Answer Six Questions Out of Nine
JUNE 2006

1. a) A car moves from rest with a constant acceleration of $4ms^{-2}$ for 5s. it the continues with the speed attained for 10s and then accelerates at $12ms^{-2}$ for 10s.

i. Explain the underlined phrase. (2marks)

ii. Sketch a speed time graph for the whole motion, giving values on both axes (3marks)

iii. Calculate the average speed of the car during the motion (3marks)

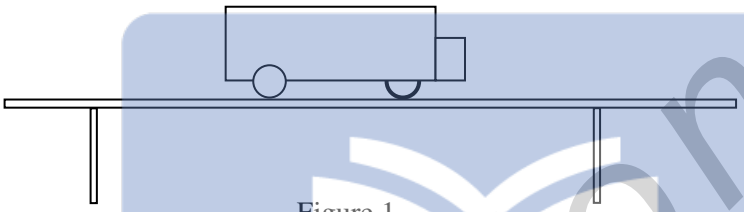

Figure 1

Figure 1 shows a wooden trolley, stationary on a table top. A pellet fired horizontally from an air riffle hits the trolley with a velocity of 120m/s and remains in the wood. The mass of the trolley is $2.63x10^{-1}$kg and 100 pellets have a mass of 0.11kg. if the trolley travels a distance of 1m in 2s after the pellet strikes it;

i. Describe how the table can be compensated for friction (2marks)

ii. Explain why measuring the mass of 100 pellets and calculating the mass of one is better than measuring the mass of one pellet directly (1 mark)

iii. State the law of conservation of linear momentum (2 marks)

iv. Show by calculation that the law holds for this situation (4 marks)

2. a) Figure 2 shows a pulley system used to draw water from a well 8m deep. The bucket has a volume $0.001m^3$

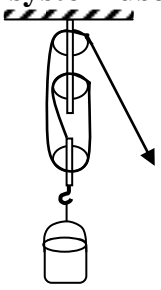

Figure 2

i. **What length of rope must be pulled to raise a bucket full of water out of the well?(2 marks)**

ii. **If the mechanical advantage of the system is 2.4 and the density of water is 1000kgm^{-3}. What effort would be needed to just raise a bucket full of water out of the well? (Ignore the weight of the bucketitself) (4marks)**

iii. **Calculate the efficiency of the system (2 marks)**

iv. **Suggest two reasons for the efficiency being less than 100% (2 marks)**

b) A car that would not start is given a gentle push and then released

i. **State Newton's first law of motion (2 marks)**

ii. **Explain whether or not Newton's first law of motion holds in this situation (2 marks)**

iii. **Briefly describe a motion that easily illustrates Newton's first law (3 marks)**

3. a) Figure 3 below shows the aerial view of water in a ripple tank. The base of section B of the tank is raised by a thick sheet of glass and waves produced by a dipper are travelling as shown

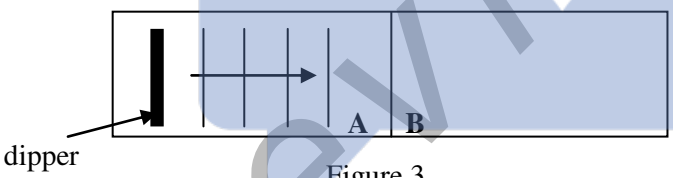

Figure 3

i. **Copy the figure and draw the wave pattern you would expect in section B (1 mark)**

ii. **Name the phenomenon illustrated by this and explain the cause (2 marks)**

iii. **State two factors that remain the same as the wave passes from section A to section B and explain why they do not change (3marks)**

iv. **Find the separation between two successive troughs in section B, given that the separation in section A is 3cm and he refractive index of the medium is 4/3 (2marks)**

b) Figure 4 below represents the displacement- time trace for a note from a signal generator

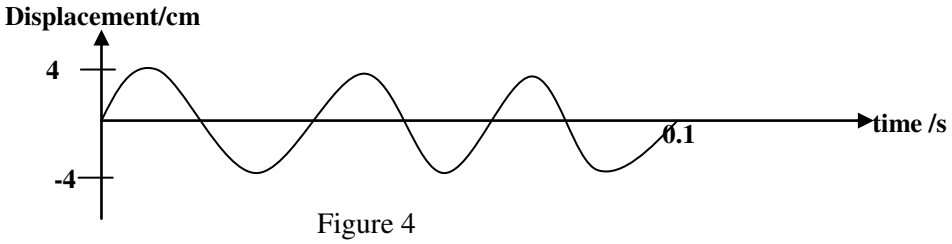

Figure 4

i. **What is the frequency of the note?**
(2marks)

ii. **Sketch the trace for a note with half the pitch of the note represented by the trace above (2marks)**

iii. **Sketch the trace for the note with twice the intensity of the note represented by he trace above (2 pts)**

c) **The electromagnetic spectrum consists of different sections having different properties**

i. **Name one of these sections**
(1mark)

ii. **Give the use of the named section and state the property on which each depends**
(2marks)

4. a) **You are provided with a calorimeter and stirrer of heat capacity C, a balance, a stop watch, a thermometer and a heating coil of known power rating P. you are required to measure the specific heat capacity c, of a liquid**

i. **Draw a set up of the apparatus properly assembled to carry out the experiment**
(2marks)

ii. **List the measurements you would take**
(2marks)

iii. **Show how you would use these measurements to find the specific heat capacity of the liquid (1pt)**

iv. **State one likely source of error in this experiment**
(2marks)

b) **Figure 5 shows how the temperature of 0.05kg of benzene varied with temperature during an experiment when heated by a 25W electric heater**

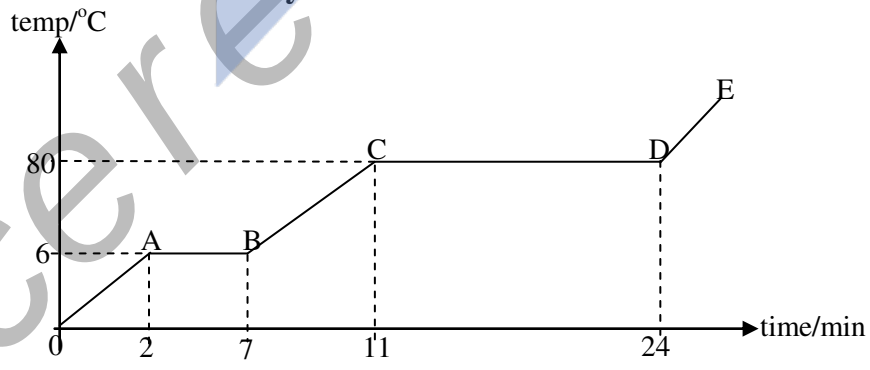

Figure 5

i. **What are the states of benzene in the interval AB and CD?**
(2marks)

ii. **Explain why the length CD is greater than AB**
(3marks)

iii. Calculate the energy supplied by the heater in the interval OA
(2marks)

iv. Calculate the specific heat capacity of <u>liquid</u> benzene.(Assume the power of the heater is constant)
(3marks)

5. a) Gas molecules are invisible but are known to be in a state of continuous motion

i. Draw a diagram to show the path of a single molecule in gas. Explain why the path is as shown (2pts)

ii. Describe an every day observation which gives evidence about the way gas molecules behave (2pts)

iii. What would be the effect of an increase in temperature o the observation in (ii) above?(2marks)

iv. What would be the effect of an increase in pressure on the observation in (ii) above? (2marks)

b) State the relationship between pressure of a fixed mass of gas and its temperature (2marks)

c) An air bubble released from a drivers suit deep under water has a volume of $2.5x10^{-6}m^3$ just as it burst out of water
(2marks)

i. Explain why the volume of the bubble increases as it rises
(2marks)

ii. Determine the depth at which the diver is, if atmospheric pressure is equivalent to 10m depth of water
(4marks)

iii. State any assumption made in your calculation
(1mark)

6. a) A plane mirror and a convex lens both use light to form images

i. Name the effect of each on the light in the process of forming the image
(2marks)

ii. Name one instrument that uses a convex lens
(1mark)

b) i. Distinguish between real and virtual images
(2marks)

ii. Draw ray diagrams to show how a converging lens can form (4marks)
- A real image
- A virtual image

c) Figure 6 shows a ray of white light striking one face of a triangular glass prism whose refractive index is 1.55 for red light

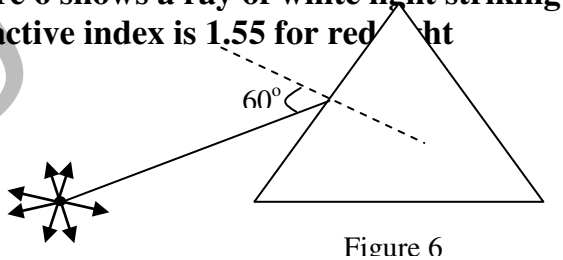

Figure 6

i. **Copy and complete the diagram with rays to show how the prism produces a spectrum of the white light. Label the red and violet colours in the spectrum (3marks)**

ii. **The spectrum above is said to be impure. Explainwhy (1mark)**

iii. **Describe how you would produce a pure spectrum using the above prism and any other item(s)**
In your description list the additional equipments and explain their functions (4marks)

7. **a). Figure 7 below shows two charged metal plates A and B having equal but opposite charges.**

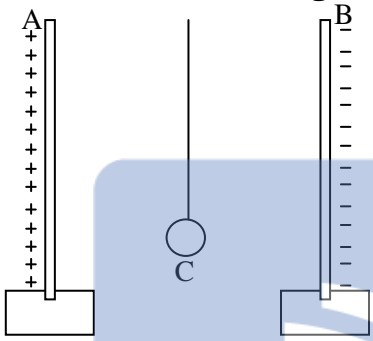

Figure 7

C is a light weight conducting sphere hanging from an insulated thread
State and explain what happens when;

i. **The sphere is suspended midway between the plates (2marks)**

ii. **The sphere touches plate A (2marks)**

b)

i. **State how the resistance of a material in the form a wire depends on its length and its cross sectional area (2marks)**

ii. **State one other factor which affects the resistance of the material (1mark)**

c) You are required to investigate how the potential difference across a torch bulb varies with the current flowing through it

i. **Draw a labeled diagram of the circuit you would use (3marks)**

ii. **Sketch a graph of current against voltage you are likely to obtain (2marks)**

d) Figure 8 shows a net work of resistors connected to a 12V battery

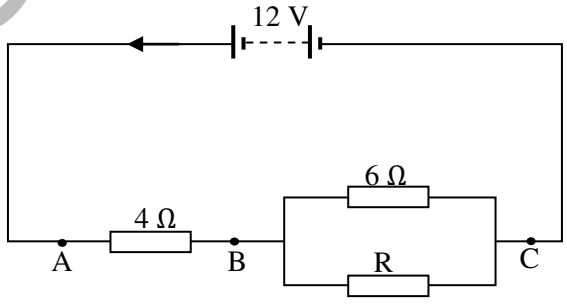

Figure 8

Calculate

i. **The potential difference between B and C** **(1mark)**
ii. **The current through the 6Ω resistor** **(2marks)**
iii. **The value of the resistor R** **(2marks)**

8. **a). Figure 9 shows a rectangular coil ABCD carrying current I and lying horizontally between the poles of a powerful magnet. The coil is free to turn about the axis XY**

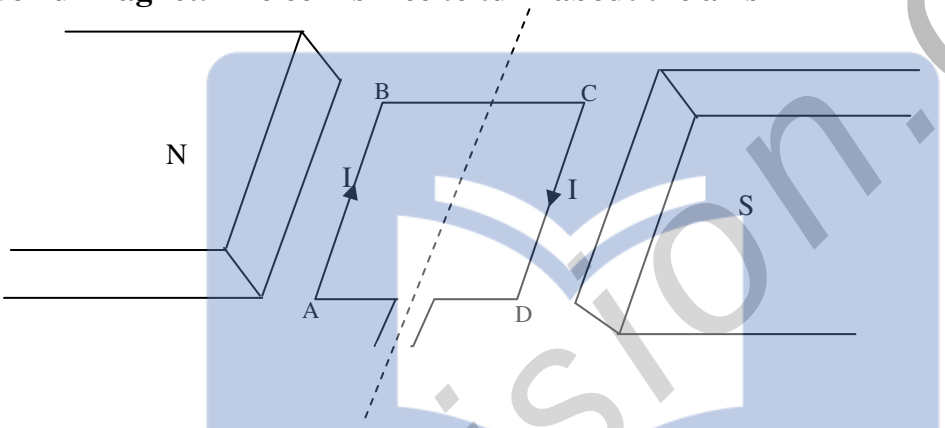

Figure 9

i. **Describe the direction of the forces on the sides AB and CD of the coil due to the current in it (2marks)**
ii. **Name the rule which enabled you to determine the direction of these forces (1mark)**
iii. **Name two ways of making these forces stronger (2marks)**
iv. **Name two electrical devices whose functioning depends on the rotation of a current carrying coil in a magnetic field (2marks)**

SONEL uses both step up and step down transformers in the transmission of electrical energy through high tension cables from the power station to the consumers

i. **State and explain what type of transformer is used at each end of the high tension line (4marks)**
ii. **Describe any design of the high tension cable that helps to reduce the power lost during transmission (2marks)**

b. A domestic transformer draws a current of 0.6A from a 240V mains supply to light five 12V, 20W lamps connected in parallel. Calculate

i. **The power input of the transformer**
(1mark)

ii. **The power output of the transformer**
(1mark)

iii. **The efficiency of the transformer**
(2marks)

9. **Uranium $^{235}_{92}U$,is known to disintegrate when bombarded with a neutron $^{1}_{0}n$, into two nuclides which may be represented with he symbols $^{A}_{56}X$, and $^{92}_{B}Y$, with the release of three other neutrons**

i. **Write a nuclear equation representing the above reaction**
(1mark)

ii. **Determine the value of A and B**
(2marks)

iii. **Write down the name of this kind of reaction**
(1mark)

iv. **Why is energy always released by a radioactive nucleus as it disintegrates?**
(2marks)

b) The following results were obtained using a Geiger Muller counter to study the activity of a radioactive substance which emits beta particles

Time/s	20	40	60	80	100	120	`140	160
Activity/counts per s	150	124	104	85	70	58	48	40

i. **Plot a graph of activity (y-axis) against time(X-axis)**
(4marks)

ii. **Use the graph to determine the time taken for the activity to fall from 100 counts to 50 count/s**
(2marks)

iii. **Give the name for the value calculated in (b) ii above**
(1mark)

c) Figure the 10 below shows the trace on the screen of a cathode ray oscilloscope (CRO) connected across component in a circuit

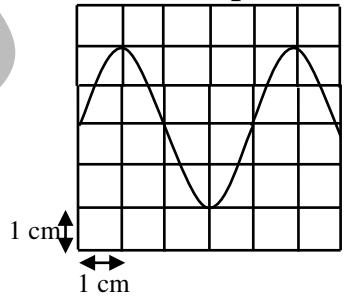

Figure 10

If the Y-gain control is set at 2V/cm while the time-base control is set at 5ms/cm. calculate;

i. **The p.d across the component**
(2marks)

ii. **The frequency of the signal in the component**
(2marks)