YEAR 11 PHYSICS *JR 99*
MOVEMENT TEST 1 **Total 28 marks**

1. John is a passenger on a train which has a velocity of 110.0 km h^{-1}. Calculate John's velocity , relative to the ground if he walks towards the

(a) front of the train at 5.00km h^{-1},

(1)

(b) back of the train at 5.00 kmh^{-1}

(1)

2. A ball of mass 400.0g hits the ground with a velocity of 8.40 ms^{-1} and bounces back with a velocity of 6.00ms^{-1}.

Calculate the change in velocity.

(3)

3. Driving in good conditions at 70.0kmh^{-1}, you could expect to be able to stop in 48.0m if something unexpected happened. If you were actually driving at 80.0kmh^{-1}, and something happened and you had to stop, what would your speed be at the end of 48.0m?

(6)

4. Linda accelerates from rest at $2.00ms^{-2}$ for 4.00s. She then continues with constant velocity for 10.0s, she then slows down to a stop in another 3.00s. Draw a velocity-time graph for Linda's race, and use the graph to find **(a) the total displacement after 17.0s** and **(b) the average velocity for the race.**

(7)

5. (a) Also for the above race draw the acceleration-time graph for the 17.0s period.

(2)

(b) What is her average speed?

□□

(3)

(6) A helicopter is rising vertically with a uniform speed $14.7ms^{-1}$ and a wheel drops off when it is 49.0m from the ground.

(a) Calculate the velocity on impact with the ground

(3)

(b)Calculate the time taken for the wheel to reach the ground

(2)

END

YEAR 11 PHYSICS *JR 99*
MOVEMENT TEST 1 **Total 28 marks**

1. John is a passenger on a train which has a velocity of 110.0 km h^{-1}. Calculate John's velocity , relative to the ground if he walks towards the

(a) front of the train at 5.00km h^{-1},

Take forwards as +ve.

$v = 110{\cdot}0 + 5{\cdot}00$
$= 115{\cdot}0 \text{ kmh}^{-1}$ forwards

(1)

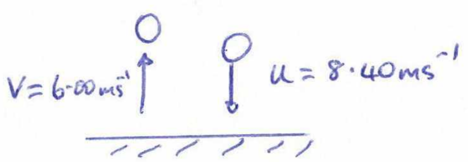
(b) back of the train at 5.00 kmh^{-1}

$v = 110{\cdot}0 - 5{\cdot}00$
$= 105{\cdot}0 \text{ kmh}^{-1}$ forwards

(1)

2. A ball of mass 400.0g hits the ground with a velocity of 8.40 ms^{-1} and bounces back with a velocity of 6.00ms^{-1}.

Calculate the change in velocity.



↑ +ve.

$\Delta v = v - u$
$= 6{\cdot}00 - (-8{\cdot}40)$
$= \underline{14{\cdot}4 \text{ ms}^{-1} \text{ upwards}}$

(3)

3. Driving in good conditions at 70.0kmh^{-1}, you could expect to be able to stop in 48.0m if something unexpected happened. If you were actually driving at 80.0kmh^{-1}, and something happened and you had to stop, what would your speed be at the end of 48.0m?

Take forwards as +ve.

$v = 0{\cdot}00 \text{ms}^{-1}$
$u = 19{\cdot}44 \text{ms}^{-1}$
$a = ?$
$t = ?$
$s = 48{\cdot}0 \text{m}$

$v^2 = u^2 + 2as$
$\Rightarrow 0 = (19{\cdot}44)^2 + 2a(48{\cdot}0)$
$\Rightarrow a = -3{\cdot}937 \text{ ms}^{-2}$

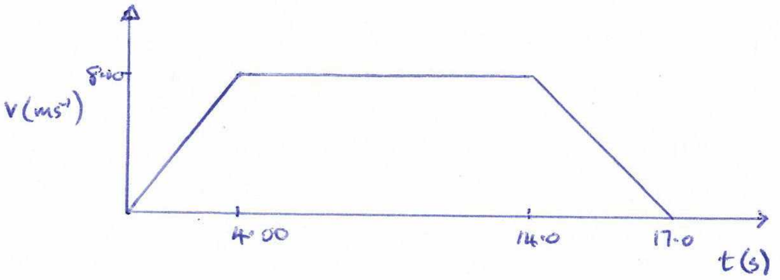
$v = ?$
$u = 22{\cdot}22 \text{ms}^{-1}$
$a = -3{\cdot}937 \text{ms}^{-2}$
$t =$
$s = 48{\cdot}0 \text{m}$

$v^2 = u^2 + 2as$
$= (22{\cdot}22)^2 + 2(-3{\cdot}937)(48{\cdot}0)$
$\Rightarrow v = 10{\cdot}72 \text{ ms}^{-1}$.

(6)

$\therefore$ <u>Velocity = 10·7 ms⁻¹ forwards</u>

4. Linda accelerates from rest at 2.00ms-2 for 4.00s. She then continues with constant velocity for 10.0s, she then slows down to a stop in another 3.00s. Draw a velocity-time graph for Linda's race, and use the graph to find **(a) the total displacement after 17.0s** and **(b) the average velocity for the race.**



$v = u + at$
$= 0 + (2.00)(4.00)$
$= 8.00 ms^{-1}$

(3).

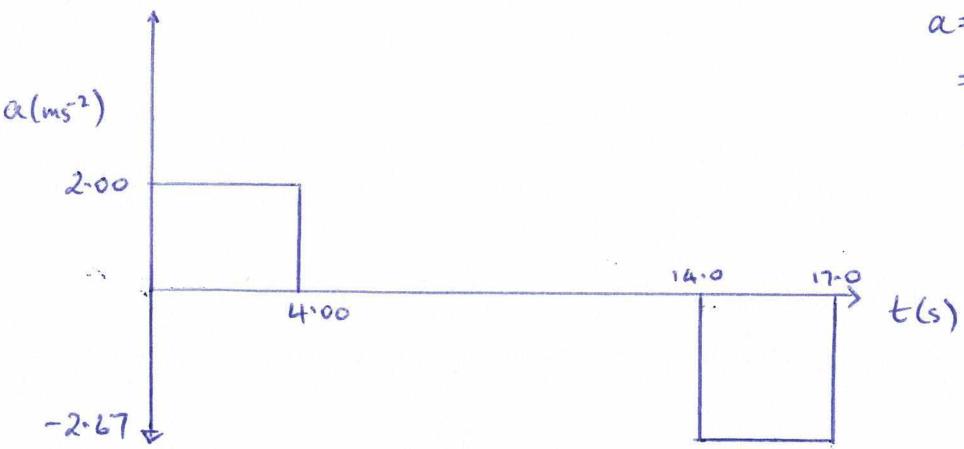
(a) s = area under graph
$= \frac{1}{2}(4.00)(8.00) + (10.0)(8.00) + \frac{1}{2}(3.00)(8.00)$
$= 108.0$ m

$\therefore$ displacement $= 1.08 \times 10^2$ m forwards. (2)

(b) $v_{av} = \frac{s}{t}$
$= \frac{108.0}{17.0}$
$= 6.35$ ms^{-1} forwards. (2)

(7)

5. (a) Also for the above race draw the acceleration-time graph for the 17.0s period.



$a = \frac{v-u}{t}$
$= \frac{0 - 8.00}{3.00}$
$= -2.67 ms^{-2}$

(3) **(2)**

(b) What is her average speed?

speed $= \frac{d}{t}$
$= \frac{108.0}{17.0}$
$= 6.35$ ms^{-1}.

□□

(2) **(3)**

(6) A helicopter is rising vertically with a uniform speed 14.7ms-1 and a wheel drops off when it is 49.0m from the ground.

(a) Calculate the velocity on impact with the ground

$\downarrow$ +ve.

$v = ?$

$u = -14.7 ms^{-1}$

$a = 9.80 ms^{-2}$

$t = ?$

$s = 49.0 m$

$v^2 = u^2 + 2as$

$= (-14.7)^2 + 2(9.80)(49.0)$

$\Rightarrow v = 34.30 ms^{-1}$

$\therefore$ velocity = 34.3 ms^{-1} down.

(3)

(b)Calculate the time taken for the wheel to reach the ground

$s = ut + \frac{1}{2}at^2$

$\Rightarrow 49.0 = (-14.7)t + \frac{1}{2}(9.80)t^2$

$\Rightarrow t = 5.00 s.$

$\therefore$ Time taken = 5.00 s.

(2)

END

YEAR 11 PHYSICS

MOVEMENT TEST

1. (a) (i) $v = 0{\cdot}00\,ms^{-1}$ ↓+ve. $v^2 = u^2 + 2as$

$u = -28{\cdot}61\,ms^{-1}$ $\Rightarrow$ $0 = (-28{\cdot}61)^2 + 2(9{\cdot}80)s$

$a = 9{\cdot}80\,ms^{-2}$ $\Rightarrow$ $s = -41{\cdot}76\,m.$

$t = ?$

$s = ?$ $\therefore$ Max height = 41·8 m above the point of contact. (3)

(ii) $v = ?$ ↓+ve $s = ut + \frac{1}{2}at^2$

$u = -28{\cdot}61\,ms^{-1}$ $\Rightarrow$ $0 = -28{\cdot}61\,t + \frac{1}{2}(9{\cdot}80)t^2$

$a = 9{\cdot}80\,ms^{-2}$ $\Rightarrow$ $t = 5{\cdot}839\,s.$

$t = ?$

$s = 0{\cdot}00\,m$ $\therefore$ Time of flight = 5·84 s. (3)

(iii) $v = ?$ ↓+ve $s = ut + \frac{1}{2}at^2$

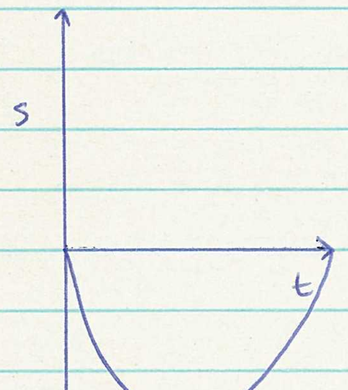
$u = -28{\cdot}61\,ms^{-1}$ $\Rightarrow$ $-12{\cdot}0 = -28{\cdot}61\,t + \frac{1}{2}(9{\cdot}80)t^2$

$a = 9{\cdot}80\,ms^{-2}$ $\Rightarrow$ $t = 0{\cdot}4549\,s$ or $5{\cdot}384\,s.$

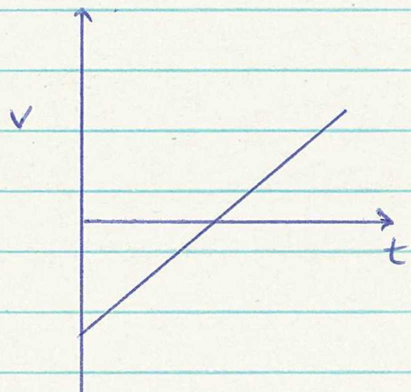
$t = ?$

$s = -12{\cdot}0\,m$ $\therefore$ Times at 12·0 m are 0·455 s and 5·38 s. (4)

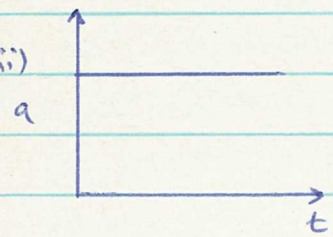
(b) (i) ↓+ve



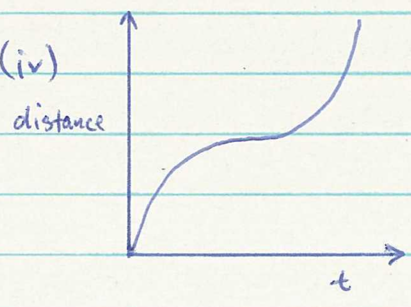
(ii) ↓+ve



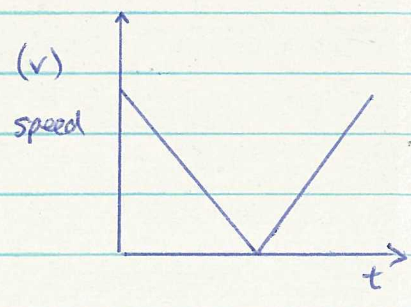
(iii) ↓+ve



(iv)

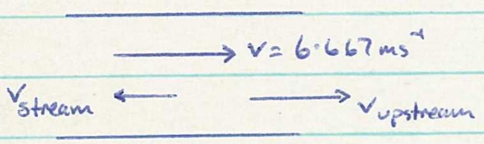


(v)



(10)

2. (a)



$$V_{upstream} = \frac{s}{t} = \frac{1{\cdot}80\times10^{3}}{3{\cdot}00\times10^{2}} = 6{\cdot}00\,ms^{-1}$$

$$V_{upstream} = V_{boat} + V_{stream}$$

$$\Rightarrow V_{stream} = 6{\cdot}00 - 6{\cdot}667 = -0{\cdot}667\,ms^{-1}$$

$\therefore$ Velocity of stream $= 0{\cdot}667\,ms^{-1}$ downstream (4)

(b)

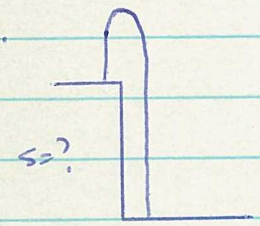
$$V = \frac{s}{t}$$

$$\Rightarrow t = \frac{s}{V} = \frac{8{\cdot}40\times10^{3}}{(6{\cdot}667+0{\cdot}667)}$$

$$= 1{\cdot}145\times10^{3}\,s.$$

$\therefore$ Time taken $= 1{\cdot}14\times10^{3}\,s.$ (2)

3.



To calculate the height of the building:

$v = ?$

$u = 0{\cdot}00\,ms^{-1}$

$a = 9{\cdot}80\,ms^{-2}$

$t = 5{\cdot}62\,s$

$s = ?$

$\downarrow$ +ve

$$s = ut + \tfrac{1}{2}at^{2} = 0 + \tfrac{1}{2}(9{\cdot}80)(5{\cdot}62)^{2} = 1{\cdot}548\times10^{2}\,m.$$

To calculate u:

$v = ?$

$u = ?$

$a = 9{\cdot}80\,ms^{-2}$

$t = 22{\cdot}3\,s$

$s = 1{\cdot}548\times10^{2}\,m$

$\downarrow$ +ve

$$s = ut + \tfrac{1}{2}at^{2}$$

$$\Rightarrow 1{\cdot}548\times10^{2} = u(22{\cdot}3) + \tfrac{1}{2}(9{\cdot}80)(22{\cdot}3)^{2}$$

$$\Rightarrow u = -1{\cdot}023\times10^{2}\,ms^{-1}$$

$\therefore$ Initial velocity $= 102\,ms^{-1}$ upwards.

(4)

4. $u = 34.7\,ms^{-1}$ E

$v = 51.4\,ms^{-1}$ W.

$\xleftarrow{+ve}$

$$\Delta v = v - u$$
$$= 51.4 - (-34.7)$$
$$= 86.1\,ms^{-1}$$

$$\Delta p = m\Delta v$$
$$= (0.165)(86.1)$$
$$= 14.21\,kgms^{-1}$$
$$\therefore \underline{\Delta p = 14.2\,kgms^{-1}\ W} \qquad (3)$$

5. (a) MATS: increase the time for the change of momentum to occur to a person landing on them.
Since $F = \frac{\Delta p}{t}$, increasing t leads to a smaller force experienced. (2)

(b). BAT: ball is in contact with the surface for less time.
Since $F = \frac{\Delta p}{t}$ and Δp (ball) remains unchanged, a smaller time of contact gives a larger impulsive force.

RACQUET: ball remains in contact longer - the strings deform as the ball strikes them.

Impulse is the same in both instances since $I = \Delta p$. (4)

6. (a). Take direction of larger carriage as +ve.

$$\Sigma p_i = \Sigma p_f$$
$$\Rightarrow m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$
$$\Rightarrow (5.00\times10^4)(14.0) + (2.50\times10^4)(0) = (5.00\times10^4)v_1 + (2.50\times10^4)(10.0)$$
$$\Rightarrow v_1 = 9.00\,ms^{-1}$$

$\therefore$ $\underline{\text{Final velocity} = 9.00\,ms^{-1}\text{ forwards.}}$ (3)

(b) $\Sigma E_k \text{ (initial)} = \frac{1}{2} m_1 u_1^2$

$= \frac{1}{2}(5\cdot 00 \times 10^4)(14\cdot 0)^2$

$= \underline{4\cdot 90 \times 10^6 \text{ J}}$

$\Sigma E_k \text{ (final)} = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$

$= \frac{1}{2}(5\cdot 00 \times 10^4)(9\cdot 00)^2 + \frac{1}{2}(2\cdot 50 \times 10^4)(10\cdot 0)^2$

$= \underline{3\cdot 28 \times 10^6 \text{ J}}$ (3)

(c) NO - energy has been lost due to friction (heat) and sound. (2)

7. $P = \frac{W_{OUTPUT}}{t}$

$\Rightarrow W_{OUTPUT} = Pt$

$= (4\cdot 00 \times 10^2)(196\cdot 2)$

$= 7\cdot 848 \times 10^4 \text{ J},$

$\% \text{ eff} = \frac{W_{OUTPUT}}{W_{INPUT}} \times \frac{100}{1}$

$\Rightarrow 78\cdot 0 = \frac{7\cdot 848 \times 10^4}{W_{INPUT}} \times \frac{100}{1}$

$\Rightarrow W_{INPUT} = 1\cdot 006 \times 10^5 \text{ J}$

$W_{INPUT} = \Delta E_p = mg\Delta h$

$\Rightarrow 1\cdot 006 \times 10^5 = m(9\cdot 80)(45 \times 12 \times 0\cdot 280)$

$\Rightarrow m = 67\cdot 89 \text{ kg}.$

$\therefore$ $\underline{\text{Mass} = 67\cdot 9 \text{ kg}}$ (6)

TOTAL: /53

YEAR 11 PHYSICS ELECTRICITY TEST

1. Sarah determined the resistivity of nichrome wire by collecting the following data during a physics experiment.

   Length of aluminium wire 98.2cm
   4 readings of the wires diameter .280mm, .290mm, .270mm, .280mm
   P.D between the ends of the wire = 12.0V and the current along the = 0.750A
   What is the resistivity of the nichrome wire?

2. Eleasha used a battery from her car to supply 3.50A to operate an electric motor for 30min. Calculate the total amount of charge that flowed from the battery.

3. When performing an investigation to verify Ohm's Law, what relationship between current and potential difference would you expect to find?

4. A student wants to determine the value of an unknown resistor. She has the following equipment to work with; leads 6v battery, switch, unknown ceramic resistor, ammeter and voltmeter.
   a) Draw the circuit diagram that she would draw to help her set up the circuit

b) Explain why she set up the components in that particular way.

5. An electric motor found in a child's toy requires two 1.50V dry cell batteries in series. If the motor draws a maximum current of 3.00x102 milliamps .Calculate

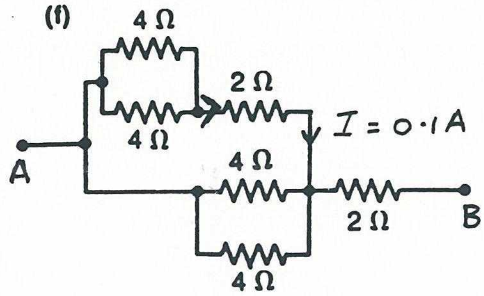
a) the resistance of the motor

b) what would the current be if the child tried to run two motors from the batteries.

c) What would be observed?

6. If a student was given the circuit below and told that 0.1A of current passed through the circuit where shown, calculate the voltage across **AB**. Show all steps in your calculation

(f)



YEAR 11 PHYSICS

SHORT TEST: OHM'S LAW, RESISTIVITY

1. Average diameter = 0.280 mm. (1)

$V = IR$

$\Rightarrow R = \frac{V}{I}$

$= \frac{12.0}{0.750}$

$= 16.0\,\Omega$ (1)

$\rho = \frac{RA}{l}$

$= \frac{(16.0)\pi(1.40\times10^{-4})^2}{0.982}$

$= 1.003\times10^{-6}\ \Omega m$

$\therefore \underline{\rho = 1.00\times10^{-6}\ \Omega m}$ (2)

2. $I = \frac{q}{t}$

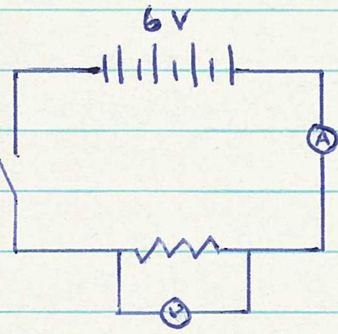
$\Rightarrow q = It$

$= (3.50)(30.0)(60.0)$

$= \underline{6.30\times10^{3}\ C}$. (2)

3. Direct relationship between V and I. (1)

4. (a)



(2)

(b) AMMETER - in series to measure the current flowing through the resistor.
VOLTMETER - in parallel across the resistor to measure the potential difference across it. (2).

5. (a) $V = IR$

$\Rightarrow R = \frac{V}{I}$

$= \frac{3.00}{0.300}$

$= \underline{10.0\,\Omega}$ (2)

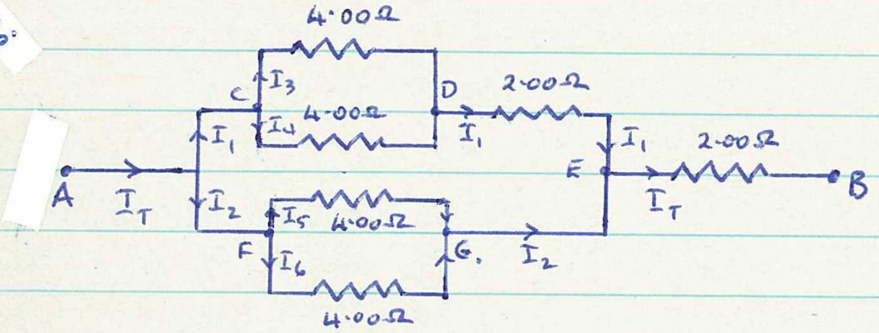
(b). $I = \frac{V}{R}$

$= \frac{3.00}{20.0}$

$= \underline{0.15 A}$. (2)

(c) The motors would work slower when in tandem. (1)

6.



$I_1 = 0.100\,A$.

$I_1 = I_3 + I_4 = 0.100\,A$

Since I_3 and I_4 flow through similar resistances (4.00 Ω),

$$I_3 = I_4 = \tfrac{1}{2}(0.100) = 0.0500\,A.$$

$$V_{CD} = I_3 R_{4.00\Omega} = (0.0500)(4.00) = 0.200\,V.$$

$$V_{DE} = I_1 R_{2.00\Omega} = (0.100)(2.00) = 0.200\,V.$$

From the diagram: $V_{FG} = V_{CE} = V_{CD} + V_{DE}$
$= 0.200 + 0.200$
$= 0.400\,V.$

$$\frac{1}{R_{FG}} = \frac{1}{4.00} + \frac{1}{4.00} = \frac{1}{2.00}$$

$$\Rightarrow R_{FG} = 2.00\,\Omega.$$

$$V_{FG} = I_2 R_{FG}$$

$$\Rightarrow I_2 = \frac{0.400}{2.00} = 0.200\,A.$$

$$\therefore I_T = I_1 + I_2 = 0.100 + 0.200 = 0.300\,A.$$

$$V_{EB} = I_T R_{2.00\Omega} = (0.300)(2.00) = 0.600\,V.$$

$$V_{AB} = V_{FG} + V_{EB} = 0.400 + 0.600 = \underline{1.00\,V}.$$

(8)

(Can do it in 8 steps).

TOTAL: 24 MARKS

YEAR 11 PHYSICS

TEST : HEATING AND COOLING

1. (a) ASSUMPTIONS $m(\text{water}) = 0.100\ kg$ $m(\text{steam}) = 0.100\ kg$

$T(\text{skin}) = 35.0°C$.

JAN. $Q = m_w c_w \Delta T$

$= (0.100)(4.18 \times 10^3)(100.0 - 35.0)$

$= 2.717 \times 10^4\ J$ (1)

STEPHEN $Q = m_s L_v + m_s c_w \Delta T$

$= (0.100)(2.25 \times 10^6) + (0.100)(4.18 \times 10^3)(100.0 - 35.0)$

$= 2.522 \times 10^5\ J$ $(1\frac{1}{2})$

∴ Stephen receives about $9 \times$ the heat that Jan does. $(\frac{1}{2})$ (3)

(b) Stephen (1)

(c) The steam must change phase to water at 100°C, releasing its potential energy as it does so. This amount of heat is very large and leads to a severe burn. (2)

2. (a) $Q = m_w c_w \Delta T + m_s c_s \Delta T$ (1)

$= (1.210)(4.18 \times 10^3)(82.8) + (1.230)(4.45 \times 10^2)(82.8)$ (1)

$= 4.641 \times 10^5\ J$

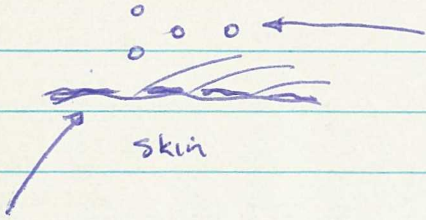
∴ Heat required $= 4.64 \times 10^5\ J$. (1) (3)

(b) $\%\ eff = \frac{Q_{needed}}{Q_{supplied}} \times \frac{100}{1}$

$\Rightarrow 59.2 = \frac{4.641 \times 10^5}{Q_{supplied}} \times \frac{100}{1}$

$\Rightarrow Q_{supplied} = 7.839 \times 10^5\ J$ (2)

$\text{Cost} = \frac{7.839 \times 10^5}{3.60 \times 10^6} \times 13.7 = 2.98c$ (1) (3)

3. (a) 

Wind blows evaporated H_2O molecules away, allowing more molecules to evaporate from the surface

As the H_2O molecules gain enough heat energy from the skin to become gaseous, the temperature of the skin decreases.

For the bottle, no liquid evaporates so no cooling effect occurs. (2)

(b) Light colour clothes reflect heat and are used in hot conditions (summer)
Dark colour clothes absorb heat better and are used in cool conditions (winter).

Light clothes radiate heat poorly.
Dark clothes radiate heat well.

For the body to cool in summer and keep cool, wear light clothes.
" " " " heat " " " " warm, " dark " . (3)

4. No. The amount of perspiration is so small that it will evaporate within 1-2 steps. Beyond this, it is a tolerance of pain which allows people to complete the journey. (3)

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

$\Rightarrow m_{Fe} c_{Fe} \Delta T = m_w c_w \Delta T + m_{cu} c_{cu} \Delta T$ (2)

$\Rightarrow (0.0616) c_{Fe} (4.00 \times 10^2) = (0.100)(4.18 \times 10^3)(18.0) + (0.2064)(3.88 \times 10^2)(18.0)$ (2)

$\Rightarrow c_{Fe} = 3.639 \times 10^2 \text{ J kg}^{-1} \text{K}^{-1}$.

$\therefore \underline{c_{Fe} = 3.64 \times 10^2 \text{ J kg}^{-1} \text{K}^{-1}}$. (1) (5)

6. (a) m (sea water) $= \rho V$

$$= (1.09)(8.50\times10^{5})$$
$$= 9.265\times10^{5}\ \text{kg}. \quad (2)$$

$$Q = m_w c_w \Delta T$$
$$= (9.265\times10^{5})(4.02\times10^{3})(70.4)$$
$$= 2.622\times10^{11}\ \text{J}$$
$$\therefore\ \underline{Q = 2.62\times10^{11}\ \text{J}} \quad (2) \qquad (4)$$

(b) The heat passes into the pipe and then into the surrounding water. It is also lost to the cooler water as the hot water mixes with it once out of the pipe by the process of convection. (3)

7. (a)
$$Q = m_{air}\, c_{air}\, \Delta T \quad (1)$$
$$= (60.0\times1.30)(1.00\times10^{3})(15.0) \quad (3)$$
$$= 1.17\times10^{6}\ \text{J} \quad (1)$$
$$\therefore\ \underline{Q = 1.17\times10^{6}\ \text{J}}\ \text{(for every half-hour)} \qquad (6)$$

$$\text{Rate} = \frac{1.17\times10^{6}}{1.80\times10^{3}}$$
$$= \underline{6.50\times10^{2}\ \text{J s}^{-1}} \quad (1)$$

(b) Less since the heat exchanger in the air conditioner is not 100% efficient at converting. It will need to work longer to heat the room. (2)

(c) The air is constantly moving and hence its density (mass / unit volume) will constantly change.
Also, as the air is heated, it expands so its density decreases. (2)
(best reason.

TOTAL: $\overline{42}$

PHYSICS 11

TOPIC TEST : ELECTRICITY

1. In order to clean the dust off a CD you rub it with a tissue. A few seconds later it is worse than before you wiped it. Why?

(2)

2. A 1.50 V battery in a portable cassette player is rated at 1.00 A h.

(a) What is the total amount of charge which can be moved through this battery before its chemicals have reacted fully?

(2)

(b) The cassette player uses 50.0 mA altogether, to operate the earphones and the cassette motor. What is the maximum length of time that the cassette player can be used before the batteries need replacing.

(2)

(c) What is the total amount of electrical work that the battery can do before it is fully discharged?

(2)

3. A student at a Scicence show notices that a small sphere stays suspended above a charged sphere for a short time. Both spheres are in a vertical tube in an "electrostatics experiment" at the show. She is told that the spheres are .720m apart and have a charge of 1.60 μC on each them and that "g" was 9.81ms^{-2}in the room.

(a)What is the approximate mass of the small sphere?

(4)

(b) Why can this expriment only last a short time?

(2)

4. A cassette player's rechargeable battery supplies 12.6 joules to 10.0 coulombs of charge which pass through it. What potential difference does the battery provide?

(2)

5. The cost of electricity is 13.7 cents per kW h.

(a) What are you paying for?

A. Power
B. Voltage
C. Current
D. Energy

(1)

(b) A 1.20 kW kettle takes 4.37 minutes to boil. How much does this cost?

(3)

6. A 6.00×10^2 W microwave oven is operated using the 240 V mains supply. What current does it draw?

(1)

7. A string of thirty 2.00 W light bulbs is used to decorate a Christmas tree. The light bulbs are connected in parallel to the 240 V mains supply.

(a) What is the total power used?

(2)

(b) What is the resistance of each light?
The fifteenth light bulb blows.

(2)

(c) What change is observed in the brightness of the other lamps?Why?

(2)

8. Draw a graph in the space below to illustrate Ohm,s Law for metal X and metal Y where the resistance of X is less than the resistance of metal Y.

(3)

9. A physics student replacing a fuse wire in the meter box at home notices that the fuse wire was rated at $1.00X10^{-6}$ Ωm. He measured the length of the fuse at 7.80cm and calculated the resistance to be 18.5ohms

a) What would be his calculated value for the diameter of the fuse wire he was replacing.

(3)

(b) If the fuse was for the power circuit in the house and the maximum current for his Carine house was 15.0A was his calculation for resistance correct?

(2)

(c) Can this fuse protected against electrocution. Why?

(2)

(d) What is a earth leakage system?

(2)

10. A old torch battery has an EMF of 6.00V. The output voltage is measured at 3.40V. The current flowing in the globe is 825mA.

(a) What is the internal resistance of the battery.

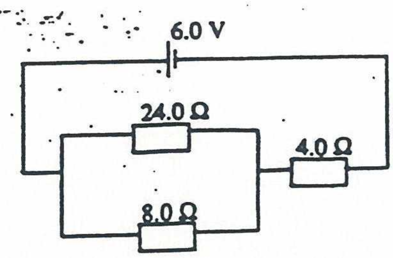
(2)

(b) What is the power output of the globe?

(2)

11. For the following circuit diagram, calculate

(a) The total resistance of the circuit



(2)

(b) The current passing through each resistor

(2)

(c) The power dissipated in the 8.00Ω resistor

(2)

12. You are given three resistances of 10Ω each. You are asked use all three resistors and connect them in separate ways to get three different total resistances. Show your circuit connections and your calculations.

(a)

(2)

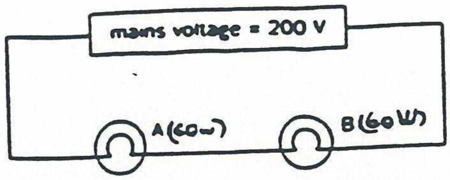
(b)

(2)

(c)

(2)

13. If two light bulbs were connected in series as shown below:



(a) What is the voltage difference across light bulb A?

(1)

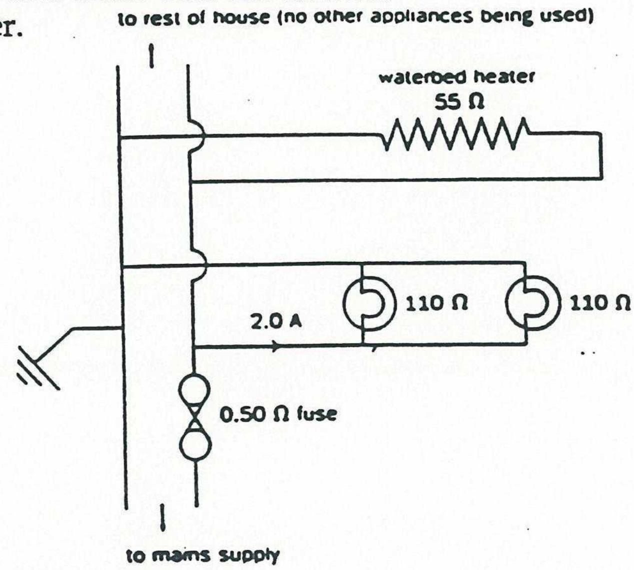
(b) What current goes through light bulb B?

(1)

(c) What current passes through the battery?

(2)

14. A fuse with a resistance of 5.00 ohm is connected as shown. A thermostatically controlled heater to the water bed and two bedside lamps are also being used. An electrician ,trying to trace a fault, uses an ammeter and finds that the current being used by the bedside lamps is 2.00 A altogether.



(a) What current goes through the water-bed heater?

(2)

(b) What current goes through the fuse?

(2)

(c) What is the mains voltage supply in this foreign country?

(2)

15. Why isn't a plastic hair dryer earthed?

(2)

16. You hear a thump come from the lounge room.
You run in to see a person clutching a wire attached to the television. The person is in obvious distress. What should you do? Why?

(4)

END OF PAPER

SOLUTIONS

JR 99

PHYSICS 11

TOPIC TEST: ELECTRICITY

1. In order to clean the dust off a CD you rub it with a tissue. A few seconds later it is worse than before you wiped it. Why?

A static charge is built up on the CD due to the wiping process. This attracts the dust particles to the surface.

(2)

2. A 1.50 V battery in a portable cassette player is rated at 1.00 A h.

(a) What is the total amount of charge which can be moved through this battery before its chemicals have reacted fully?

$$q = It = (1.00)(3.60\times10^3) = \underline{3.60\times10^3\ C}.$$

(2)

(b) The cassette player uses 50.0 mA altogether, to operate the earphones and the cassette motor. What is the maximum length of time that the cassette player can be used before the batteries need replacing.

$$I = \frac{q}{t} \Rightarrow t = \frac{3.60\times10^3}{50.0\times10^{-3}} = \underline{7.20\times10^4\ s}$$

(2)

(c) What is the total amount of electrical work that the battery can do before it is fully discharged?

$$W = Vq = (1.50)(3.60\times10^3) = \underline{5.40\times10^3\ J}$$

(2)

3. A student at a Scicence show notices that a small sphere stays suspended above a charged sphere for a short time. Both spheres are in a vertical tube in an "electrostatics experiment" at the show. She is told that the spheres are .720m apart and have a charge of 1.60 μC on each them and that "g" was 9.81ms-2in the room.

(a)What is the approximate mass of the small sphere?

$\left\{ F = mg \quad F = \frac{kq_1q_2}{d^2} \right\}$ (1)

$$F_e = \frac{9\times10^9 \times 1.60\times10^{-6} \times 1.60\times10^{-6}}{(0.720)^2} = 4.44\times10^{-2}\ N \quad (2)$$

(4)

$$m = \frac{F}{g} = 4.53\times10^{-3}\ kg\ (4.53g)\ (1)$$

(b) Why can this expriment only last a short time?

Difficult to keep the charge on each sphere because they could be easily earthed.

(2)

4. A cassette player's rechargeable battery supplies 12.6 joules to 10.0 coulombs of charge which pass through it. What potential difference does the battery provide?

$$V = \frac{W}{q}$$
$$= \frac{12.6}{10.0}$$
$$= \underline{1.26\ V}$$

(2)

5. The cost of electricity is 13.7 cents per kW h.

(a) What are you paying for?

A. Power
B. Voltage
C. Current
D. Energy

(1)

(b) A 1.20 kW kettle takes 4.37 minutes to boil.
How much does this cost?

$1\ kWh = 3.6 \times 10^6 J$ (1)

$$E = Pt$$
$$= 1200 \times 4.37 \times 60$$
$$= 3.15 \times 10^5 J \quad (1)$$

$$Cost = \frac{3.15 \times 10^5}{3.6 \times 10^6} \times 13.7$$
$$= \underline{\underline{1.20\ ¢}} \quad (1)$$

(3)

6. A 6.00×10^2 W microwave oven is operated using the 240 V mains supply. What current does it draw?

$$P = VI$$
$$I = \frac{6.00 \times 10^2}{2.40 \times 10^2}$$
$$= \underline{\underline{2.50\ A}}$$

(1)

7. A string of thirty 2.00 W light bulbs is used to decorate a Christmas tree. The light bulbs are connected in parallel to the 240 V mains supply.

(a) What is the total power used?

$$P_{Total} = 30 \times 2.00$$
$$= 60.0W$$

(2)

(b) What is the resistance of each light?
The fifteenth light bulb blows.

$$P = \frac{V^2}{R}$$
$$R = \frac{(240)^2}{2} = \underline{\underline{2.88 \times 10^4 \,\Omega}}$$

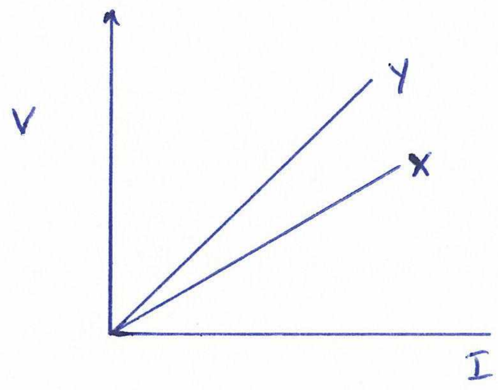
(2)

(c) What change is observed in the brightness of the other lamps?Why?

All globes remain alight. The effective resistance increases. This decreases the ~~total~~ total current flowing but it is flowing through fewer paths. Hence the current remains unchanged through each globe and the brightness is unchanged.

(2)

8. Draw a graph in the space below to illustrate Ohm,s Law for metal X and metal Y where the resistance of X is less than the resistance of metal Y.



(3)

9. A physics replacing a fuse wire in the meter box at home notices that the fuse wire was rated at 1.00X106 $^{-6}$ Ω m. He measured the length of the fuse at 7.80cm and calculated the resistance to be 18.5ohms

a) What would be his calculated value for the diameter of the fuse wire he was replacing.

$\rho = 1.00 \times 10^{-6} \Omega m$

$l = 7.80 \times 10^{-2} m$

$R = 18.5 \Omega$

$R = \frac{\rho l}{A}$

$A = \frac{\rho l}{R}$ (1)

$A = \frac{1.00 \times 10^{-6} \cdot 7.80 \times 10^{-2}}{18.5}$ (1)

$A = 4.22 \times 10^{-9} m^2$

$r = \sqrt{\frac{4.22 \times 10^{-9}}{\pi}} = \underline{3.66 \times 10^{-5} m}$ (1)

(3)

(b) If the fuse was for the power circuit in the house and the maximum current for his Carine house aws 15.0A aws his caculation for resistance correct?

$P = VI$

$V = IR$

$R = \frac{V}{I} = \frac{240}{15} = 16 \Omega$

(2)

(c) Can this fuse protected against electrocution. Why?

No. The current is simply too high for the fuse to protect humans (1)

Death can occur with a current of 200mA or more (1) (2)

(d) What is a earth leakage system?

Detects any current lost from the active-neutral circuit – most likely is a fault or a person

The device can detect and switch off power in around 20 milliseconds. (2)

10. A old torch battery has an EMF of 6.00V. The output voltage is measured at 3.40V. The current flowing in the globe is 825mA.

(a) What is the internal resistance of the battery.

$V_{out} = 3.40 V$

'$V_{internal}$' $= 2.6 V$

$\therefore I . r(internal) = 2.60 V$ (1)

$r = \frac{2.60}{0.825} = \underline{\underline{3.15 \Omega}}$ (1)

(2)

(b) What is the power output of the globe?

$P = VI$

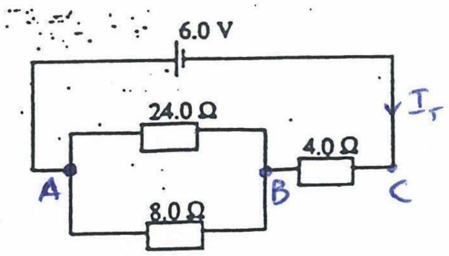
$= 0.825 \times 3.4$

$= \underline{\underline{2.805 W}}$

(2)

11. For the following circuit diagram, calculate

(a) The total resistance of the circuit



$$\frac{1}{R_{AB}} = \frac{1}{8{\cdot}00} + \frac{1}{24{\cdot}0} = \frac{4{\cdot}00}{24{\cdot}0}$$

$$\Rightarrow R_{AB} = 6{\cdot}00\,\Omega.$$

$$R_T = R_{AB} + R_{BC} = 6{\cdot}00 + 4{\cdot}00 = \underline{10{\cdot}0\,\Omega}$$

(2)

(b) The current passing through each resistor

$$I_T = \frac{V_T}{R_T} = \frac{6{\cdot}00}{10{\cdot}0} = 0{\cdot}600\,A.$$

$$V_{AB} = I_T R_{AB} = (0{\cdot}600)(6{\cdot}00) = 3{\cdot}60\,V$$

$$I_{24{\cdot}0\Omega} = \frac{V_{AB}}{R_{24{\cdot}0\Omega}} = \frac{3{\cdot}60}{24{\cdot}0} = 0{\cdot}150\,A.$$

$$I_{8{\cdot}00\Omega} = I_T - I_{24{\cdot}0} = 0{\cdot}600 - 0{\cdot}150 = 0{\cdot}450\,A.$$

$$\therefore \underline{I_{4{\cdot}00\Omega} = 0{\cdot}600\,A,\ I_{24{\cdot}0\Omega} = 0{\cdot}150\,A,\ I_{8{\cdot}00\Omega} = 0{\cdot}450\,A.}$$

(2)

(c) The power dissipated in the 8.00Ω resistor

$$P = I^2 R = (0{\cdot}450)^2(8{\cdot}00) = \underline{1{\cdot}62\ W}$$

(2)

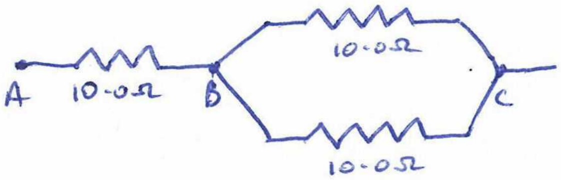
12. You are given three resistances of 10Ω each. You are asked use all three resistors and connect them in separate ways to get three different total resistances. Show your circuit connections and your calculations.

(a)

$$R_T = 10{\cdot}0 + 10{\cdot}0 + 10{\cdot}0 = \underline{30{\cdot}0\,\Omega}.$$

(2)

(b)



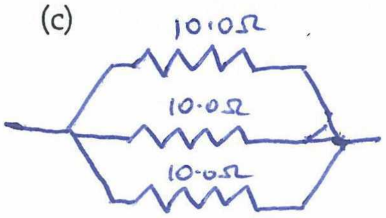
$$\frac{1}{R_{BC}} = \frac{1}{10{\cdot}0} + \frac{1}{10{\cdot}0}$$

$$\Rightarrow R_{BC} = 5{\cdot}00\,\Omega$$

(2)

$$R_T = R_{BC} + R_{AB} = 5{\cdot}00 + 10{\cdot}0 = \underline{15{\cdot}0\,\Omega}$$

(c)

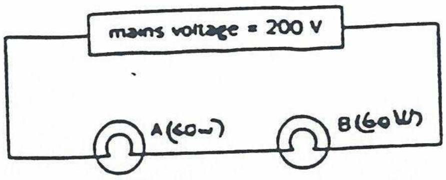


$$\frac{1}{R_T} = \frac{1}{10{\cdot}0} + \frac{1}{10{\cdot}0} + \frac{1}{10{\cdot}0}$$

$$\Rightarrow \underline{R_T = 3{\cdot}33\,\Omega}.$$

(2)

13. If two light bulbs were connected in series as shown below:



(a) What is the voltage difference across light bulb A?

$V_A = \frac{1}{2} \times V_T = \frac{1}{2}(2.00 \times 10^2) = \underline{1.00 \times 10^2\ V}.$

(1)

(b) What current goes through light bulb B?

$P = VI \Rightarrow I = \frac{P}{V}$

$= \frac{60.0}{1.00 \times 10^2} = \underline{0.600\ A}.$

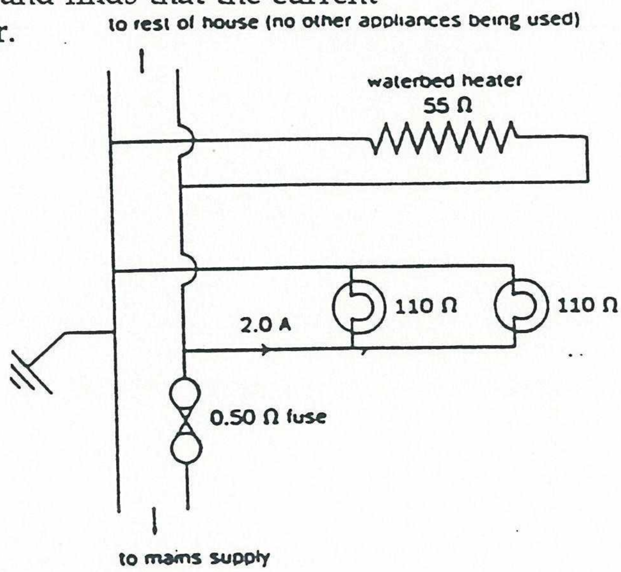
(1)

(c) What current passes through the battery?

$\underline{0.600\ A}$ (circuit is in series).

(2)

14. A fuse with a resistance of 5.00 ohm is connected as shown. A thermostatically controlled heater to the water bed and two bedside lamps are also being used. An electrician ,trying to trace a fault, uses an ammeter and finds that the current being used by the bedside lamps is 2.00 A altogether.



(a) What current goes through the water-bed heater?

(2)

(b) What current goes through the fuse?

(2)

(c) What is the mains voltage supply in this foreign country?

(2)

15. Why isn't a plastic hair dryer earthed?

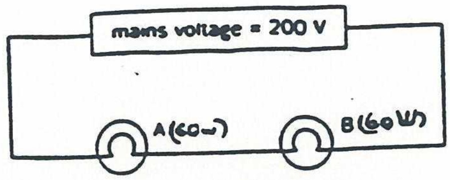
(2)

16. You hear a thump come from the lounge room.
You run in to see a person clutching a wire attached to the television. The person is in obvious distress. What should you do? Why?

(4)

END OF PAPER

13. If two light bulbs were connected in series as shown below:



(a) What is the voltage difference across light bulb A?

$V_A = \frac{1}{2} \times V_T = \frac{1}{2}(2.00\times10^2) = \underline{1.00\times10^2 \text{ V}}$

(1)

(b) What current goes through light bulb B?

$P = VI \Rightarrow I = \frac{P}{V}$

$= \frac{60.0}{1.00\times10^2} = \underline{0.600 \text{ A}}$.

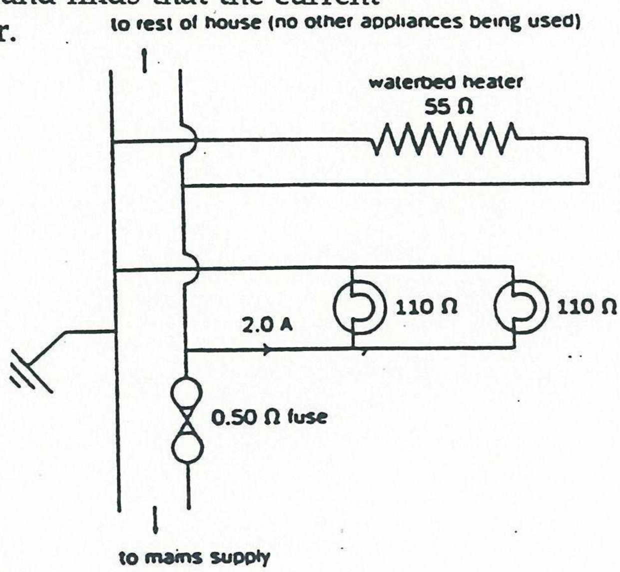
(1)

(c) What current passes through the battery?

0.600 A (circuit is in series)

(2)

14. A fuse with a resistance of ~~5.00~~ 0.500 ohm is connected as shown. A thermostatically controlled heater to the water bed and two bedside lamps are also being used. An electrician ,trying to trace a fault, uses an ammeter and finds that the current being used by the bedside lamps is 2.00 A altogether.



(a) What current goes through the water-bed heater?

$V_{heater} = V_{globes} = IR$

$= (2.00)(55.0)$

$= 1.10\times10^2$ V.

$\frac{1}{R_{globe}} = \frac{1}{110} + \frac{1}{110}$

$= \frac{2.00}{110}$.

$\Rightarrow R_{globe} = 55.0\,\Omega$.

$\therefore I_{heater} = \frac{V_{heater}}{R}$

$= \frac{1.10\times10^2}{55.0}$

$= \underline{2.00 \text{ A}}$.

(2)

(b) What current goes through the fuse?

(2)

$I_T = I_{globe} + I_{heater} = 2.00 + 2.00$

$= \underline{4.00 \text{ A}}$.

(c) What is the mains voltage supply in this foreign country?

$V_T = V_{globe} = \underline{1 \cdot 10 \times 10^2} V.$

(2)

15. Why isn't a plastic hair dryer earthed?

Everything inside is double insulated with plastic to protect the user from short circuits.

(2)

16. You hear a thump come from the lounge room.
You run in to see a person clutching a wire attached to the television. The person is in obvious distress. What should you do? Why?

(1) Turn the electricity off and pull out the plug (in case the problem originated in the socket)

(2) Use a wooden object (or an insulator of some kind) to knock the wire from their hand. This is in case their is some charge or electricity that can still flow (there shouldn't be any!). (4)

(3) Ring for the ambulance!

END OF PAPER

Solns

11 PHYSICS
HEATING AND COOLING
Short test

1. (a)Using the kinetic theory and your knowledge of heat transfer explain why scientists have been able to achieve a temperature of 0.2 K in a laboratory (2)

   (b)Also explain why they will never be able to reach 0 K. (1)

2. If a material has a property that changes with temperature it may be used as thermometer.
   List two different properties of materials which change with temperature . (2)

3. A 1.50 kg sample of a material is heated by exactly 5.00^{0}C in a small electric oven . This process requires 4.65×10^{3}J of energy .

   (a) What is the specific heat capacity of the material ? (2)

   (b)What material do you think it is ? (1)

4. A 3.14 kg metal electric kettle contains 1.17×10^{3} mL of water and both are at room temperature of 17.9^{0}C. The kettle is switched on and left on for 10.4 minutes. What is the final temperature if heat is supplied at 2.16×10^{2} Js^{-1} to the kettle. Ignore heat loss to the surroundings.

   $C_{metal} = 4.21 \times 10^{2} J\ kg^{-1}\ K^{-1}$
   $C_{water} = 4.18 \times 10^{3} J\ kg^{-1}\ K^{-1}$

   (3)

5. If a student starts with 227g of ice at -17.8^{0}C and adds 7.21×10^{5} J of heat to the ice using a hot plate (Ignoring the heat absorbed by the container) .Calculate the final temperature of the steam produced by the heating process.(Assume no steam escapes)

   $L_v = 2.25 \times 10^{6}\ Jkg^{-1}$
   $C_{water} = 4.18 \times 10^{3} J\ kg^{-1}\ K^{-1}$
   $C_{ice} = 2.10 \times 10^{3} J\ kg^{-1}\ K^{-1}$
   $L_f = 3.34 \times 10^{5}\ Jkg^{-1}$
   $C_s = 2.00 \times 10^{3}\ J\ Kg^{-1}\ K^{-1}$ (4)

11Physics TEST 1 . Heating/Cooling

1(a) As an object is cooled its temp. drops because the average E_K of the particles drop. At zero Kelvin the E_K of the particles is theorectically zero. (1)

Heat flows from "hot" objects to cooler ~~ob~~ object. Scientist have been able to cool objects to 0.2K because heat has been lost to the objects surroundings. (1)

(b) To get an object to 0K it must transfer heat to something at below zero. $\Rightarrow$ impossible (1).

2) a) volume
b) density.
c) electrical conductivity.
d) Magnetic effects. any 2 (2).
e) Colour!
f) Average E_K of particles.
g) Phase!

3)(a) $C = ?$

$M = \cancel{3.74}\ kg$

$\Delta T = 5.00\ °C$

$Q = 4.65 \times 10^3 J$

$Q = mc\Delta T$

$C = \dfrac{Q}{m\Delta T}$

$= \dfrac{4.65 \times 10^3}{1.5 . 5}$ (1)

$= \underset{\frac{1}{2}}{6.2 \times 10^2}\ \underset{\frac{1}{2}}{J Kg^{-1} K^{-1}}$ (2).

(b) Some sort of metal or alloy. (1)

(4) Q supplied $= \text{Rate} \times \text{time}$

$= 2.16 \times 10^2 \times 10.4 \times 60$

$= 134784\ J$ (1)

$1.17 \times 10^3\ mL = 1.17\ Kg\ (H_2O)$

$Q = mc\Delta T_{metal} + mc\Delta T_{H_2O}$ ($\frac{1}{2}$)

$134784 = 3.14 \cdot 421\,\underbrace{(T - 17.9°C)}_{\Delta T} + 1.17 \times 4180 \times \underbrace{(T - 17.9°C}_{\Delta T}$

$134784 = 1321.94\ \Delta T + 4890.6\ \Delta T$ ($\frac{1}{2}$)

$134784 = 6212.5\ \Delta T$

$\Delta T = \dfrac{134784}{6212.5}$

$= 21.7°C$ ($\frac{1}{2}$).

$\therefore$ FINAL TEMP $= 21.7 + 17.9$

$= \underline{39.6°C}$ ($\frac{1}{2}$) 3

(5) $m = 0.227\ Kg$.

$Q = mc\Delta T_{ICE} + mL_f + mc\Delta T_{H_2O} + mL_v + mc\Delta T_{s(}$

$7.21 \times 10^5 = 0.227 \times 2.1 \times 10^3 . 17.8 + 0.227 \times 3.34 \times 10^5 + 0.227 \times 4180 \times 10($

$+ 0.227 \times 2.25 \times 10^6 . \Delta T$

$7.21 \times 10^5 = 8485.3 + 94886 + 75818 + 510750 + 454\ \Delta T\ (1$

$454\ \Delta T = 721 \times 10^5 - 689939.3$ ($\frac{1}{2}$)

$= 31060.7$

$\Delta T = \dfrac{31060.7}{454}$

$= 68.4°C$ (1)

$\therefore$ FINAL TEMP $= 168.4°C$ ($\frac{1}{2}$). 4

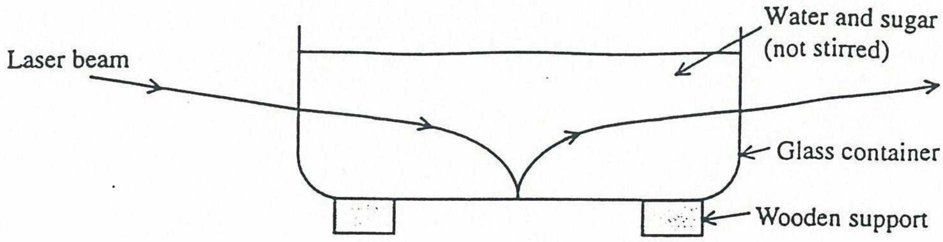
JR-99

YEAR11PHYSICS

TEST: Sight and Light

1.

A chemistry student who was investigating the solubility of sugar cubes in water with time and without stirring the water noted the following:
"While I was waiting for the sugar cubes to dissolve, and when they were almost dissolved, I directed a narrow red coloured laser beam into the solution as shown in the diagram below. To my surprise it did not pass through the solution in a straight line but bent down to the bottom of the container, reflected off the bottom of the container and then slightly bent down again before leaving the container."



Explain why the laser beam was observed to:

a) bend down after entering the solution.

(2)

b) reflect off the bottom of the container; and

(2)

c) bend downwards after reflecting off the bottom of the container.

(2)

2. Why is it not possible to see an image of yourself off a sheet of clean white paper?

(2)

3 a) Under what conditions does total internal reflection occur.

(2)

b) Calculate the critical angle for a transparent solid-air surface if the ray of light in the solid is incident at an angle of 35^0 and deviated through 16^0.

(3)

4) A ray of light is incident at an angle of 50.0^0 to the glass wall of a cube shaped aquarium. At what angle to the glass will the light enter the water?
$n_{air}=1.00$ $n_{glass}=1.50$ $n_{water}=1.33$

(4)

5. A man stands in front of his shaving mirror and is suprised by what he sees. The focal length of the mirror is 60cm , and he is standing 1.5m from its pole. Use a ray diagram to explain what he sees and why it is difficult for him to shave.(Use graph paper)

(5)

6. Explain the following situations.

(a) A red block under white light is red.

(2)

(b) A green block in red light is black.

(2)

(c) White light shone through a blue filter, then a red filter, gives no light.

(2)

7. A person looks up at a security mirror while in a deli. The mirror is use by the owner instead of a video camera and it has a centre of curvature of 1.00m If the person is standing 4.50m from the mirror andshe was 1.66m high. How tall would she appear in the mirror?

(4)

8. An astonomer used a 35.0mm slide in a slide projector to show the audience a photo of Mars. The screen was 4.44m from the projector lens which had a focal length of 8.20cm.

a) How far from the lens was the slide positioned ?

(3)

b) To accommodate the complete image, how wide was the screen?

(2)

c) Would the astronomer have to invert the slide when inserting it into the projector. Explain

(2)

9. Explain chromaic abberation in a lens.

(2)

10. How does the eye change when looking at objects that are at a distance and objects that are in close?

(2)

11. In an eye defect the image formed by the eye is 2.20mm behind the retina.

a) What is this disorder called ? (1)

b) With the aid of diagrams explain how this eye defect can be corrected

(3)

(3)

JR-99

YEAR 11 PHYSICS

TEST : SIGHT AND LIGHT

1. (a) The sugar concentration is greater near the bottom so the refractive index is greater here.
As the light enters the water, it slows down and refracts towards the normal. This continues as it travels towards the bottom. (2)

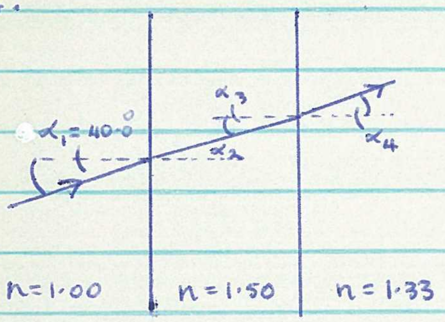
(b) The laser is travelling from the optically more dense medium out into the air.
It hits the interface at an angle greater than the critical angle and totally internally reflects. (2)

(c) The reverse of part (a) occurs - the refractive index decreases as the light nears the surface.
Hence it speeds up and refracts away from the normal. (2)

2. The light from your body which strikes the paper is scattered in all directions (diffuse reflection). Hence the rays do not form an image. (2)

3. (a) Light must:
(i) travel from optically more dense to less dense medium.
(ii) strike the interface at an oblique angle greater than the critical angle. (2)

4.



FIRST INTERFACE

$$n_{1\to 2} = \frac{n_2}{n_1} = \frac{\sin\alpha_1}{\sin\alpha_2}$$

$$\Rightarrow \frac{1.50}{1.00} = \frac{\sin 40.0°}{\sin\alpha_2}$$

$$\Rightarrow \alpha_2 = 25.37° = \alpha_3 \qquad (2)$$

SECOND INTERFACE

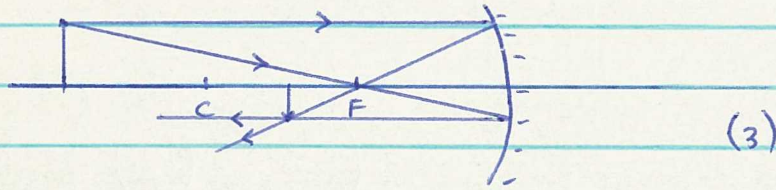
$$n_{1\to 2} = \frac{n_2}{n_1} = \frac{\sin\alpha_3}{\sin\alpha_4}$$

$$\Rightarrow \frac{1.33}{1.50} = \frac{\sin 25.37°}{\sin\alpha_4}$$

$$\Rightarrow \alpha_4 = 28.90°$$

$\therefore$ Ray enters water at 61.1° to the glass face. (2)

5.



(3)

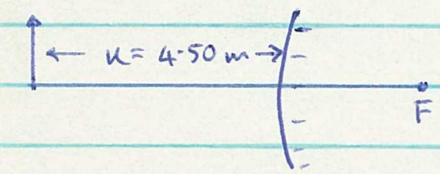
The image is real but it is much smaller and inverted. He would have no chance of shaving successfully. (2)

6 (a) Red block reflects red light so it appears red.

(b) Green block reflects green light. Red light is absorbed so the block appears black.

(c) Blue filter lets blue light through. The red filter blocks blue light so no light makes it through. (6)

7.



$r = 1{\cdot}00\,m$

$\Rightarrow f = 0{\cdot}500\,m$ (1)

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$\Rightarrow -\frac{1}{0{\cdot}500} = \frac{1}{4{\cdot}50} + \frac{1}{v}$$

$$\Rightarrow v = -0{\cdot}450\,m$$

(2)

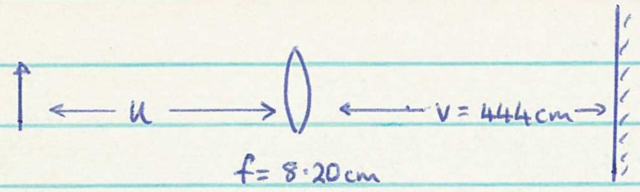
$$m = \left|\frac{v}{u}\right| = \frac{h_i}{h_o}$$

$$\Rightarrow \frac{0{\cdot}450}{4{\cdot}50} = \frac{h_i}{1{\cdot}66}$$

$$\Rightarrow h_i = 0{\cdot}166\,m$$

$\therefore$ Height of image $= 0{\cdot}166\,m$. (1)

8.



(a) $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\Rightarrow \frac{1}{8{\cdot}20} = \frac{1}{u} + \frac{1}{444}$

$\Rightarrow u = 8{\cdot}354\text{cm}$

$\therefore$ Slide is 8·35cm from the lens. (3)

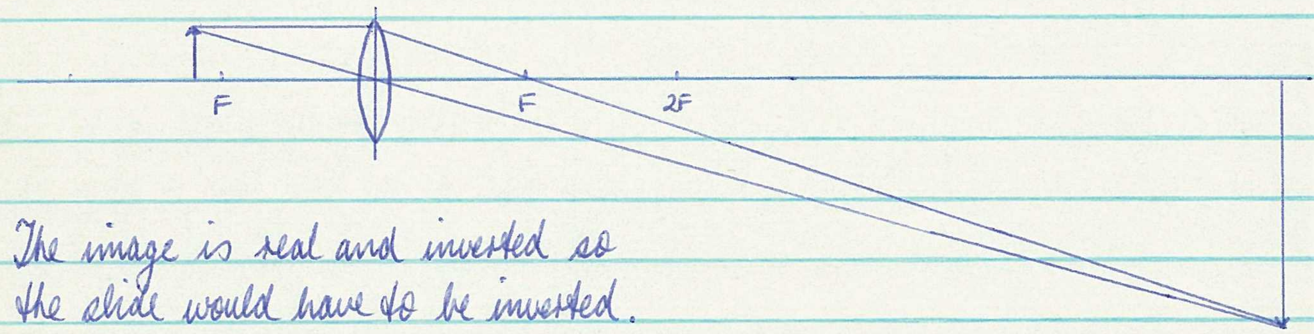
(b) $m = \left|\frac{v}{u}\right| = \frac{h_i}{h_o}$

$\Rightarrow \frac{444}{8{\cdot}354} = \frac{h_i}{3{\cdot}50}$

$\Rightarrow h_i = 186{\cdot}0\text{ cm}$

$\therefore$ Screen is 1·86 m wide. (2)

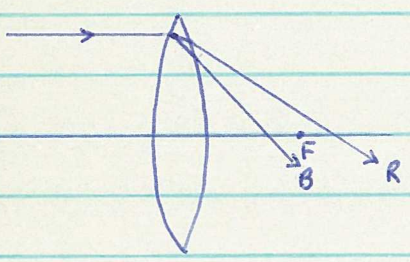
(c)



The image is real and inverted so the slide would have to be inverted.

(2)

9.

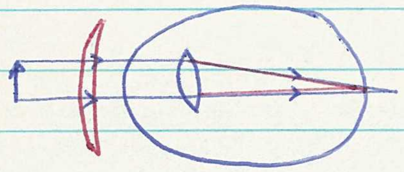


Light hitting the lens near the edge splits up into the component colours, causing the image to have colour fringes.
This occurs since each colour travels at a different speed to the others, causing each to refract a different amount. (2)

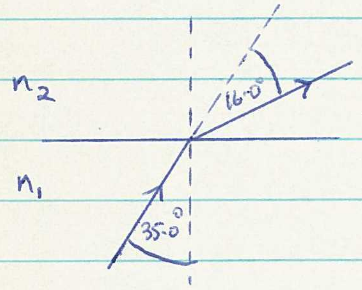
10. DISTANCE: ciliary muscles relax and the lens is thin (larger focal length)

CLOSE: ciliary muscles fatten the lens (smaller focal length). (2)

11. (a) hypermetropia (long-sightedness) (1)

(b) 

A convex lens is used to concentrate the light rays a little, focussing them onto the retina. (3)

3 (b) 

$$n_{1\to 2} = \frac{n_2}{n_1} = \frac{\sin\alpha_1}{\sin\alpha_2} = \sin\alpha_c$$

$$\Rightarrow \frac{\sin 35.0°}{\sin 51.0°} = \sin\alpha_c$$

$$\Rightarrow \alpha_c = 47.57°$$

$\therefore$ Critical angle = $47.6°$ (3)