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June 2012

1. (a) A uniform wooden plank, 2 m long, has a weight of 200 N. It is supported on a knife edge (pivot) at a point 0.4 m away from one end.

(i) Calculate the downward force that should be applied on the end of the plank nearer the pivot so that the plank balances horizontally. **(2 marks)**

(ii) Calculate the reaction force produced at the pivot when the plank balances horizontally. **(1 mark)**

(iii) Name a device whose functioning depends on the principle on which you based your calculations in (i) above. **(1 mark)**

(b) Describe an experiment, using dynamic trolleys, to show the relationship between the mass of a body and the acceleration produced when a constant force acts on the body. Your description should include:

- An outline of the procedure.
- The readings taken.
- An analysis of the readings to arrive at the required relationship.
- A precaution taken to ensure accurate results. **(6 marks)**

(c) When an object is hung from a Newton balance, the balance reads 20 N when the object is hung in air and reads 17.5 N when the object is fully immersed in water.

(i) Explain the difference in readings. **(1 mark)**

(ii) Name a practical application of the observation described above. **(1 mark)**

(d) A girl drags a box of eggs along a horizontal surface by means of a rope which makes 30° with the horizontal. The tension in the rope is 4000 N and the force of friction between the box and surface is 100 N.

(i) Draw a labelled diagram to show the forces acting on the box. **(2 marks)**

(ii) Calculate the horizontal force applied by the girl to cause the box to move. **(2 marks)**

(iii) What is the magnitude of the resultant force on the box if the girl pulled it with a uniform speed? Explain. **(2 marks)**

(iv) State and explain why it was necessary for the girl to pack the eggs in cotton before pulling the box as described above. **(2 marks)**

2. (a) Define the following terms.

(i) Displacement **(1 mark)**

(ii) Acceleration **(1 mark)**

(b) A lead ball of mass 2.0 kg is thrown vertically upward into the air with an initial velocity of 20 m/s. Draw sketch graphs to show how:

(i) its speed varies with time of motion. **(2 marks)**

(ii) its velocity varies with time of motion. **(2 marks)**

Calculate:

(iii) the maximum height attained by the ball during its motion. **(2 marks)**

(iv) the total time of motion of the ball. **(2 marks)**

(v) State any assumption made in your calculations in (iii) and (iv) above. **(1 mark)**

(c) The graph in figure 1 represents the motion of a body.

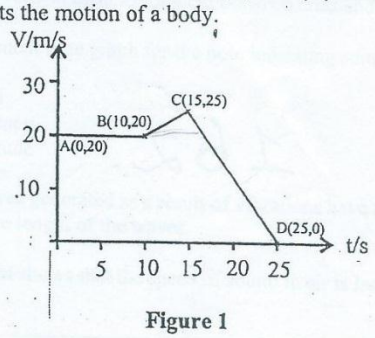

Figure 1

Use the graph to calculate:

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(ii) The average speed of the car. (2 marks)
(iii) The average deceleration with which the body was brought to rest. (2 marks)
(iv) The momentum of the body at its 15th second of motion if the mass of the body is 1400 kg. (2 marks)

3. (a) A hot liquid is contained in a closed dish.
(i) Name two methods by which it loses heat. (1 mark)
(ii) Briefly explain how each method occurs. (2 marks)

(b) What do you understand by each of the following statements?
(i) The specific heat capacity of water is 4200 J/kgK. (1 mark)
(ii) The specific latent heat of fusion of ice is 335000 J/kg. (1 mark)
Name one practical application of:
(iii) Water (1 mark)
(iv) Ice. (1 mark)
based on the properties given in (i) and (ii) above.

(c) A hill is inclined at 30° to the horizontal. A car of mass 4000 kg is driven from the foot to the top of the hill at a steady speed of 5 m/s against a constant frictional force of 800 N. The car uses 0.5 litre of petrol to move 100 m along the hill upwards.
N.B 1 litre of petrol contains 6.0×10^6 J of energy. Calculate
(i) The work the car did against friction. (2 marks)
(ii) The gain in potential energy of the car. (2 marks)
(iii) The gain in kinetic energy of the car. (2 marks)
(iv) The energy input into the car from the petrol. (1 mark)
(v) The total energy output. (1 mark)
(vi) The efficiency of the car. (2 marks)

(d) A ball dropped from a height of 6 m rebounds to a height of 4.5 m after hitting the floor.
(i) State the energy changes which take place from when it is dropped to just before it hits the ground. (2 marks)
(ii) Why is the rebound height less than the initial height of 6.0 m? (1 mark)

4. (a) A fixed mass of gas is heated at constant pressure.
(i) Sketch a graph of the variation of its volume (Y- axis) against its temperature in °C (X – axis). (2 marks)
(ii) State the numerical value and the significance of the temperature where the line cuts the X- axis. (2 marks)

(b) (i) State Hooke's Law. (2 marks)
(ii) Name a substance which is elastic but does not obey Hooke's Law. (1 mark)

In an experiment to study the stretching of a spring the following results were obtained.

Length of spring (m)	0.34	0.40	0.46	0.52	0.58	0.66	0.86	1.0
Applied force (N)	0.0	20.0	40.0	60.0	80.0	100.0	120.0	140.0
Extension of spring (m)								

Table 1

(iii) Copy table 1 into your answer booklet and complete the row for extension. (2 marks)
(iv) Plot a graph of force (Y-axis) versus extension (X-axis). (4 marks)
(v) What do you understand by the elastic limit of a spring? (1 mark)
(vi) Use the graph you have drawn in (iv) above to determine the magnitude of the elastic limit of this spring. (Clearly show your method on the graph). (2 marks)

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(c) Figure 2 shows water of density 1000 kg/m^3 in a U-tube. A student places her mouth at X and causes the indicated change in water levels in the two arms.

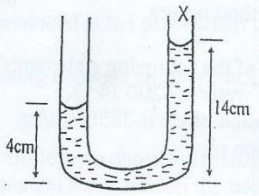

Figure 2

(i) Is she blowing or sucking? Explain. **(2 marks)**
(ii) Determine the excess pressure in the above diagram. **(2 marks)**

5. (a) Copy table 2 below and complete it to distinguish between a liquid and a gas in terms of the specified properties. **(6 marks)**

S/N	Property	Liquid	Gas
(i)	Spacing of molecules		
(ii)	Intermolecular attraction		
(iii)	Motion of molecules		

Table 2

(b) (i) What is Brownian motion? **(1 mark)**
(ii) Describe an experiment used in a laboratory to observe Brownian motion in a gas. **(4 marks)**
(iii) State and explain two factors that affect Brownian motion. **(4 marks)**

(c) Explain in terms of molecules why:
(i) A gas exerts pressure. **(3 marks)**
(ii) The pressure of a gas will increase when the temperature of the gas is increased at constant volume. **(2 marks)**

6. (a) Figure 3 shows two charged metal spheres A and B which are suspended by nylon threads, each (thread being) about 0.5 m long from fixed supports.

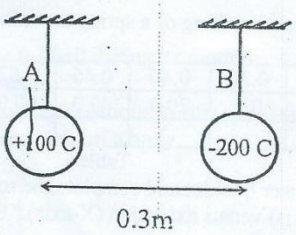

Figure 3

(i) State and explain what is observed. **(4 marks)**
(ii) Calculate the magnitude and sign of the final charge that sphere A will have if the two spheres touched each other. **(2 marks)**
(iii) In which direction will an electric current flow if a wire were used to connect spheres A and B in (i) above? Explain. **(2 marks)**

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(b) Figure 4 shows the current / time trace produced on a cathode ray oscilloscope by an a.c. source.

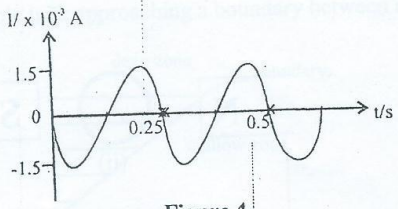

Figure 4

(i) What is the magnitude of the peak current? **(1 mark)**
(ii) Calculate the frequency of the source. **(2 marks)**
(iii) Calculate the amount of charge that flows in 0.5 seconds. **(2 marks)**
(iv) Calculate the energy needed to transfer this amount of charge across two points at a p.d. of 220 V. **(2 marks)**

(c) You are provided with an uncharged Perspex rod, a dry woolen cloth, an uncharged metallic sphere on an insulating stand.
(i) State how you will charge the perspex rod. **(1 mark)**
(ii) With the aid of labelled diagrams, describe how you will use the charged perspex rod to give the metallic sphere a negative charge. **(4 marks)**

7. (a) An electric iron is rated 1200W, 240V.
(i) Name a device or connection made in the iron to guard against electric shock. **(1 mark)**
(ii) State how the device or connection named in (i) above is connected and explain how it works. **(3 marks)**
(iii) This iron is used from 8p.m to 11p.m every day for one week. Calculate the electric bill. (1kW/h of electrical energy costs 65frs) **(3 marks)**
(iv) An electrician installed an 8A fuse in this iron. Explain whether or not this was correct. **(2 marks)**

(b) Figure 5 shows an electric circuit.

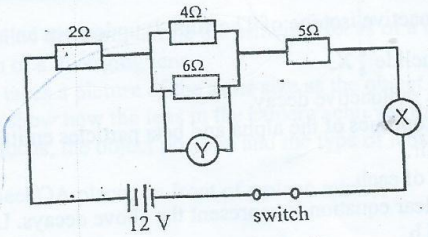

Figure 5

Use the circuit to calculate:
(i) The total resistance of the circuit. **(2 marks)**
(ii) The reading of the meter X. **(2 marks)**
(iii) The reading of the meter Y **(2 marks)**
(iv) The 2 Ω and 6 Ω resistors are wires of the same material. Name two properties and state how they have been varied so that each resistor has the specified resistance. **(3 marks)**
(v) Explain why each of the meters X and Y is connected as shown. **(2 marks)**

8. (a) (i) Your teacher tells you that repulsion is the only sure test to use in identifying a magnetic pole. Explain why attraction cannot also be a valid test. **(2 marks)**
(ii) What is a magnetic field? **(1 mark)**
(iii) The conductor shown in Figure 6 (i) is a straight conductor which is carrying a steady current perpendicularly into the paper. Copy the diagram in 6(i) and complete it to show the magnetic flux pattern. **(2 marks)**

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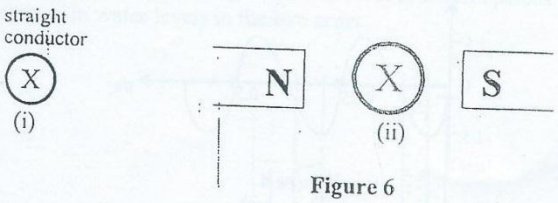

Figure 6

(iv) In Figure 6 (ii) the current-carrying straight conductor has been placed between two magnetic pole pieces. Copy and complete the diagram to show the resultant magnetic flux pattern and the direction of the force on the conductor. **(3 marks)**

(v) Name one variation that can be made to the set up in Figure 6 (ii) to increase the strength of the force on the conductor. **(1 mark)**

(b) A transformer has 400 turns in the primary windings and 100 turns in the secondary windings. The primary voltage is 240 V and the primary current is 10 A. Calculate:

(i) The secondary voltage. **(2 marks)**

(ii) The secondary current. **(2 marks)**

(iii) What assumption have you made in the calculations in (i) and (ii) above? **(1 mark)**

(iv) What type of transformer is described in this question? **(1 mark)**

(v) Name a device which uses this type of transformer. **(1 mark)**

(vi) State and explain two factors which explain why your assumption in (iii) above is not true in a practical transformer. **(4 marks)**

9. (a) The nuclide $^{232}_{90}Th$ is a radioactive isotope of Thorium. It undergoes an alpha decay followed by a beta decay to produce the nuclide $^{a}_{b}X$.

(i) Name any one property of a radioactive decay. **(1 mark)**

Compare by tabulation the properties of the alpha and beta particles emitted in these decays by stating:

- The range of each in air. **(2 marks)**
- The stopping material of each. **(2 marks)**

(ii) Write a single balanced nuclear equation to represent the above decays. Use your equation to calculate the values of a and b. **(3 marks)**

(iii) By doing necessary calculations, compare the relative stabilities of $^{232}_{90}Th$ and the nuclide $^{a}_{b}X$. **(3 marks)**

(b) The readings in Table 3 below were obtained in an experiment to study the activity of a radioactive ore.

Time / Days	0	1	2	3	4	5	6	10	12	14	16
Count rate/counts/s	225	192	171	146	126	115	105	71	57	47	43

Table 3

It was also observed that the average background radiation count rate was 25 counts/s.

(i) Name one source of background radiation. **(1 mark)**

(ii) Name one health hazard which is due to very high background radiation. **(1 mark)**

(iii) Produce another table of readings in which you have made allowances for background radiation. **(1 mark)**

(iv) Use the table you have produced in (iii) above and draw a graph of count-rate (Y-axis) versus time (X-axis). **(4 marks)**

(v) Use the graph drawn in (iv) above to determine a value for the half life of the ore. **(2 marks)**

10. (a) (i) Differentiate between longitudinal waves and transverse waves. **(2 marks)**

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(iii) Choose one of the electromagnetic waves named in (ii) above and for it name one source and one application. **(2 marks)**

(b) Figure 7 shows waves in a ripple tank approaching a boundary between deep and shallow zones of water.

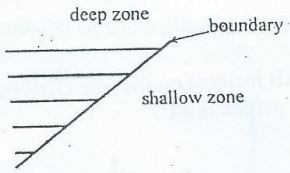

Figure 7

(i) Copy and complete the diagram by showing
- a ray on the incident wave front. **(1 mark)**
- the wave fronts after the wave has crossed the boundary. **(2 marks)**

(ii) Name one property common to the waves in both mediums. **(1 mark)**

(c) (i) Describe an experiment to measure the speed of sound in air using a method which involves direct measurements. In your description, indicate clearly:
- the apparatus used and the procedure followed.
- the readings taken.
- an analysis of the readings to obtain the speed of sound.
- the precautions taken to ensure accurate results. **(6 marks)**

(d) (i) Radio Buea broadcasts radio waves of wavelength 94.5 m. To what frequency must a radio receiver be tuned so as to receive Radio Buea? (Speed of radio waves = 3×10^8 m/s). **(2marks)**

(ii) Explain why it is possible to hear a sound from a radio set behind a door but not seeing it. **(2 marks)**

11. (a) (i) With the aid of a labelled diagram, define the principal focus of a diverging lens. **(2 marks)**

(ii) Name one application of a diverging lens. **(1 mark)**

(iii) A simple lens camera takes a picture of the same size as the object. Draw a ray diagram to show how the lens in the camera achieves this. Clearly label in your diagram the principal focus, the object position and the type of lens used. **(4 marks)**

(b) Figure 8 shows an object OA placed in front of a plane mirror.

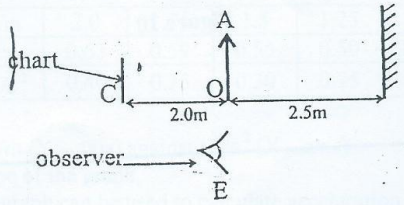

Figure 8

(i) Draw a labelled ray diagram to show how an observer at E sees the image of OA in the mirror. **(3 marks)**

(ii) If C is a chart placed behind OA as shown, calculate the distance between OA and the image of C in the mirror. **(2 marks)**

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(c) Figure 9 shows a ray of light AB incident on the side OBC from inside a semicircular perspex block. The critical angle for perpex is 40°.

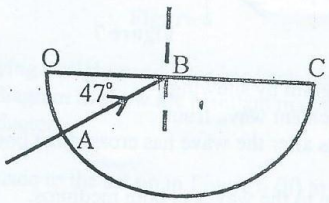

Figure 9

(i) Copy and complete the diagram to show the path of the ray after incidence. Give a reason for the diagram you have drawn. **(2 marks)**

(ii) What is the name of the effect produced? **(1mark)**

(d) Figure 10 shows a stone O at the bottom of a pond 1m deep as viewed by an observer. The refractive index of water is 1.33.

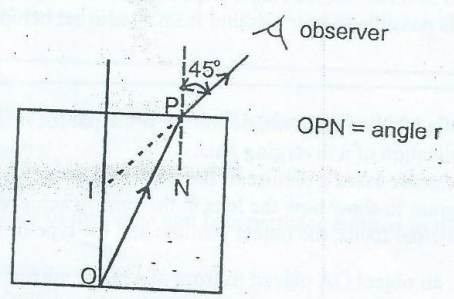

Figure 10

Calculate:

(i) The angle marked r. **(2 marks)**

(ii) The distance IO. **(3 marks)**