2010

1 (a) A plastic balloon is filled with hydrogen and its mouth tied. It is next rubbed on the sleeves of a shirt and released into the air in a room. It is seen to rise

(i) Draw and show all the forces acting on the balloon as it rises. (3 marks)
(ii) Explain why it rises. (2 marks)
(iii) The balloon ends up sticking on the ceiling. Explain why. (2 marks)
(iv) What would be the observation if the balloon were instead filled with air before releasing it? Explain. (2 marks)
(v) Using your answer in (iv) above, compare the density of air and that of hydrogen. (1 mark)
(vi) The rope used in tying the mouth of the balloon loosens and the air rushes out upward. In which direction will the balloon move? Explain. (3 marks)

(b) Figure1 shows a metre rule pivoted at its centre of gravity using a 2 N load, a 6 N load and a tension X in a rope to keep the metre rule balanced horizontally.

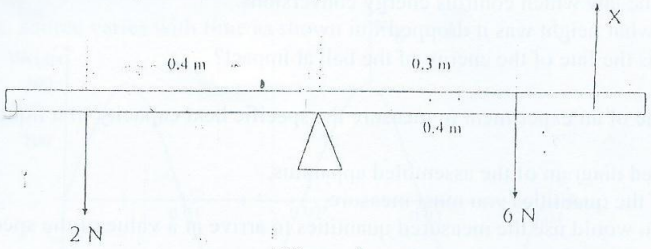

Figure 1

(i) State the principle of moments. (1 mark)
(ii) Calculate the moment of the 2 N and 6 N forces respectively about the pivot. (2 marks)
(iii) Using your answer in (ii) above, determine X. (2 marks)
(iv) What is the reaction of the pivot on the metre rule? (2 marks)

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2 (a) The graph in Figure 2 represents the journey of a woman from her house to her office.

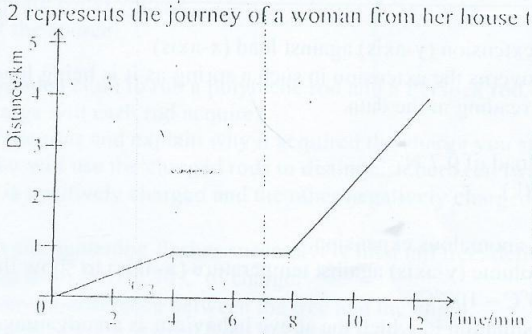

Figure 2

(i) Determine her speed during the first 4 s. (3 marks)
(ii) For how long was she caught by traffic lights? Explain. (2 marks)
(iii) Calculate the average speed during the whole journey (2 marks)
(iv) Calculate the average speed if there were no traffic light. Explain. (2 marks)

b) (i) State the law of conservation of linear momentum. (2 marks)
(ii) Water from a hose is sprayed onto a car to wash it. The water bounces back while the car remains stationary. State whether the law of conservation of momentum is obeyed. Explain. (2 marks)

c) A stone is thrown upward at an initial speed of 5m/s.
(i) Calculate the maximum height reached by the stone. (2 marks)
(ii) Calculate the time it takes to return to the thrower. (2 marks)
(iii) Sketch a graph showing how the speed of the stone varies with time until it returns to the thrower. Indicate important values on the axes. (3 marks)

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3. a) (i) Define work. (2 marks)

(ii) A boy carries a bag of cement from a truck and moves along a level road at uniform speed to a packing store. Explain whether or not he does work on the cement. (3 marks)

b) A ball is dropped from a certain height and it hits the ground with a speed of 8 m/s.

(i) Describe any energy changes that occur from when it is released to just before it hits the ground. (2 marks)

(ii) State the law which controls energy conversions. (2 marks)

(iii) From what height was it dropped? (2 marks)

(iv) What is the fate of the energy of the ball at impact? (1 mark)

c) Give the outline of an experiment to measure the specific heat capacity of a liquid. Your outline should consists of

(i) a labelled diagram of the assembled apparatus, (2 marks)

(ii) a list of the quantities you must measure, (2 marks)

(iii) how you would use the measured quantities to arrive at a value of the specific heat capacity; (2 marks)

(iv) One possible source of error and how its effect can be minimised. (2 marks)

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4. (a) In an experiment using a spiral sprig, the following readings were taken

Load /N	0	0.2	0.4	0.6	0.8	1.0	1.2
Extension /cm	0	1.8	3.6	5.4	6.2	9.0	10.8

(i) Plot a graph of the extension (y-axis) against load (x-axis) (5 marks)

(ii) State the law that governs the extension in such a spring as it is being loaded in small steps, hence identify any wrong reading in the data. (3 marks)

Using the graph determine

(iii) the extension for a load of 0.7 N (1 mark)

(iv) the spring constant (k). (2 marks)

(b) Water is known to have an anomalous expansion.

(i) Sketch a graph of volume (y-axis) against temperature (x-axis) to show this behaviour over the temperature range 0°C – 100°C. (2 marks)

(ii) State and explain a situation in which the above behaviour is an advantage and another in which it is a disadvantage. (4 marks)

(c) (i) Give two reasons why liquids can be used in hydraulic machines. (2 marks)

(ii) Explain why water is not used in these machines even though it is a liquid. (1 mark)

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5. (a) Explain how the kinetic theory of matter may be used to account for

(i) the pressure developed by a gas in a gas cylinder. (3 marks)

(ii) the cooling effect of an evaporating liquid. (3 marks)

(iii) the absolute zero of temperature. (2 marks)

b) (i) A gas has a volume of 600 cm^3 at a temperature of 27 °C and a pressure of 1.2 atmospheres. Calculate its volume when the pressure rises to 2 atmospheres and the temperature to 100 °C. (3 marks)

(ii) Explain how you could cause the gas at 100°C to cool without extracting heat from it. (2 marks)

(i) What is matter? (1 mark)

(ii) Copy the table below and use it to compare the solid with the gas.

State	Spacing of particles	Particles arrangement	Force between particles
Solid			
gas			

(6 marks)

6 (a) (i) Distinguish between the electromotive force (*emf*) and the potential difference (pd) of a voltage source. (3 marks)

(ii) Name and define the *SI* units in which electrical potential difference is measured. (2 marks)

(b) The voltage of an a.c. source varies with time as shown in Figure 3.

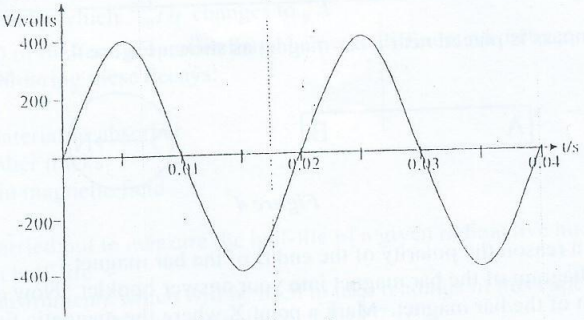

Figure 3

Use the graph to determine

(i) the peak voltage (1 mark)

(ii) the root mean square (*rms*) voltage (1 mark)

(iii) the frequency of the source (2 marks)

(c) A student uses a dry wooden cloth to rub a polythene rod and a Perspex rod, each in its own turn.

(i) What type of charge will each rod acquire? (2 marks)

(ii) Choose ONE of the rods and explain why it acquired the charge you stated in (i) above. (2 marks)

(iii) Describe how you will use the charged rods to distinguish between two suspended pith balls, X and Y, one of which is positively charged and the other negatively charged. (3 marks)

(d) During a thunder storm six lightening flashes successively hit a tall tree, delivering a total of 21000 J of energy. Each lightening flash carried 30 C of charge.

(i) Calculate the potential difference between the tree and the cloud. (2 marks)

(ii) If an average current of 1.5 A passed from the cloud to the tree during the thunderstorm, how long did the storm last? (2 marks)

7 (a) It is required to wire 3 power sockets in the sitting room of a house (each socket being a 3-pin socket) in a ring circuit.

(i) Draw a labelled diagram showing how you will wire the sockets. Indicate the switch OR the fuse for one socket. (3 marks)

(ii) State one advantage of this type of circuit over a linear circuit (1 mark)

(iii) State one risk to which appliances and / or users are exposed when using electricity. Explain how this risk can be checked or avoided (3 marks)

(iv) A house wife uses a 2500 W electric cooker for 3½ hrs everyday. What will be her electric bill at the end of a month of 30 days? (1 unit of electricity costs 63 Frs.) (3 marks)

(b) A student is asked to measure the resistance of a copper wire. He is given an ammeter, a voltmeter, a battery.

(i) Draw a labelled diagram of the circuit he will use. (2 marks)

(ii) He discovers that if he changes the voltage of the battery the readings of the voltmeter and the ammeter change. State the law linking the readings. **(2 marks)**

(iii) The following readings were got:

V /V	0	1.0	1.6	3.2	4.8	6.0	8.0
I /A	0	0.12	0.2	0.4	0.6	0.75	1.0

Draw a graph of voltage (y-axis) against current (x-axis). Using your graph, state with reasons whether the copper wire obeys the law you stated in (ii) above or not. **(4 marks)**

(iv) Use your graph to determine the resistance of the copper wire. **(2 marks)**

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8. (a) A magnetic compass is placed near a bar magnet as shown Figure 4.

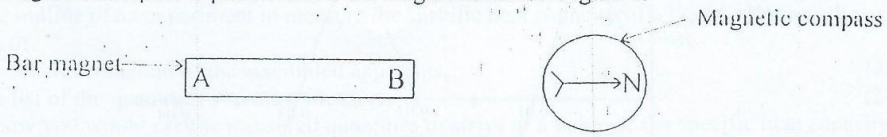

Figure 4

(i) State with a reason the polarity of the end B of the bar magnet. **(2 marks)**

(ii) Copy the diagram of the bar magnet into your answer booklet. Now draw and label the magnetic flux pattern of the bar magnet. Mark a point X where the magnetic field strength is rather weak. **(3 marks)**

(b) Study Figure 5 and answer the questions that follow.

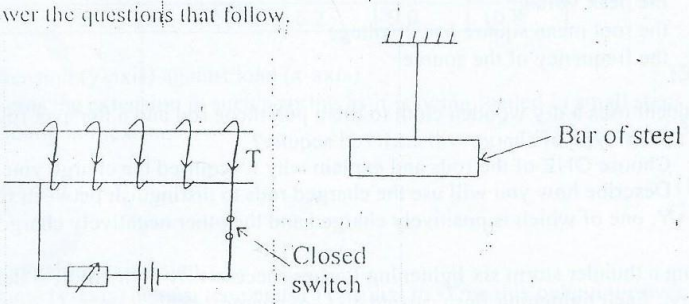

Figure 5

(i) What is the polarity of the end T of the solenoid when current flows in the circuit as shown? **(1 mark)**

(ii) Name the rule you have used to determine the polarity of the end T. **(1 mark)**

(iii) What will be observed of the steel bar when current flows in the solenoid as shown? Explain. **(3 marks)**

(iv) State and explain one possible change that you can make on this set up to increase the magnitude of the observation in (iii) above. **(2 marks)**

(c) In the set-up shown in Figure 6 there is no electrical contact (for connection, between coil 1 and coil 2.

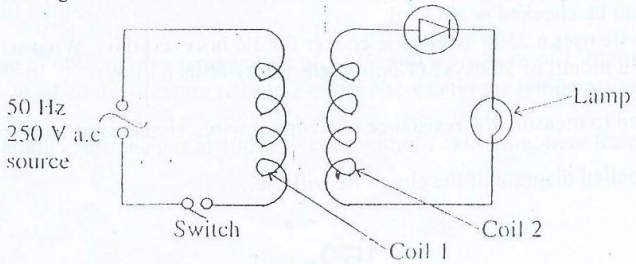

Figure 6

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(i) Explain why the lamp in coil 2 lights when the switch in coil is closed. (2 marks)

(ii) Name and explain one possible change which can be made on this set up to increase the brightness of the lamps in coil 2. (2 marks)

(iii) A CRO was connected across the 250 V a.c. source and then later across the lamp. Draw two voltage/time graphs to show the CRO trace which will be obtained in each case for 2 ½ cycles. (Assume that both coils have the same number of turns. (3 marks)

(iv) Name one practical application of the set up in Figure 6. (1 mark)

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1 (a) The element thorium is represented by the notation $^{234}_{90}Th$.

(i) Explain why thorium is electrically neutral. (1 mark)

Thorium undergoes an alpha decay, followed by a beta decay to produce a daughter nuclide $^{A}_{B}X$.

(ii) Write a single nuclear equation to represent these decays (1 mark)

(iii) Calculate the values of A and B (2 marks)

(iii) Name the process by which $^{234}_{90}Th$ changes to $^{A}_{B}X$. (1 mark)

(v) Use ANY TWO of the four properties listed below to differentiate between the alpha and beta particles emitted during these decays:

- range in air
- stopping material or absorber
- cloud chamber tracks
- deflection in magnetic field

(4 marks)

(b) An experiment was carried out to measure the half-life of a given radioactive nuclide.

(i) Define the term half-life (1 mark)

(ii) Name the two instruments which will be used to take readings in this experiment. (1 mark)

In the absence of the source, readings were noted.

(iii) What is the name of such readings (1 mark)

(iv) Name 2 possible sources of such readings (2 marks)

(v) Why was it necessary to take these readings before starting the experiment? (1 mark)

During the experiment, readings were taken every minute, and for five successive minutes. The readings recorded were: 45 52 50 61 40

(vi) State two reasons why these readings varied in an irregular manner. (2 marks)

(vii) State one safety precaution you will observe while carrying out such an experiment. (1 mark)

(viii) Name ONE use of a named radioactive isotope or radiation. State how this use is related to the property of the isotope or radiation. (2 marks)

10(a)(c) Figure 7 shows wave fronts of progressive plane water waves or light waves.

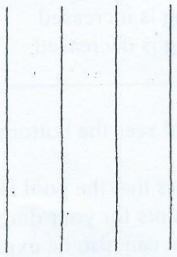

Figure 7

Draw a labelled diagram, in each case, which clearly defines or illustrates

(i) Reflection of waves (2 marks)

(ii) Diffraction of waves (2 marks)

Name a practical application which is due to

(iii) Reflection of waves (1 mark)

(iv) Diffraction of waves (1 mark)

(b) Figure 8 shows part of the electromagnetic spectrum.

Radio waves	X	Visible light	Y	X-rays	Z

Figure 8

Chose ONLY ONE of the waves labelled X, Y, and Z and state
(i) its name
(ii) its approximate wavelength range
(iii) its source
(iv) its detector
(v) one practical application **(5 marks)**

(c) Figure 9 shows the wave profile of a vibrating guitar string.

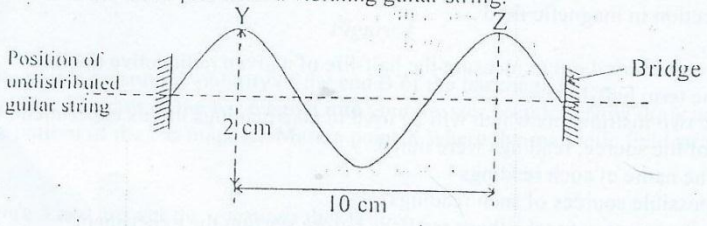

Figure 9

(i) Calculate the wavelength of the wave. **(2 marks)**
(ii) Calculate the amplitude of the wave. **(1 mark)**
It took 0.02 seconds for the crest to move from Y to Z.
(iii) Calculate the frequency of vibration of the string. **(1 mark)**
(iv) Calculate the speed of the wave. **(1 mark)**
(v) Name two exact methods by which the frequency of vibration of the string can be increased. **(2 marks)**
State the property of the sound from the vibrating string that will be affected
(vi) if the frequency of vibration of the string is increased. **(1 mark)**
(vii) if the amplitude of vibration of the string is decreased. **(1 mark)**

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11. (a) A boy standing at the edge of a swimming pool sees the bottom of the pool and concludes that it is exactly 3 m below the water surface.
(i) Draw a labelled ray diagram which shows that the pool is deeper than 3 m. **(3 marks)**
(ii) Which common property of waves accounts for your diagram in (ii) above? **(1 mark)**
(iii) Name one other natural phenomenon that can also be explained using your answer in (ii) above. **(1 mark)**
(iv) If the refractive index of water is 1.3 calculate the true depth of the pool, when it is full of water. **(2 marks)**

(b) (i) With the aid of a ray diagram or otherwise define the principal focus of a diverging lens. **(2 marks)**
(ii) Describe the auxiliary plane mirror method for determining the focal length of a converging lens. Include in your description
- a labelled diagram of the set up you would use
- an outline of the procedure
- the data taken
- how the data is analysed to obtain the focal length, and
- precautions taken to ensure accurate results. **(5 marks)**

c) Study Figure 10 and answer the questions that follow.

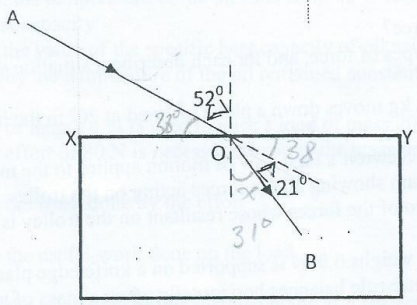

Figure 10

(i)	Calculate the angle of refraction of the ray OB in the glass	(1 mark)
(ii)	Calculate the refractive index of the glass	(2 marks)
(iii)	Calculate the speed of light in glass (if the speed of light in air is 3×10^8 m/s)	(2 marks)
(iv)	Name one practical use of the refractive indices of materials.	(1 mark)