1. (a) An object is taken from a town around the earth's equator to another town around the earth's south pole.
State and explain any changes in:
(i) the mass of the object **(2 marks)**
(ii) the weight of the object **(2 marks)**

(b) Figure 1 shows a boy of mass 50 kg and a girl of mass 60 kg standing on a uniform plank of mass 20 kg and of length 3 m on a support Y.

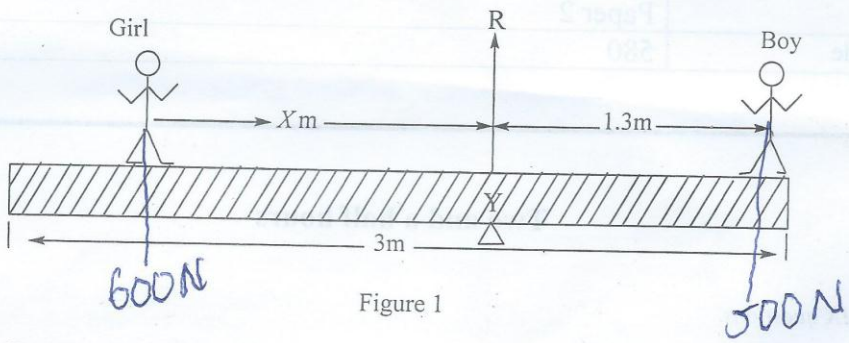

Figure 1

(i) State the conditions necessary for this system to be in equilibrium. **(2 marks)**
Calculate:
(ii) The distance, X , of the girl from the support when the system is in equilibrium. **(4 marks)**
(iii) The reaction force R on the plank by the pivot. **(2 marks)**

(c) (i) State Newton's first law of motion. **(2 marks)**
(ii) State and explain one practical situation where the law is applied. **(2 marks)**
(iii) A mass of 10 kg is attached to the lower end of a spring hanging vertically, using a string. Indicate on a diagram all the forces acting in the system and determine the size of each force. **(4 marks)**

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2. (a) The Olympic record for the 100 m track race is 9.7 seconds.
(i) Draw a sketch graph showing the distance (Y-axis) against time (X-axis) for this sprinter. Indicate important values. **(2 marks)**
(ii) Calculate the average speed of the sprinter. **(2 marks)**
(iii) State the difference between speed and velocity by defining both. **(2 marks)**

(b) A student took the following readings of the time, t (in seconds) a steel ball took to fall freely from various heights in metres.

h/m	2.0	1.75	1.5	1.25	1.0
t/s	0.63	0.59	0.55	0.50	0.45
t^2/s^2	0.40	0.35	0.30	0.25	0.20

except

(i) plot a graph of h/m (Y – axis) against t^2/s^2 (X – axis). **(2 marks)**
(ii) calculate the slope of the graph. **(4 marks)**
(iii) the slope of the graph can be used to calculate acceleration due to gravity. Define the underlined and state its unit (2). **(2 marks)**

(c) An airplane flying at a uniform horizontal speed of 200 m/s at a height of 20 m, drops a bag of rice of mass 60 kg directly above a warehouse for flood victims. The bag eventually attains terminal velocity.
(i) Define "terminal velocity"? **(2 marks)**
(ii) State and explain whether the bag would land on the warehouse. **(2 marks)**
(iii) The falling bag has momentum. Define momentum and state its units. **(2 marks)**

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3. (a) State the principle of conservation of energy. **(2 marks)**

(b) Figure 2 shows a 50 kg bag of cement being pulled using a force of 500N along a plank using a rope passing over a pulley at B as shown. The plank AB is 5 m long and inclined at 60° to the horizontal.

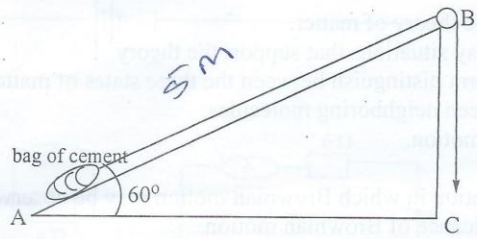

Figure 2

Calculate:

(i) the energy output of the system. **(2 marks)**

(ii) the energy input in taking the cement to the pulley. **(2 marks)**

(iii) the efficiency of the system and state a factor that led to the efficiency being less than 100%. **(3 marks)**

(iv) If at the pulley the cement falls vertically, describe the energy changes that occur until it hits the ground. **(3 marks)**

(c) A 0.8 kg mass of a metal initially at 120 °C is dropped quickly into a large beaker containing 0.08 kg of water at 30 °C. The final temperature of beaker and water after stirring is 50 °C. Assume that the beaker and stirrer absorb no heat and that the specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

(i) Explain why the metal is transferred quickly into water. **(1 mark)**

(ii) Explain why the water is stirred before taking the final temperature. **(1 mark)**

(iii) Define specific heat capacity. **(2 marks)**

(iv) Calculate the heat gained by the water. **(2 marks)**

(v) Calculate the specific heat capacity of the metal. **(2 marks)**

---

4. (a) Wires and rubber bands stretch when loaded.

(i) Sketch a force-extension graph for a copper wire and another for a rubber band. For each sketch state whether or not each material obeys Hooke's Law. **(4 marks)**

(ii) Define the elastic limit of a material. **(2 marks)**

(b) Water has a density which varies with temperature leading to an anomalous expansion.

(i) Sketch a graph of density (Y-axis) against temperature (X-axis) for water to show this behaviour. **(3 marks)**

(ii) State two advantages and two disadvantages of this anomalous behaviour of water. **(4 marks)**

(c) A driver checks the pressure in his car tyres in Bamenda and it is 3 Pa and the temperature is 24 °C. He drives to Yaounde and the pressure is found to be 4Pa. Calculate the temperature of the air in the tyres in Yaounde. **(3 marks)**

(d) Figure 3 can be modified to function as a hydraulic lift.

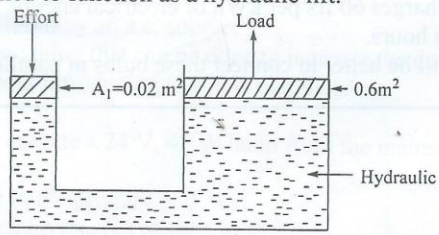

Figure 3

The master (smaller) cylinder has a cross sectional area of 0.02 m^2 while the larger (slave) cylinder has a cross sectional area of 0.6 m^2.

(i) If the effort applied is 150 N, what is the pressure transmitted by the fluid? **(2 marks)**

(ii) State two properties of liquid which make it suitable in this machine. **(2 marks)**

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5. (a) (i) State the kinetic theory of matter.

(ii) Name 2 everyday situations that support the theory **(2 marks)**

(iii) In a tabular form distinguish between the three states of matter under the following headings

- Force between neighboring molecules.
- Molecular motion. **(6 marks)**

(b) (i) Describe a situation in which Brownian motion may be observed at home. **(3 marks)**

(ii) State the significance of Brownian motion. **(1 mark)**

(iii) Explain how Brownian motion is affected by

- a rise in temperature of the medium.
- Size of suspended particles. **(4 marks)**

(c) Define absolute zero and state its value in °C. **(2 marks)**

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6. (a) Figure 4 shows two charged metal spheres A and B. A is charged to +3000 V while B is charged to 2900 V and is suspended by a cotton thread.

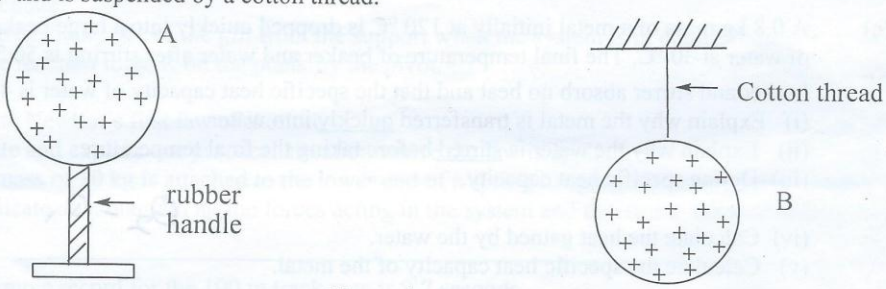

Figure 4

(i) Why is A put on the rubber stand. **(2 marks)**

(ii) If A is moved towards but not touching B, state and explain what is observed. **(2 marks)**

(iii) Calculate the p.d. between A and B. **(2 marks)**

(iv) If the two spheres are connected using a copper wire, state and explain what will happen. **(2 marks)**

(b) A current of 8 A flows in a wire for 12 s. The charge on an electron is 1.6×10^{-19} C.

(i) What do you understand by a current of 8 A? **(2 marks)**

(ii) Calculate the total charge flowing in the wire. **(2 marks)**

(iii) Determine the number of electrons that pass a point in the wire during this time. **(2 marks)**

(c) A conference hall uses two bulbs of 500 W each and 20 bulbs of 20 W each.

(i) Calculate the total power dissipated. **(2 marks)**

(ii) If AES SONEL charges 60 frs per kWh of electrical energy. Calculate the cost of having all the lights on for four hours. **(3 marks)**

(iii) Explain why it will be better to connect these bulbs in parallel. **(1 mark)**

$I = \frac{8V}{8R}$

$R =$

7. (a) A conductor may be ohmic or non ohmic.
Define the underlined words and give one example of each. **(4 marks)**

(b) Figure 5 below shows a closed electric circuit.

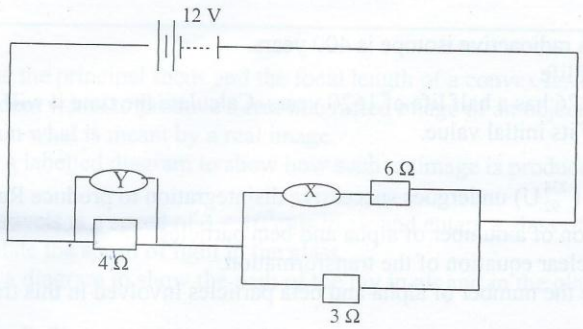

Figure 5

(i) Name the meters X and Y. **(2 marks)**
(ii) Explain why each is connected as shown. **(4 marks)**
(iii) Calculate the reading of each meter. **(4 marks)**
(iv) State the effect on the total current if the 3 Ω resistor burns. **(1 mark)**

(c) (i) A wire has a resistance R. A similar wire of the same material is twice as long but same cross sectional area.
Compare the new resistances of the wires. **(3 marks)**
(ii) State and explain one other factor which determines the resistance of a wire. **(2 marks)**

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8. Figure 6 shows two circuits close to one another. Circuit A has a battery while circuit B has a centre zero galvanometer.

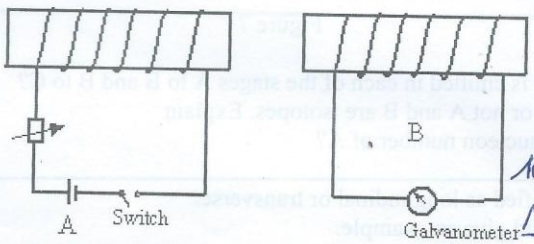

Figure 6

(a) (i) Copy circuit A of Figure 6 and show the direction of current flow and the field lines of the coil. **(3 marks)**
State and explain what happens to the pointer of the galvanometer in B when:
(ii) The switch in A is closed. **(2 marks)**
(iii) The switch is kept closed for some time. **(2 marks)**
(iv) The switch is opened again. **(1 mark)**
(v) The battery A is replaced by an a.c. source: **(2 marks)**
(vi) State and explain one thing that can be done to increase the deflection of the pointer of the galvanometer, without introducing any new material. **(2 marks)**

(b) A transformer is used to operate a 24 V, 48 W lamp from the mains of 240 V. Assume its efficiency is 100%:
(i) Calculate the current in the primary coil. **(3 marks)**
(ii) Determine the turns ratio (N_p/N_s) of the transformer. **(2 marks)**

(c) A diode is connected to the lamp in the secondary coil of the above transformer in (b).
(i) State and explain the effect of the diode. **(2 marks)**
(ii) Draw the output waveform. **(1 mark)**

9. (a) The half life of a radioactive isotope is 400 years.
(i) Define half life **(2 marks)**
(ii) Radium- 226 has a half life of 1620 years. Calculate the time it will take for its activity to drop to ¼ of its initial value. **(2 marks)**

(b) Uranium – 238 ($^{238}_{92}U$) undergoes successive disintegration to produce Radium – 226 ($^{226}_{88}Ra$) with the emission of a number of alpha and beta particles.
(i) Write a nuclear equation of the transformation. **(1 mark)**
(ii) Determine the number of alpha and beta particles involved in this transformation. **(4 marks)**
(iii) State two practical uses of radioactive radiations. For each use, state the radiation and property exploited. **(6 marks)**

(c) Fig. 7 shows part of a radioactive decay series.

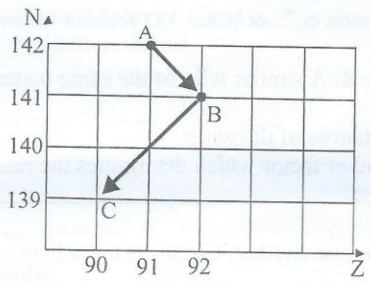

Figure 7

(i) Which particle is emitted in each of the stages A to B and B to C? **(2 marks)**
(ii) State whether or not A and B are isotopes. Explain **(2 marks)**
(iii) What is the nucleon number of A? **(1 mark)**

10. (a) Waves may be classified as longitudinal or transverse.
(i) Define each and give an example. **(4 marks)**
(ii) Describe how you would use a ripple tank to demonstrate the following wave properties:
- Reflection
- Refraction
- Diffraction **(6 marks)**

(b) Describe an experiment to measure the speed of sound in air, stating precaution(s) which must be taken. **(6 marks)**

(c) Figure 8 shows the trace of a sound signal from a microphone connected to a cathode ray oscilloscope.

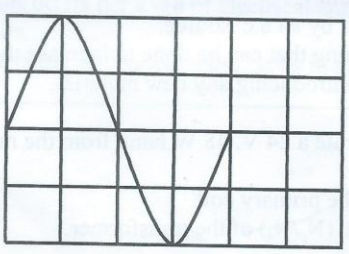

Figure 8

If the Y – gain control is set at 5 Vcm^{-1} and the X – gain (time base) is set at 10 $ms\ cm^{-1}$.
Determine:

(i) The frequency of the signal. **(2 marks)**

(ii) Its amplitude. **(2 marks)**

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11. (a) (i) Define the principal focus and the focal length of a convex lens. **(2 marks)**
A student wants to produce a real magnified image of an object.

(ii) Explain what is meant by a real image. **(1 mark)**

(iii) Draw a labelled diagram to show how such an image is produced by a convex lens. **(2 marks)**

(b) A ray of light travels at a speed of 3×10^8 m/s in air and enters a glass of refractive index 1.5.

(i) Calculate the speed of light in the glass. **(2 marks)**

(ii) Draw a diagram to show the path of the ray in air and in the glass. **(2 marks)**

(c) The occupants of a house at night notice the presence of thieves outside. Explain whether it is advisable to switch on the security light outside or the lights inside the house if the occupants want to see the thieves without being located by the thieves. **(4 marks)**

(d) An object of height 5 cm is placed 10 cm in front of a convex lens. The image produced is the same size as the object.

(i) Determine the image distance from the lens. **(2 marks)**

(ii) Calculate the focal length of the lens. **(2 marks)**

(iii) State two properties of the image formed. **(2 marks)**

(iv) Name one device which is an application of such an arrangement of lens and object. **(1 mark)**
