Physics Year 11

Homework 10

January 2018 Paper 1

Question 1

a. In solar cells, the **light** of the rays of the Sun is transferred to **electrical** energy.

b. i. As we recall current is the rate of charge. This means that:

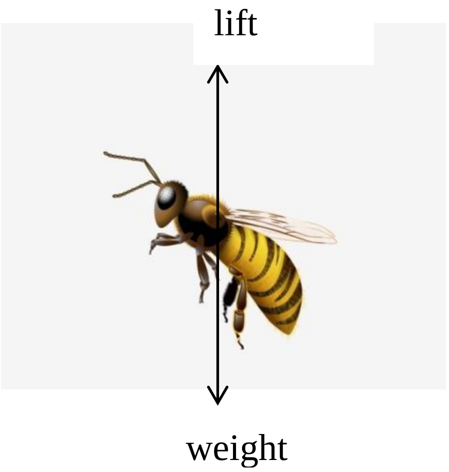
$\mathbf{I} = \frac{Q}{t}$ OR **current** = $\frac{charge}{time}$.

ii. Q = I x t = 2.3 A x 15 = **34.5 C**.

Just like the simple idea of the operation of lamps in a circuit, likewise the cells are connected in parallel in case one of them is malfunctioning, the rest should keep producing electricity BUT most important channel/provide this produced electricity through a closed circuit.

Question 2

a.



b. i. According to the graph, the bee stops at stage 'B' for 8 seconds and at stage 'D' for 10 seconds. So your answer is: **B**.

ii. Again according to the graph, the bee moves during stages 'A' and 'C'. Obviously, the greatest speed is obtained during stage **A**.

iii. the equation required is: **(average) speed** = $\frac{distance\ (moved)}{time\ (taken)}$.

iv. From the graph we see that for the first 35 seconds, the bee has moved 20 m.

hence $v = \frac{20\ m}{35\ s}$ = **0.57 m/s**.

c. i. Ultra violet waves can be used as:

killing bacteria
cosmetic reasons (tanning lamps)
treatment of skin conditions/cancer.
fluorescent tubes (see p. 107 & 100)

ii. similarity: both in the EM Spectrum/travel with speed of light/transverse waves

difference: different frequency/ different wavelength

Question 3

Write three of the following factor that can affect your **braking** distance:

Thinking distance: intoxication (medical drugs/alcohol), mobile talking or texting/web-surfing, loud music, poor sleeping/exhaustion/body fatigue.

Braking distance: poor tyre condition, poorly serviced car (especially for brakes and brake pads), bad weather conditions (rain or snow), size of the vehicle (bigger truck needs more distance to stop due to high momentum/kinetic energy), speed (again high-speed car needs more distance to stop due to high momentum/kinetic energy).

Question 4

The student only needs to find the volume V of the bolt so it can use it for the equation $\boldsymbol{\rho} = \frac{\boldsymbol{m}}{\boldsymbol{V}}$ and calculate the mass. In order to find the volume of a geometrically complicated component such as a bolt, we need to use the **displacement method**. (see Practical on Page 174 of the textbook/Archimedes crown example). So we immerse the bolt to a container full of water and we measure the volume of the water displaced by this immersion.

<u>Question 5</u>

a. From the diagram we see that trough the walls we lose 25% of the **thermal losses/day**. This means that for a whole week the thermal energy losses through the walls will be:

$$1.2 \text{ x } 10^{7} \text{ Joules x } 0.25 \text{ x } 7 = \mathbf{21.000{,}000\ J} = 21 \text{ MJ.}$$

b. By introducing **double glazing** windows and dress them up with **curtains**.

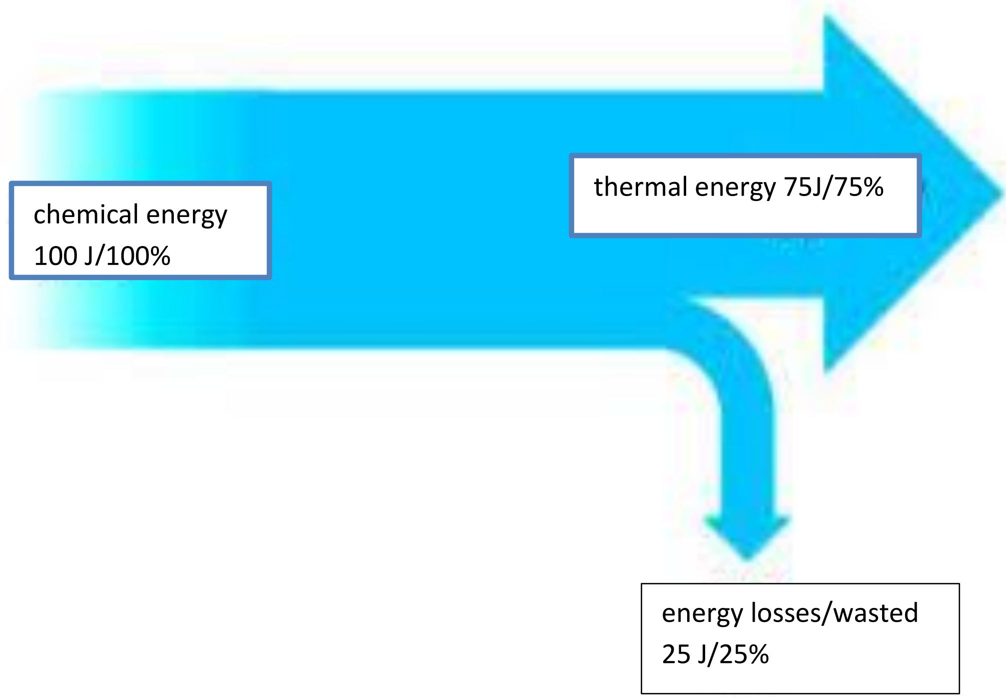
c. You need to mention:

air is a good thermal insulator

fiber glass is a good insulator

warm air from inside is trapped and in turn gives more warmth, so it is stopped form executing any further conduction towards the air outdoors.

d. Our Sankey diagram will look like this:



Question 6

a. Roughly draw it at the centre of its profile/side view at the begibing of the weight arrow.

b. i. $\boldsymbol{p = \frac{F}{A}}$ OR $\boldsymbol{pressure = \frac{force}{area}}$

ii. The weight/force on each foot will be $\frac{370\ N}{4}$ = **92.5 N**. This means that for every foot the pressure will be:

$p_{foot} = \frac{92.5\ N}{5.2\ cm^2}$ = **17.79 Ncm^{-2}**.

c. Provided the **surface of the cup is larger than 5.2 cm^2** and that the weight of the chair does not increase (**force is constant**), the more we increase the denominator, the less the pressure of each of the feet of the chair on the floor.

Question 7

a. i.

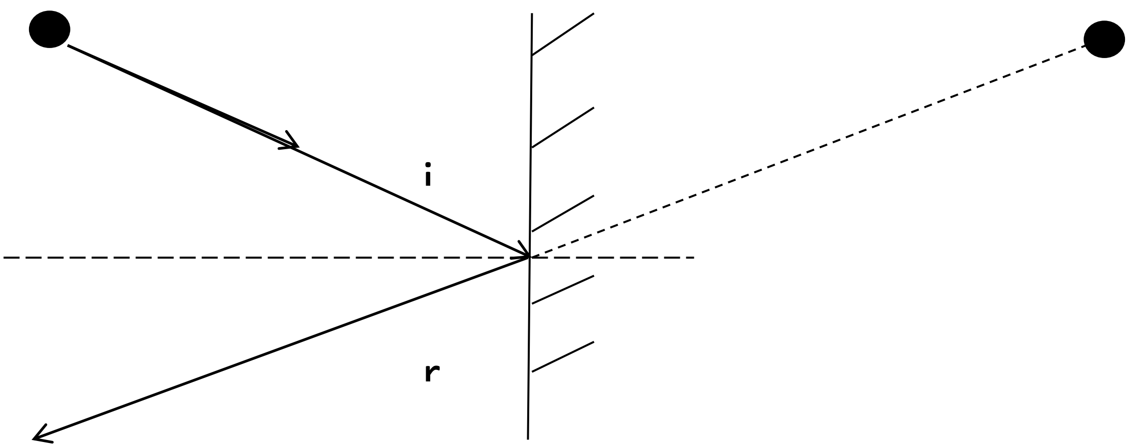
moment = force x (perpendicular) distance

ii. M = F x d so F = $\frac{M}{d} = \frac{4.8\ Nm}{0.40\ m}$ = **12 N**.

b. If we want to double the moment to 9.6 Nm we either double the length of the spanner to 1 m which will give us the (double) **perpendicular distance** of the force to the pivot equal to **0.80 m**, **OR** we just double the force to **24 N**.

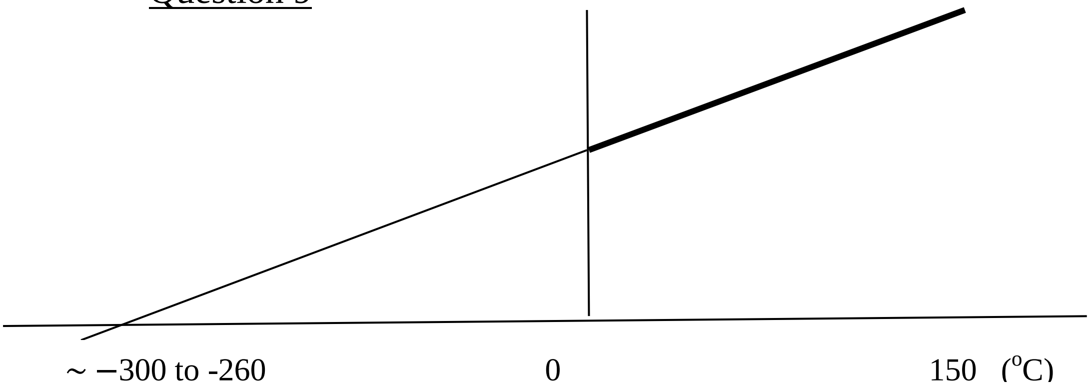
Question 8

a. The image should look like this: (NO MARK)



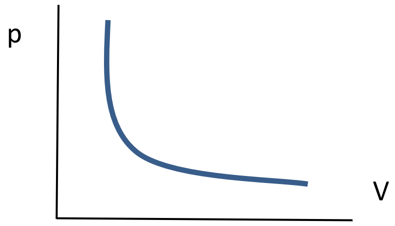
b. **virtual** image (NO MARK)

Question 9



a. i. Within the range of **-300 to -260 °C**.
ii. When temperature increases, molecules gain thermal energy and convert it to **kinetic energy**, i.e. their **speed increases**.

b. i. The two variables that she must control for this experiment are: the **temperature** and the **amount/mass of the gas**.
ii. According to **Boyle's Law**:
pV = constant/ more volume means less pressure and vice-versa.



Question 10

a. Any two of the following:
The orbit of a comet is **highly elliptical** while the orbit a moon is more like circular
Comets orbit the **Sun** while moons orbit a **planet**
A moon has **constant speed** but a comet has **variable speed** (as it approaches the Sun)

b. i.

$E_p = m \times g \times h$ OR **potential energy = mass x g x height**

ii. $h = \dfrac{E_p}{m\ x\ g_{moon}} = \dfrac{2.2\ N}{0.75\ kg\ x\ 1.6\ N/kg}$ = **1.83 m**.

iii. The work done is equal to the potential energy at this height, that is **2.2 J**.

iv. Because W = m x g x h (=E_p) where the 'g' (gravitational force) is greater on Earth/ more weight hence more effort.

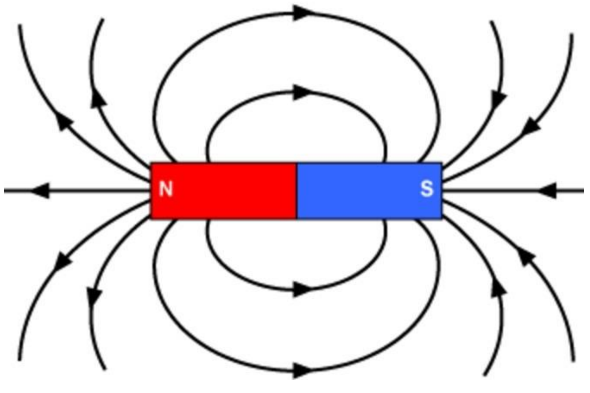
c. For one day the ISS would have taken:

$v = \dfrac{2x\ \pi\ x\ R}{T}$ so T = $\dfrac{2\ x\ \pi\ x\ 6780\ km}{7.66\ km/s}$ = **5558.56 s** which is the time taken to complete one full orbit. During a day the space station orbits the Earth:

$\dfrac{24\ x\ 60\ x\ 60\ s}{5558.56\ s} = \dfrac{86400\ s}{5558.56\ s}$ = **15.54 times**.

Question 11

a. Similarly to the lab on magnetism, we use an **A4 blank page** to cover the magnet and we smear **iron filings** on top of it to determine the lines of the magnetic field. We then use a number of simple **compasses** to determine on which end of the magnet is **North** and **South** poles.



b. Because the flux (magnetic field) lines are so close, **parallel** and **evenly spaced** to each other that it is so **homogeneous** and uniformly distributed.

c. i. Because by moving the wire (conductor) into the magnetic field, we **induce** the flow of **current**. This is because each free electron in the wire experiences a force (remember Fleming's 3 finger rule/left hand) which makes it move through the wire so a small current flows through it.

ii. If we want to increase the current we either:

1) move the magnet **faster**

2) introduce **more coils**

3) use a **more powerful magnet**

Question 12

Write three of the following:

Brownian motion/ erratic random movement of microscopic particles in a fluid, as a result of continuous bombardment from molecules of the surrounding medium (pages 181 and 183 of the Textbook)

continuous change of direction of the pollen on the water

particles of a liquid (water)

talk about continuous collisions with each other

Question 13

a. She would need a **Geiger-Muller tube** for counting the radiation and a **stopwatch** to time her measures.
b. i.

	Alpha	**Beta**	**Gamma**
Source 1			√
Source 2		√	
Source 3	√	√	

ii. This extra count that seems (actually is) to be the same is the **background radiation**.
c. i. The half-life of a radioactive substance is a characteristic constant. It measures the **time** it takes for a given amount of the substance to become **reduced by half** as a consequence of decay, and therefore, the emission of radiation.
ii. Since we have half-life of 6 days, it means that:

After 6 days the count will fall to 390 counts/min, and after 6 days it will be down to 195 counts/ min. After another 6 days (total of **18 days**) the count/min will be 97.5. So it's 18 days OR three half-lives.

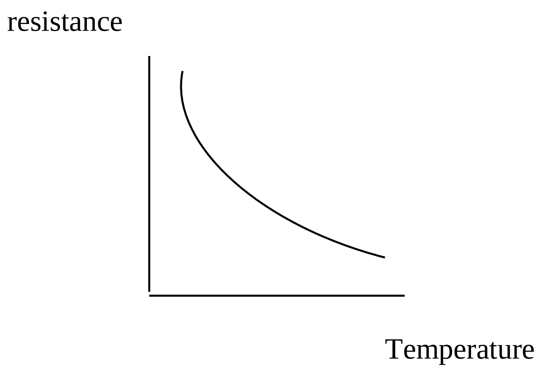
Question 14

a. The correct symbol for a thermistor is **C**.

b. i) Independent variable is **temperature**.
Dependent variable is **resistance**.

(**Note**: for better understanding of **dependent** and **independent variables** in an experiment, see YouTube video: 'What Are Independent, Dependent And Controlled Variables?' (by HighSchoolScience101)

iv. For 40^{o} C we should have a value within the range of **420 – 480 Ω**.



v. Improvements would include 3 of the following 5:

1) use of greater range of temperature

2) repeat readings and use average values

3) try to measure temperature or resistance with greater accuracy

4) try to fill the wide temperature gaps/changes with more in-between measures

5) place thermometer as close as possible to the thermometer to obtain more accurate temperature readings

c. i. This is Ohm's Law: $R = \frac{V}{I}$ OR

$$\textbf{resistance} = \frac{\boldsymbol{voltage}}{\boldsymbol{current}}.$$

ii. From the equation of Ohm's Law, we have:

I = $\frac{6.10\ V}{1060\ \Omega}$ = 5.75 x 10^{-3} A = **5.75 mA**.

iii. If you recall the basic operation of a thermistor (see page 80 of your textbook), the more the temperature introduced the less the resistance will result. This means an increase of flow of electrons i.e. an **increase of current**.