam at 100°C is blown onto a large block of ice. How much of the ice melts? (Assume not all of the ice melts). (4)

TOTAL: /25.

1. The main method of heat transfer is convection. Liquid sodium is used because it has a very high boiling point and so remains liquid at the operating temperatures within the reactor. Also, it absorbs heat readily since its specific heat is high. (3)

2. Heat: sum of the potential and kinetic energies of the particles.
Temperature: a measure of the average kinetic energy of the particles. (2)

3.
$$Q = mc\Delta T$$
$$= (2.80)(7.50\times10^2)(10.0)$$
$$= 2.10\times10^4 \text{ J}.$$

$\therefore$ the brick absorbs 2.10×10^4 J of energy. (3)

4.
$$Q = 60.0\%\, E_p.$$
i.e. $0.600\, mgh = mc\Delta T$
$$\Rightarrow \Delta T = \frac{0.600gh}{c}$$
$$= \frac{(0.600)(9.80)(50.0)}{1.30\times10^2}$$
$$= 2.262\,^\circ C.$$

$\therefore$ the temperature rise of the lead is $2.26\,^\circ C$. (4)

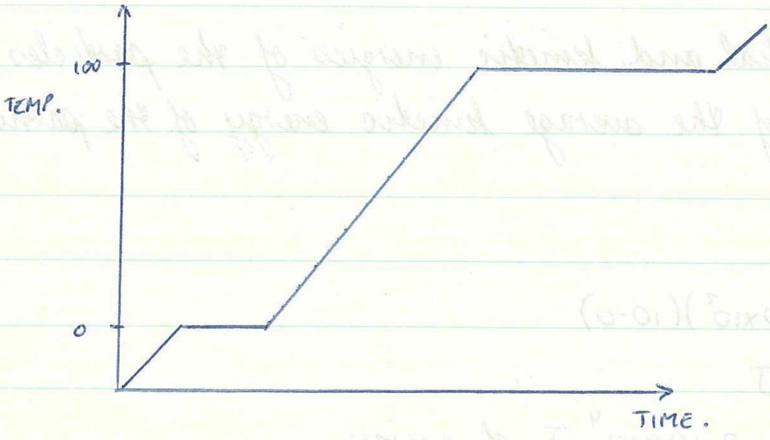
5.
$$Q_{lost} = Q_{gained}$$

$$\Rightarrow m_{cu}c_{cu}\Delta T + m_w c_w \Delta T = m_i L_f + m_i c_w \Delta T.$$
$$\Rightarrow (0.0500)(3.90\times10^2)(16.0-T) + (0.085)(4.18\times10^3)(16.0-T) = (0.00600)(3.35\times10^5) + (0.00600)(4.18\times10^3)(T-0)$$
$$\Rightarrow 312 - 19.5T + 5684.8 - 355.3T = 2010 + 25.08T$$
$$\Rightarrow 399.88T = 3986.8$$
$$\Rightarrow T = 9.970\,^\circ C.$$

$\therefore$ the final temperature of the mixture is $9.97\,^\circ C$. (4)

6. Salt lowers the melting point of ice to be below that of the existing atmospheric temperature. That is, if the air temp. is $-5.00°C$ and the melting point has been lowered to $-10.0°C$, then the ice present would melt. (2)

7.



(3)

8. $$Q_{lost} = Q_{gained}.$$

$$m_s L_v + m_s c_w \Delta T = m_i L_f$$

$$\Rightarrow (1.00)(2.25\times10^6) + (1.00)(4.18\times10^3)(100-0) = m_i\ (3.35\times10^5)$$

$$\Rightarrow 2.668\times10^6 = m_i\ 3.35\times10^5$$

$$\Rightarrow m_i = 7.964 \text{ kg}.$$

$\therefore$ <u>7.96 kg of ice would melt.</u> (4)

TOTAL: $\overline{25}$.

YEAR 11 PHYSICS SEMESTER 2 TEST 2

CONSTANTS: 1 atmosphere pressure = 101·3 kPa = 760·0 mm Hg.

1. State the kinetic theory of gases. (2)

2. Define the term "absolute zero" in terms of Charles' Law. (2)

3. Distinguish between "real" and "ideal" gases. (2)

4. In a Boyle's Law apparatus, the surface of the mercury in the open tube is 4·00 cm lower than that in the closed tube, the length of the enclosed gas column being 10·0 cm. Mercury is then added until the length of the gas column is 7·00 cm. Calculate the new difference in the levels of the mercury, given the atmospheric pressure is 101·3 kPa (or 760·0 mm Hg). (5)

5. A car tyre is pumped up to 2·10 atmospheres pressure with air at 25·0°C temperature. If its maximum pressure permitted is 2·40 atmospheres, what theoretical temperature is the air inside allowed to reach? (3)
(Assume its volume remains unaltered).

6. A glass tube with uniform bore is closed at one end and contains a bead of mercury 9·00 cm long. The length of the enclosed air column varies as follows:

   15·4 cm when the tube is held horizontally;
   13·75 cm when held vertically, open end up.
   17·5 cm when held vertically, open end down.

   What is the magnitude of the air pressure acting? (5)

7. Two flasks, A and B, are joined by a narrow tube with a tap. The volume of A and B are the same, and the pressure in A is three times that in B. After the tap is opened, the pressure establishes itself at 100·0 kPa. Find the original pressures in the flasks. (4)

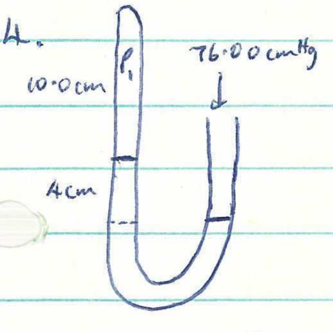
TOTAL: /23

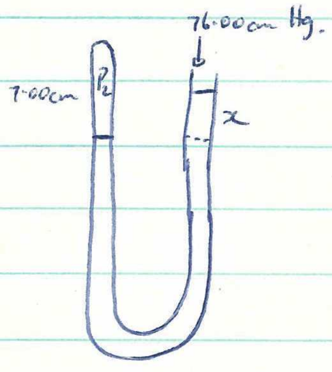
1. Gases are made up of atoms or particles.
   In a fixed volume of gas, the number of particles is large.
   The particles are in constant random motion.
   The size of the particles is small relative to their separation.
   No forces act between the particles except when they collide, so particles move in straight lines.
   All collisions are elastic and of short duration. (2)

2. Absolute zero: this is the temp. at which a gas exerts no pressure i.e. all heat energy has been removed so the particles don't move or vibrate. (2)

3. Ideal gases: particles don't exert a force on each other and follow the gas laws exactly. (2)
   Real gases: vary from ideal gases at high pressures and low temps.

4.





$76.00 = 4.00 + P_1$

$\therefore P_1 = 72.00\text{cm}$.

$P_2 = 76.00 + x$.

$P_1V_1 = P_2V_2$

$\Rightarrow P_2 = \frac{P_1V_1}{V_2}$

$= \frac{(72.00)(10.0)}{(7.00)}$

$= 102.9\text{cm}$.

$\therefore x = P_2 - 76.00$

$= 102.9 - 76.00$

$= 26.9\text{ cm}$

$\therefore$ Hg is 26.9cm above the level in the closed tube. (5)

5. $P_1 = 2.10$ atm

$T_1 = 298\,^\circ C$

$P_2 = 2.40$ atm

$T_2 = ?$

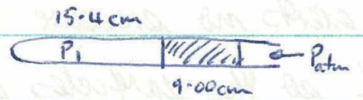
$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

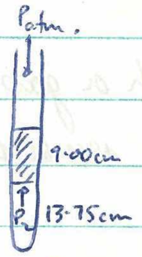
$$\Rightarrow T_2 = \frac{P_2 T_1}{P_1}$$

$$= \frac{(2.40)(298)}{2.10}$$

$$= 340.6\,^\circ K$$

$\therefore$ theoretical temp. is $3.41 \times 10^2\,^\circ K$ or $68.0\,^\circ C$. (3)

6. 



$P_1 \doteq P_{atm}$. — ①

$$P_1 V_1 = P_2 V_2$$

$$\Rightarrow P_1 = \frac{P_2 V_2}{V_1}$$

$$= \frac{P_2 (13.75)}{15.4}$$

$P_2 = P_{atm} + 9.00$.

$\Rightarrow P_{atm} = P_2 - 9.00$. — ②

Since ① = ②.

$$\Rightarrow P_1 = P_2 - 9.00$$

$$\Rightarrow \frac{P_2 (13.75)}{15.4} = P_2 - 9.00$$

$$\Rightarrow 9.00 = P_2 \left(1.00 - \frac{13.75}{15.4}\right)$$

$$\Rightarrow P_2 = \frac{9.00}{0.10714}$$

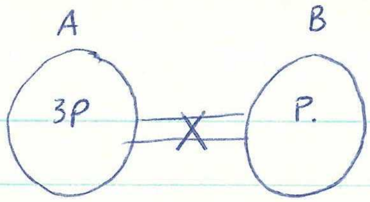
$$= 84.00 \text{ cm}.$$

$$\therefore P_{atm} = P_2 - 9.00$$

$$= 84.00 - 9.00$$

$$= 75.0 \text{ cm}$$

$\therefore$ pressure of the atmosphere is 75.0 cm Hg. (5)

7. 

$P_A = 3P_B$

Let $P_B = P$

$\therefore P_A = 3P$

For the gas in A:

$$P_1V_1 = P_2V_2$$

$$\Rightarrow P_2 = \frac{P_1V_1}{V_2}$$

$$= \frac{3PV_1}{2V_1}$$

$$\Rightarrow P_2 = \frac{3P}{2}$$

Similarly, for the gas in B:

$$P_2 = \frac{P}{2}.$$

Now:

$$\frac{3P}{2} + \frac{P}{2} = 100.0 \text{ kPa}$$

$$\Rightarrow 2P = 100.0 \text{ kPa}$$

$$\Rightarrow P = 50.0 \text{ kPa}.$$

(4)

$\therefore$ pressure in A is 1.50×10^2 kPa and the pressure in B is 50.0 kPa.

TOTAL: $\overline{23}$

YEAR 11 PHYSICS SEMESTER 2 TEST 3

W-86.

1. Distinguish between a transverse and longitudinal wave, and give an example of each. (2)

2. A stone dropped into a pool of smooth water produces, after 4·00 s, 20 wave crests spread over 5·00 m. Draw a displacement-distance and displacement-time graph for the wave motion. (4)

3. What is the wavelength of the sound emitted by a $4{\cdot}00 \times 10^2$ Hz school siren if a person $8{\cdot}00 \times 10^2$ m distant hears it 2·39 s after it is sounded? (3)

4. State the "laws of reflection" for waves. (2)

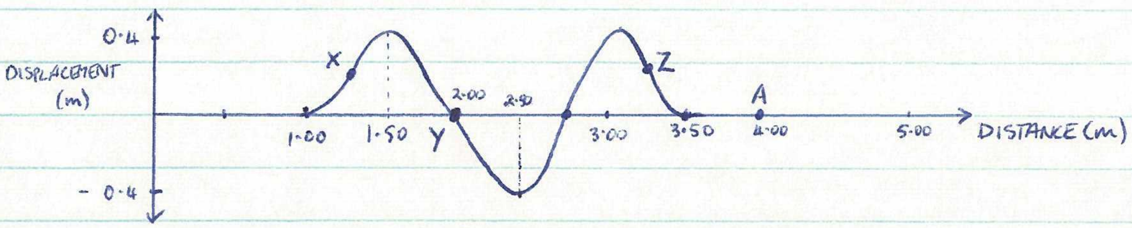
5. What energy changes occur for a wave striking a non-rigid boundary? (2)

6. Explain why ocean waves approaching a shore at an angle change their direction of movement. (2)

7. Why are sounds made outside the door of a room easily heard anywhere within the room? (Draw a diagram to help your explanation). (2)

8. Explain fully the apparent change in pitch of an ambulance siren as it approaches, and then passes, an observer. (3)

9. The following graph shows a transverse wave moving through a medium at $5{\cdot}00\,ms^{-1}$.



(a) What is the direction of movement of points X, Y and Z.

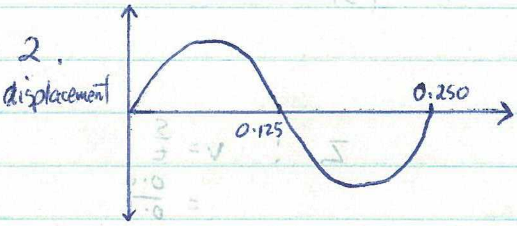
(b) Draw a displacement-time graph for point A, taking t=0 as the moment the pulse reaches A.

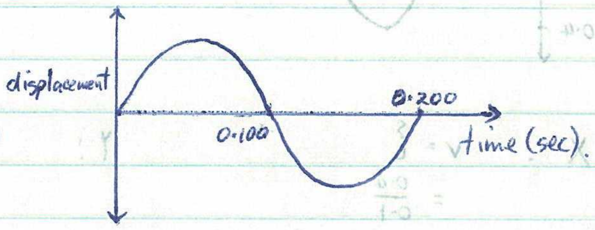
(c) Calculate the velocity of points X, Y and Z. (7)

TOTAL: $\overline{27}$.

1. Transverse wave: the particles of the medium move perpendicular to the direction of propagation of the wave. e.g. water wave

Longitudinal wave: " " " " " parallel " " " " " " " e.g. sound wave (2)

2. 



(4)

3. $c = \nu\lambda$ and $c = \frac{s}{t}$

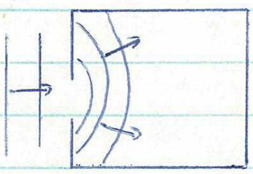
$$\therefore \lambda = \frac{c}{\nu} = \frac{s}{t\nu} = \frac{8.00\times10^{2}}{(2.39)(4.00\times10^{2})} = 0.8368 \text{ m}$$

$\therefore$ the wavelength of the sound is 0.837 m. (3)

4. Laws of reflection: (1) the incident ray, normal and reflected ray are in the same plane. (2)
(2) the angle of incidence equals the angle of reflection.

5. When a wave meets a non-rigid boundary, some of its energy is absorbed by the new medium. The rest of the energy is reflected. Hence the reflected wave has a reduced amplitude. (2)

6. As the depth of the water decreases, the waves slow down. Hence they refract towards the "normal" to the beach. Eventually, the waves are almost parallel to the shore when they reach it. (2)

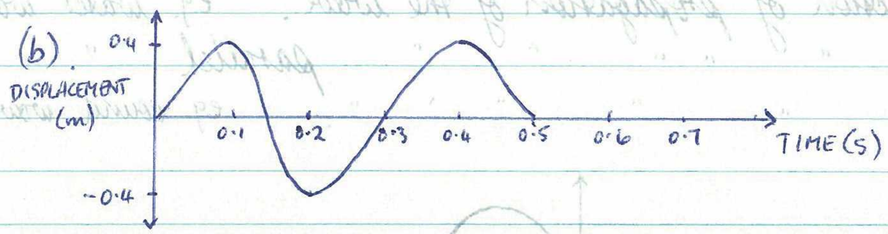
7. 
Since the doorway is approximately the same size as the wavelength of the incoming waves, they diffract through it and spread throughout the room. (2)

8. As the ambulance approaches, the pitch appears higher since the waves are apparently compressed. When the ambulance reaches the observer, he would hear the correct pitch; and when the ambulance has passed, the pitch appears lower. This last effect is due to the waves being stretched out. As λ goes up, and with the velocity of sound being constant, the ν must go down. (3)

YEAR 11 PHYSICS SEMESTER 2 TEST 3

9. (a) X ↓ , Y ↑ , Z ↑ (1)

(b)



(3)

(c) X : $v = \frac{s}{t}$ $= \frac{0.4}{0.1}$ $= 4.00 ms^{-1}$ down

Y : $v = \frac{s}{t}$ $= \frac{0.8}{0.2}$ $= 4.00 ms^{-1}$ up

Z : $v = \frac{s}{t}$ $= \frac{0.4}{0.1}$ $= 4.00 ms^{-1}$. up.

∴ all points have the same velocity of $4.00 ms^{-1}$. (3).

TOTAL: 27.

YEAR 11 PHYSICS SEMESTER 2 TEST 4

W-86

1. Draw diagrams to show the wave patterns for the following:
   (a) a closed pipe resonating in its 3rd mode of vibration.
   (b) an open pipe sounding at its 4th harmonic. (2)

2. An open pipe is 40.0 cm long. Find the frequencies of its 1st and 2nd harmonic, given the velocity of sound in air is $3.40 \times 10^{2}\ ms^{-1}$. (4)

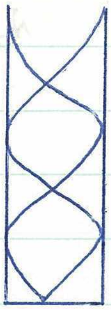
3. A pipe 3.50m long is filled with water. A 3.00×10^{2} Hz tuning fork is continuously sounded as water is allowed to drain from the bottom of the pipe. How many resonate positions are heard as the water level drops? (velocity of sound $= 3.35 \times 10^{2}\ ms^{-1}$) (4)

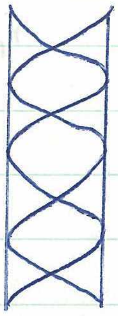
4. Two open organ pipes, 2.40×10^{2} cm and 2.42×10^{2} cm long respectively, are sounded together. If the fundamental tones alone are heard, how many beats can be counted in 10.0 s? (Take the velocity of sound $= 3.40 \times 10^{2}\ ms^{-1}$) (4)

5. The 3rd overtone of an open pipe is in unison with the 2nd overtone of a closed pipe. Find the ratio of the lengths of the pipes. (4)

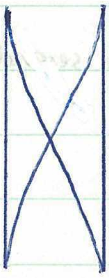
6. A telescopic open pipe is found to resonate to a tuning fork when it is 67.0 cm and 100.5 cm long. If the velocity of sound is $3.35 \times 10^{2}\ ms^{-1}$, and the fork is vibrating at its 4th harmonic, what is the natural frequency of the fork? (5)

TOTAL: $\overline{23}$

1. (a) 

(b) 

(2)

2. 

1^{st} harmonic

$l = \frac{1}{2}\lambda = 0{\cdot}400\,m$

$\therefore \lambda = 0{\cdot}800\,m$

1^{st} HARMONIC: $c = \nu\lambda$

$\therefore \nu = \frac{c}{\lambda}$

$= \frac{3{\cdot}40 \times 10^2}{0{\cdot}800}$

$= 425\ Hz.$

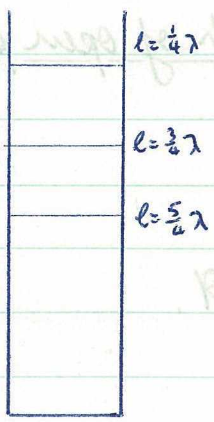
3^{rd} HARMONIC: $l = \lambda = 0{\cdot}400\,m$

$\therefore \nu = \frac{c}{\lambda}$

$= \frac{3{\cdot}40 \times 10^2}{0{\cdot}400}$

$= 8{\cdot}50 \times 10^2\ Hz.$ (4)

$\therefore$ the frequencies of the 1^{st} and 2^{nd} harmonics are $4{\cdot}25 \times 10^2$ H and $8{\cdot}50 \times 10^2$ Hz.

3. 

1^{st} HARMONIC: $\lambda = \frac{c}{\nu}$

$= \frac{3{\cdot}35 \times 10^2}{3{\cdot}00 \times 10^2}$

$= 1{\cdot}117\,m.$

$\therefore$ 1^{st} position is at $0{\cdot}2792\,m$ from the top.
and each position is $\frac{1}{2}\lambda = 0{\cdot}5584\,m$ apart.

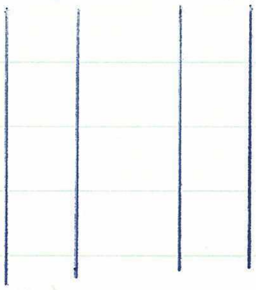
$\therefore$ number of positions $= \left(\frac{3{\cdot}50 - 0{\cdot}2792}{0{\cdot}5584}\right) + 1$

$= 6{\cdot}767.$

$\therefore$ number of positions is 6. (4)

4.

ν_1 ν_2



$l = 2.40\text{m} = \frac{1}{2}\lambda$ $l = 2.42\text{m} = \frac{1}{2}\lambda$

$\therefore \lambda_1 = 4.80\text{m}$ $\lambda_2 = 4.84\text{m}$.

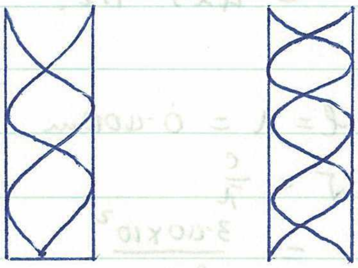
$\nu_1 = \frac{c}{\lambda_1} = \frac{3.40 \times 10^2}{4.80} = 70.83 \text{ Hz}$.

$\nu_2 = \frac{c}{\lambda_2} = \frac{3.40 \times 10^2}{4.84} = 70.25 \text{ Hz}$.

$\nu_{beat} = 70.83 - 70.25$
$= 0.580$ beats per second.

$\therefore$ in 10 seconds, 5.80 beats are heard. (4)

5.



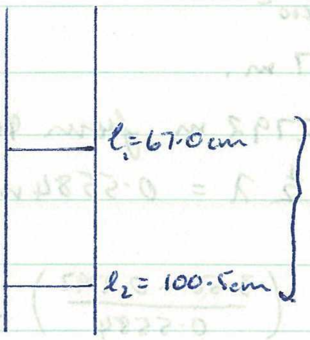
$l_1 = \frac{5}{4}\lambda$ $l_2 = 2\lambda$.

Since the pipes are in unison, they have the same frequency. Hence they must have the same wavelength, according to $c = \nu\lambda$.

$\therefore \frac{l_1}{l_2} = \frac{\frac{5}{4}}{2} = \frac{5}{8}$

$\therefore$ length of closed pipe $= \frac{5}{8} \times$ length of open pipe.

6.



$l_1 = 67.0\text{cm}$
$l_2 = 100.5\text{cm}$

successive harmonics are $\frac{1}{2}\lambda$ apart.

$\therefore \frac{1}{2}\lambda = 33.5\text{ cm}$.

$\therefore \lambda = 0.670\text{m}$.

$\nu = \frac{c}{\lambda} = \frac{3.35 \times 10^2}{0.670} = 5.00 \times 10^2 \text{ Hz}$ which is the 4th harmonic.

$\therefore$ the natural frequency of the fork is 1.25×10^2 Hz. (5)

TOTAL: $\overline{23}$

YEAR 11 PHYSICS SEMESTER 2 TEST 5

1. An object is 1·00 m in front of a plane mirror. Draw a ray diagram to show where the image is formed. Also include a total description of the image – size, nature, etc. (4)

2. A person 1·80 m tall stands 4·00 m away from a plane mirror. If his eyes are 10·0 cm below the top of his head, calculate:
   (a) the smallest vertical mirror necessary to see his entire image.
   (b) the minimum height that the base of the mirror must be above the floor for this to be possible. (4)

3. Draw ray diagrams to show:
   (a) how a convex mirror forms an image.
   (b) how a concave mirror can form a real, magnified image (4).

4. A pin is set up 30·0 cm in front of a convex mirror. It is found that a plane mirror placed between the pin and the convex mirror 20·0 cm from the pin will cause the images formed to coincide. Find the focal length of the convex mirror. (4)

5. A real image is formed 40·0 cm from a mirror, the image being twice the height of the object. What kind of mirror is it, and what is its radius of curvature? (5)

6. A convex mirror of focal length 12·5 cm is placed 50·0 cm from a 5·00 cm high object. Determine the nature, size and position of the image. (5)

7. A convex mirror and a plane mirror are placed facing each other and 28·0 cm apart. Midway between them, a small luminous object is placed. If the distance between the two images observed in the plane mirror is 24·0 cm, calculate the focal length of the convex lens. (4)

TOTAL: $\overline{30}$.

YEAR 11 PHYSICS SEMESTER 2 TEST 5.

1.

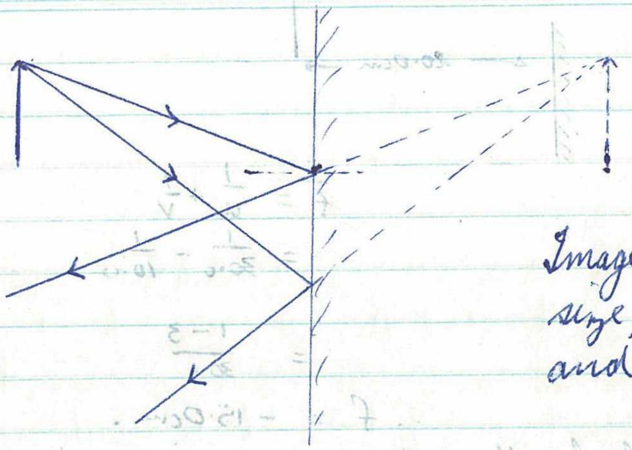
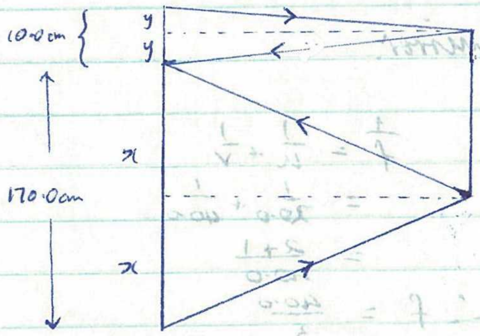


Image is virtual, upright, same size, 1.00 m behind the mirror and laterally inverted. (4)

2.



(a) From the diagram:

height of mirror $= x + y$

$= \frac{1.70}{2} + \frac{0.100}{2}$

$= 0.900\text{ m}.$

∴ min. height of the mirror is 0.900 m.

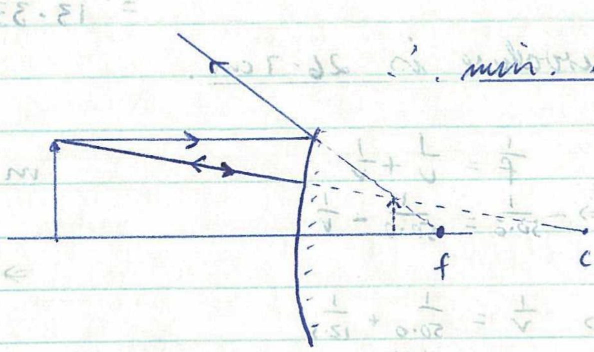
(b) height above the floor $= x$

$= \frac{1.70}{2}$

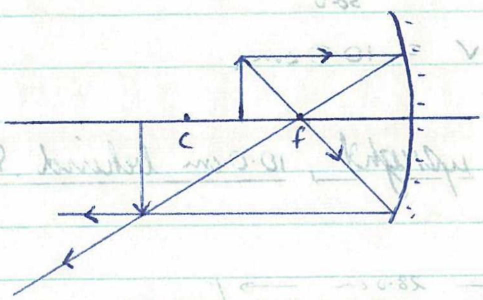
$= 0.850\text{ m}$ (4)

∴ min. height above the floor is 0.850 m.

3. (a)

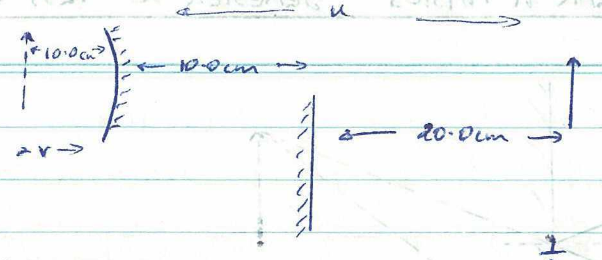


(b)



(4)

4.



$u = 30.0\text{cm}$

$v = -10.0\text{cm}$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$
$$= \frac{1}{30.0} - \frac{1}{10.0}$$
$$= \frac{1-3}{30.0}$$
$$\therefore f = -15.0\text{cm}.$$

$\therefore$ the focal length of the convex mirror is 15.0 cm. (4)

5. Real and magnified image $\Rightarrow$ concave mirror.

$v = 40.0\text{cm}$

$m = 2.$

$$m = \left|\frac{v}{u}\right|$$
$$\Rightarrow 2 = \frac{v}{u}$$
$$\therefore v = 2u.$$
$$\Rightarrow u = \frac{40.0}{2}$$
$$= 20.0\text{cm}.$$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$
$$= \frac{1}{20.0} + \frac{1}{40.0}$$
$$= \frac{2+1}{40.0}$$
$$\therefore f = \frac{40.0}{3}$$
$$= 13.33\text{ cm}$$ (5)

$\therefore$ radius of curvature is 26.7 cm.

6. $f = -12.5\text{cm}$

$u = 50.0\text{cm}$

$h_o = 5.00\text{ cm}.$

$v = ?$

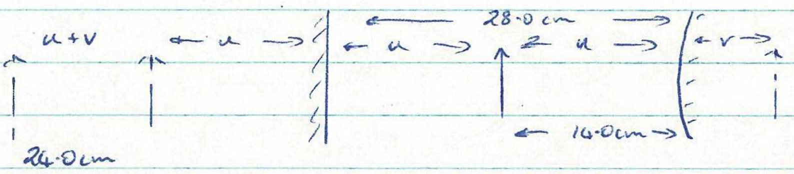
$h_i = ?$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$
$$\Rightarrow -\frac{1}{12.5} = \frac{1}{50.0} + \frac{1}{v}$$
$$\Rightarrow \frac{1}{v} = \frac{1}{50.0} + \frac{1}{12.5}$$
$$= \frac{1+4}{50.0}$$
$$\therefore v = 10.0\text{cm}.$$

$$m = \left|\frac{v}{u}\right| = \frac{h_i}{h_o}$$
$$\Rightarrow h_i = \frac{(h_o)(v)}{u}$$
$$= \frac{(5.00)(10.0)}{50.0}$$
$$= 1.00\text{cm}$$

$\therefore$ image is virtual, upright, 10.0 cm behind the mirror and 1.00 cm high. (5)

7.



$u + v = 24.0\text{cm}$ and $u = 14.0\text{cm}$

$\Rightarrow v = 24.0 - u$

$= 10.0\text{cm}$

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$
$$= \frac{1}{14.0} - \frac{1}{10.0}$$
$$= \frac{10-14}{140}$$
$$\therefore f = -35.0\text{cm}$$

$\therefore$ focal length of the convex lens is 35.0 cm. (4)

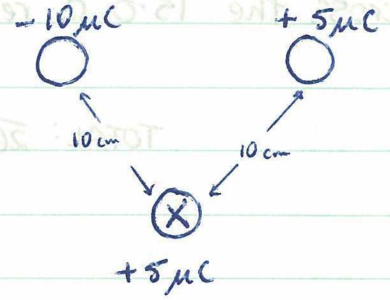
YEAR 11 PHYSICS SEMESTER 2 TEST 6.

1. A glass rod is rubbed with wool and becomes negatively charged. Explain fully why this occurred. (2)

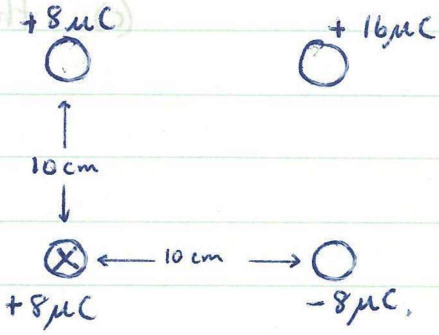
2. Draw a sequence of diagrams to show how an electroscope may be charged negatively by induction. (3)

3. Copy the following diagrams and draw the forces that act on the charge labelled X. (Include some idea of magnitude of the forces).

(a)



(b)

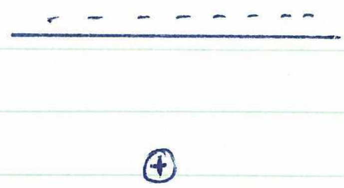


(4)

4. For the following charged bodies, draw the electric field that exists between them. (Copy the diagrams)

(a)

(b)



(2)

5. Define Ohm's Law. (2)

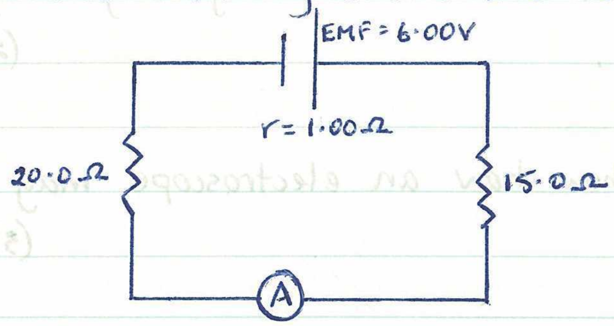
6. State 4 ways in which an EMF can be generated. (2)

7. What current exists in a $1{\cdot}20\ k\Omega$ resistor connected across a potential difference of $6{\cdot}00\ V$? (2)

8. If a standard resistor of $6{\cdot}00\ \Omega$ is to be made of constantan wire of diameter $0{\cdot}250$ mm, what length is required? (Resistivity of constantan $= 4{\cdot}90 \times 10^{-7}\ \Omega m$). (3)

P.T.O.

9. The following circuit was set up in the laboratory. The role of the ammeter is to measure current.



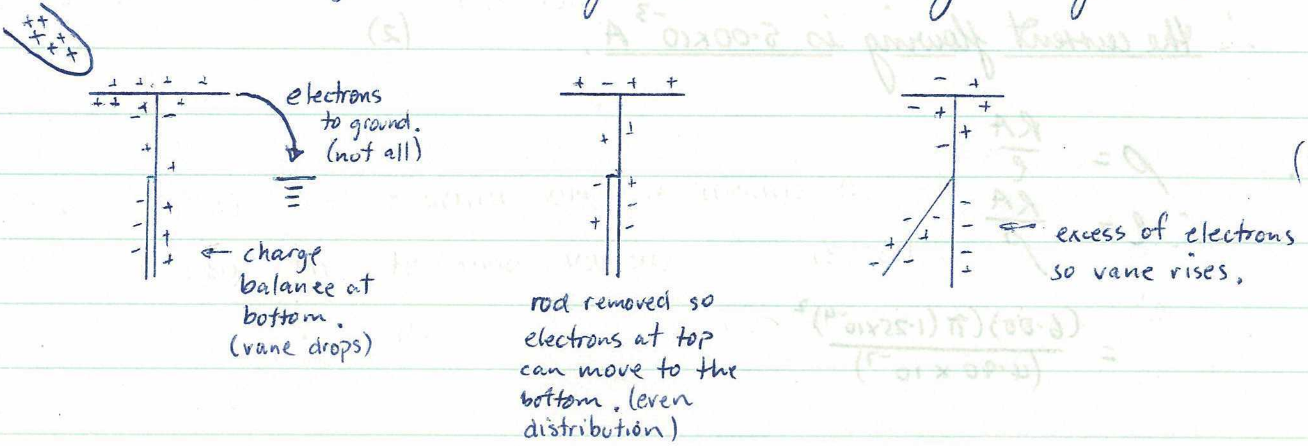
Find: (a) the reading on the ammeter.

(b) the terminal voltage of the cell.

(c) the potential drop across the 15·0 Ω resistor. (6)

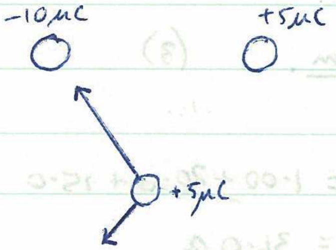
TOTAL: $\overline{26}$.

1. Electrons are easily removed from the outer energy levels (or shells) of atoms by friction. In this case, electrons are removed from the wool and transferred to the glass, thus making it negative. (2)

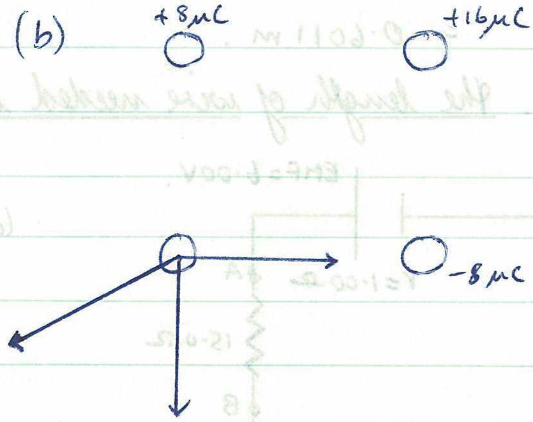
2. 

(3)

3. (a)

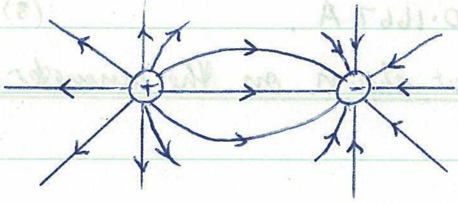


(b)

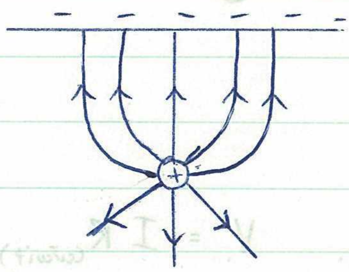


(4)

4. (a)



(b).


(2)

5. For constant temperature, the potential difference between the ends of a metallic conductor is directly proportional to the current flowing. (2)

6. Electromagnetic eg generator
Chemical eg dry cell
Photoelectric effect
Piezoelectric effect (2)
Thermoelectric effect eg. thermocouple.

7. $I = \frac{V}{R}$

$= \frac{6.00}{1.20 \times 10^{3}}$

$= 5.00 \times 10^{-3}$ A.

$\therefore$ the current flowing is 5.00×10^{-3} A. (2)

8. $\rho = \frac{RA}{\ell}$

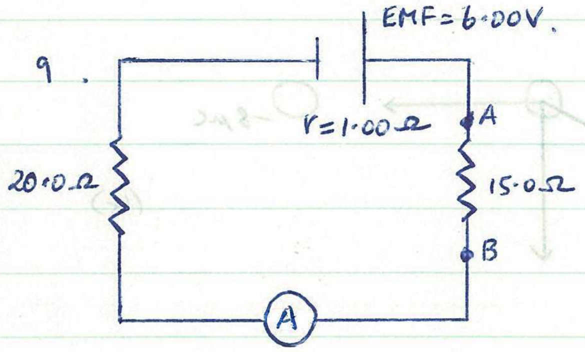
$\therefore \ell = \frac{RA}{\rho}$

$= \frac{(6.00)\,\pi\,(1.25 \times 10^{-4})^2}{(4.90 \times 10^{-7})}$

$= 0.6011$ m.

$\therefore$ the length of wire needed is 0.601 m. (3)

9.



(a). $R_T = 1.00 + 20.0 + 15.0$

$= 36.0\,\Omega$.

$\therefore I = \frac{EMF}{R_T}$

$= \frac{6.00}{36.0}$

$= 0.1667$ A. (3)

$\therefore$ current flow shown on the ammeter is 0.167A.

(b). $V = I R_{(circuit)}$

$= (0.1667)(35.0)$

$= 5.834$ V

$\therefore$ terminal voltage is 5.83 V. (2)

(c). $V_{AB} = I\, R_{AB}$

$= (0.1667)(15.0)$

$= 2.500$ V (1)

$\therefore$ potential drop across the $15.0\,\Omega$ resistor is 2.50 V.

TOTAL: $\overline{26}$

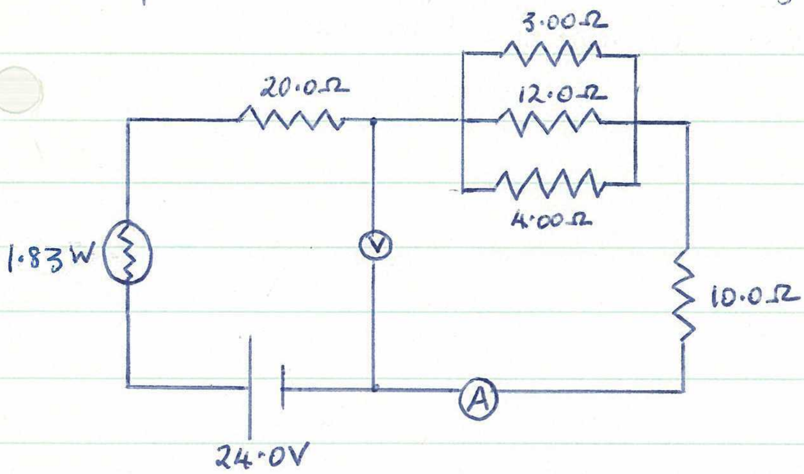
1. Draw a diagram to show how five $3 \cdot 00\,\Omega$ resistors should be arranged to give an effective resistance of $7 \cdot 00\,\Omega$. (3)

2. Two resistors of $5 \cdot 00 \times 10^{2}\,\Omega$ and $1 \cdot 00 \times 10^{3}\,\Omega$ respectively are joined in parallel and carry a total current of $60 \cdot 0$ mA. Find the current in each and the potential difference across the combination. (4)

3. A projector lamp is designed to take a current of $4 \cdot 00$ A when used with a $32 \cdot 0$ V source. What resistance must be placed in series with the lamp if it is to run on a $2 \cdot 40 \times 10^{2}$ V source? (4)

4. An electric kettle is designed to work at $5 \cdot 00$A current on a $2 \cdot 40 \times 10^{2}$ V supply. If the resistance of the heating element is $48 \cdot 0\,\Omega$ what is the power rating of the kettle? (3)

5. The kettle in Question 4 is used to heat $1 \cdot 00$ litre of water. If it takes $5 \cdot 00$ minutes to raise the water temperature from $25 \cdot 0\,°C$ to boiling, calculate the efficiency of the kettle, assuming heat absorbed by the metal is negligible. (specific heat of water is $4 \cdot 18 \times 10^{3}$ J kg^{-1} K^{-1}). (5)

6. 

The ammeter in the circuit at left reads $0 \cdot 676$ A for a potential difference of $24 \cdot 0$V. Calculate:

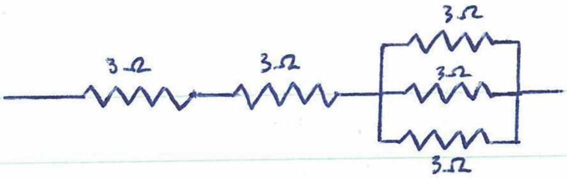
(a) the resistance of the $1 \cdot 83$ W globe

(b) the reading on the voltmeter.

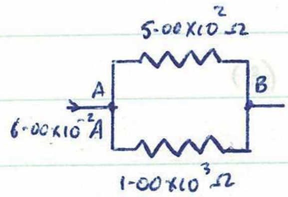
(c) the current in the $4 \cdot 00\,\Omega$ resistor.

(8)

TOTAL: /27

1. 

(3)

2. 

$V_{AB} = I_1R_1 = I_2R_2$ and $I_1 + I_2 = 6{\cdot}00\times10^{-2}$ A.

$\Rightarrow I_1 = 6{\cdot}00\times10^{-2} - I_2$

Hence: $I_1(5{\cdot}00\times10^{2}) = I_2(1{\cdot}00\times10^{3})$

$\Rightarrow (6{\cdot}00\times10^{-2} - I_2)(5{\cdot}00\times10^{2}) = 1{\cdot}00\times10^{3}\,I_2$

$\Rightarrow 30{\cdot}0 - 5{\cdot}00\times10^{2}\,I_2 = 1{\cdot}00\times10^{3}\,I_2$

$\Rightarrow I_2 = \dfrac{30{\cdot}0}{1{\cdot}50\times10^{3}}$

$= 0{\cdot}0200$ A.

Hence $I_1 = 0{\cdot}0400$ A.

$V_{AB} = I_1R_1$

$= (0{\cdot}0400)(5{\cdot}00\times10^{2})$

$= 20{\cdot}0$ V.

∴ the current in the $5{\cdot}00\times10^{2}\,\Omega$ resistor is $0{\cdot}0400$ A, that in the $1{\cdot}00\times10^{3}\,\Omega$ resistor is $0{\cdot}0200$ A, and the potential over the whole combination is $20{\cdot}0$ V. (4)

3. $V_{lamp} = I\,R_{lamp}$

$\Rightarrow R_{lamp} = \dfrac{32{\cdot}0}{4{\cdot}00}$

$= 8{\cdot}00\,\Omega$

To work on $2{\cdot}40\times10^{2}$ V source:

$V = I\,R_T$ where $R_T = R_{lamp} + R_1$

$\Rightarrow R_T = \dfrac{2{\cdot}40\times10^{2}}{4{\cdot}00}$

$= 60{\cdot}0\,\Omega$.

Since $R_T = R_{lamp} + R_1$, then:

$R_1 = 60{\cdot}0 - 8{\cdot}00$

$= 52{\cdot}0\,\Omega$.

∴ $52{\cdot}0\,\Omega$ must be placed in series with the lamp. (4)

4. $P = I^2 R$

$= (0.120)^2 (8.33 \times 10^4)$

$= 1.200 \times 10^3$ W

$\therefore$ the power of the element is 1.20×10^3 W. (3)

5. $Q_{needed} = m_w c_w \Delta T$

$= (1.00)(4.18 \times 10^3)(75.0)$

$= 3.135 \times 10^5$ J,

$\therefore P_{output} = \frac{Q_{needed}}{t}$

$= \frac{3.135 \times 10^5}{3.00 \times 10^2}$

$= 1.045 \times 10^3$ W,

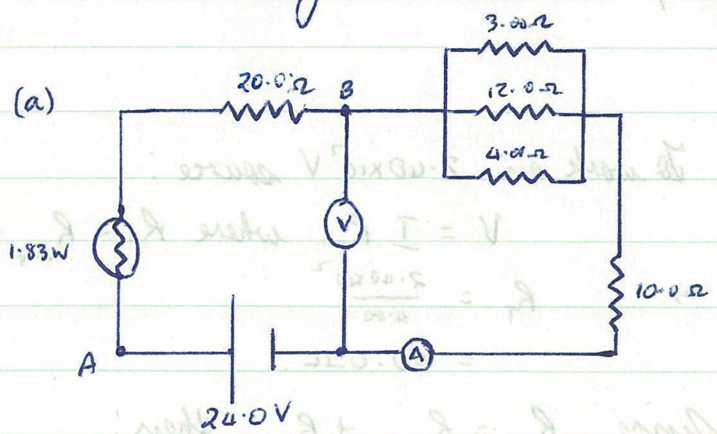
$\therefore$ % efficiency $= \frac{P_{output}}{P_{input}} \times \frac{100}{1}$

$= \frac{1.045 \times 10^3}{1.200 \times 10^3} \times \frac{100}{1}$

$= 87.08$ %

$\therefore$ the heating element is 87.1% efficient. (5)

6. (a)



Let resistance of the parallel component be R_x

$\Rightarrow \frac{1}{R_x} = \frac{1}{3.00} + \frac{1}{12.0} + \frac{1}{4.00}$

$= \frac{8.00}{12.0}$

$\therefore R_x = 1.50 \Omega$

Now: $V = I_T R_T$

$\Rightarrow 24.0 = (0.676)(R_T)$

$\Rightarrow R_T = 35.50 \Omega$

Since $R_T = R_{globe} + 20.0 + 1.50 + 10.0$, then:

$R_{globe} = 35.50 - 31.50 = 4.00 \Omega$.

$\therefore$ the resistance of the globe is 4.00Ω. (2)

(b). $V_{AB} = I_T R_{AB}$

$= (0.676)(4.00 + 20.0)$

$= 16.22 \text{ V}.$

$\therefore$ the voltmeter must read $24.0 - 16.22 = 7.78 \text{ V}.$ (3).

i.e. the reading is 7.8 V

(c). $V_{R_x} = I_T R_x$ Now $V_{R_x} = I_{4\Omega} R_{4\Omega}$

$= (0.676)(1.50)$ $\Rightarrow I_{4\Omega} = \frac{1.014}{4.00}$

$= 1.014 \text{ V}.$ $= 0.2535 \text{ A}$

$\therefore$ the current in the 4.00Ω resistor is 0.254 A. (3)

TOTAL: $\overline{27}$