

June 2009

- 1 a) (i) Name two examples of contact forces. *Friction, normal force, tension, air resistance, magnetic force, electrostatic force* (2 marks)  
 (ii) State two differences between mass and weight. (2 marks)  
 (iii) A certain mass has a weight of 50 N on the moon where the gravitational intensity is 2.5 N/kg. Determine the weight of this mass on earth. *Weight on moon = 50 N,  $W = mg$ ,  $50 = m \times 2.5$ ,  $m = 20$  kg,  $W_e = 20 \times 9.8 = 196$  N* (2 marks)
- b) The acceleration of a parachutist dropped from a plane decreases until at some point in his fall his velocity becomes constant.  
 (i) Draw a diagram indicating all the forces acting on the parachutist as he falls. (3 marks)  
 Explain why:  
 (ii) his acceleration decreases during the early part of the fall. (2 mark)  
 (iii) his velocity becomes constant later. *terminal velocity* (2 marks)  
 (iv) Name the constant velocity. *Terminal velocity* (1 mark)
- c) (i) State two factors which determine the magnitude of the moment of a force. *Force, perpendicular distance* (2 mark)  
 A uniform solid beam 1m long is pivoted at a point 20 cm from one end of the beam. The beam is balanced horizontally by a weight 10 N hanging from the end close to the pivot.  
 (ii) Draw a diagram showing the beam balanced by the forces. (1 mark)  
 (iii) Determine the weight of the beam. (2 mark)  
 (iv) Name one device which is an application of the principle of moments. *levers, scissors, see-saw, machines* (1 mark)

- 2 a) The following graph shows the motion for the first 30 s of an object moving in a straight line.

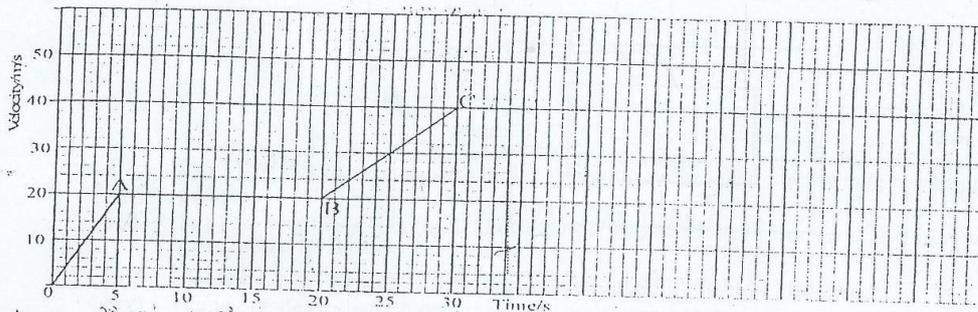


Figure 1

- (i) Describe the motion of the body during each stage of this period. (3 marks)  
 (ii) What displacement did the body make in the 30 s? (3 marks)  
 (iii) Draw the displacement time graph for the whole motion using the scale on the time axis and indicating three important values on the displacement axis. (4 marks)
- b) A car travelling at 5 m/s is accelerated uniformly and travels a distance of 300 m in 20s. Calculate  
 (i) the acceleration of the car.  *$a = 2.5 \text{ ms}^{-2}$*  (2 marks)  
 (ii) the speed of the car at the end of 20 s.  *$v = 55 \text{ m/s}$*  (2 marks)
- c) Name the Newton's Law involved and use it to explain the following:-  
 (i) As air escapes through the mouth of an inflated balloon, it darts forward in the opposite direction. *Newton's 3rd Law* (3 marks)  
 (ii) When a fast moving car suddenly slows down, the occupants are thrown forward. *Newton's 1st Law* (3 marks)

- a) The diagram shows a block of mass 200 kg being pulled up an inclined plane at constant speed by a force of 1500 N.

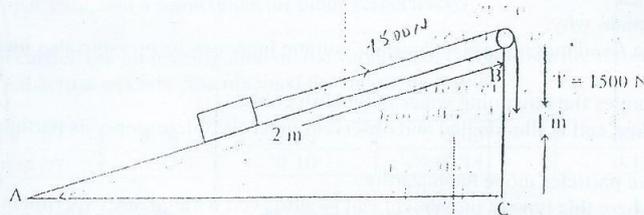


Figure 2

- (i) Calculate the gain in potential energy of the mass as it moves from A to B. (2 marks)
- (ii) Determine the work done by the force (T) in moving the mass from A to B. (2 marks)
- (iii) Account for the difference between the values obtained in (i) and (ii) above. (2 marks)
- b) You are provided with a heater of known power, a thermometer, some insulating material, stop watch and balance to use in measuring the specific heat capacity of a solid metal block.
- (i) Draw a diagram showing this apparatus properly assembled for this purpose. (2 marks)
- (ii) List all the quantities you would measure. (2 marks)
- (iii) Show how you would use these measured quantities to obtain a value for the specific heat capacity of the metal. (2 marks)
- (iv) State one precaution you would take to ensure good results. (1 mark)
- c) (i) During hot sunny periods in coastal areas, a steady wind which reverses direction every 12 hours is often noticed. State the direction of the day time breeze and account for its existence. (4 marks)
- (ii) Explain why a scald caused by steam at 100°C is more serious than one caused by an equal mass of water at the same temperature. (3 marks)

- (a) Explain the meaning of "the density of mercury is 13,600 kg/m<sup>3</sup>". (2 marks)

- (b) You are given sufficient quantities of two similar miscible liquids A and B in two different Jars, one beaker of unknown volume (v) and a balance. You are told that the density of A is greater than that of B.

- (i) List the measurements you would make in an experiment to investigate this fact. (3 marks)

- (ii) Using the measurements made and the unknown volume (v) of the beaker, write down expressions

- for the densities  $\rho_A$  and  $\rho_B$  of the liquids. (2 marks)

- (iii) Write down your conclusion to confirm that  $\rho_A > \rho_B$ . (2 marks)

- (c) (i) State Hooke's Law. (2 marks)

- (ii) Give one example each, of a substance which obeys Hooke's Law and one which does not obey Hooke's Law. (2 marks)

- (iii) On the same axis, sketch force versus extension graphs for the two materials. (2 marks)

- (d) (i) State two characteristics of pressure in liquids. (2 marks)

- (ii) In order to avoid sinking, soldiers crawl on their bellies across swampy ground instead of walking. Explain how this action prevents sinking. (3 marks)

- (a) Explain the following observations:

- i) Solids have a fixed shape and a fixed volume. (2 marks)

- ii) Liquids take up the shape of their container but have a fixed volume. (2 marks)

- iii) A gas from a small container can fill a very large container. (2 marks)

- (b) (i) Gases are compressible but liquids are not compressible. Explain. (2 marks)

- (ii) Give one useful consequence in each case of the incompressibility of liquid and of the compressibility of gases. (2 marks)
- (c) Use the kinetic theory to explain why: (3 marks)
- as the temperature of a fixed mass of gas at constant volume increases its pressure also increases. (3 marks)
  - as water in dish evaporates the remaining water in the dish cools. (3 marks)
- (d) When smoke trapped in a glass cell is illuminated and observed under the microscope, its particles are seen to be moving haphazardly. (2 marks)
- Explain why the smoke particles move haphazardly. (2 marks)
  - Describe a situation where this type of movement can be observed without any experiment set up. (2 marks)

(a) Judith rubbed the cork of her plastic pen on dry cloth, then brought it near some small pieces of paper. The pieces of paper immediately jumped onto the cork. On seeing what happened, her sister Pauline, rubbed the cork of a similar plastic pen on a moist cloth and brought near the pieces of paper. To her surprise the pieces of paper were not attracted.

- Explain carefully why Judith's (cork) pen could pick up the pieces of paper. (3 marks)
- Explain why Pauline's pen (cork) could not pick up the pieces of paper. (2 marks)

(b) You are provided with a negatively charged leaf electroscope, a charged polythene rod and an uncharged polythene rod.

- State the type of charge on the polythene rod, and explain how it might have acquired the charge. (2 marks)
- Explain how the leaf-electroscope may be used to identify the charged polythene rod and the uncharged polythene rod. (4 marks)

(c) A current of 20 A passes a point in a conductor for 8 s. (Electronic charge =  $1.6 \times 10^{-19}$  C)

- What do you understand by a current of 20 A? (1 mark)
- How many electrons flow in the conductor? (3 marks)

(d) Figure 3 shows two pith balls coated with metallic paint and suspended by light insulating threads

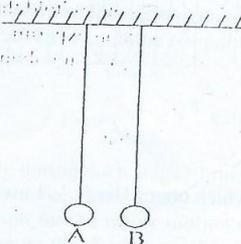


Figure 3

- State what you would observe as soon as both balls are given equal positive charges. (1 mark)
- State how this "effect" varies with the separation between A and B. (1 mark)
- Draw a diagram showing all the forces acting on ball A while the "effect" is in operation. (3 marks)

- 7.7. (a) (i) State Ohm's law. (2 marks)  
 (ii) Sketch graphs of current (I) (on the vertical axis) against p.d. (V) (on the horizontal axis), for a copper wire, and a semiconductor diode respectively. (2 marks)

(b) A student carried out an investigation on the variation of current flowing through an unnamed material with the p.d. across its ends. She obtained the following results:

p.d./V	0.50	1.00	2.00	3.00	4.00
Current/A	0.07	0.10	0.14	0.17	0.20

- (i) Plot a graph of p.d. (vertical axis) against current (horizontal axis). (4 marks)  
 (ii) Use the graph to find the p.d. across the material when the current is 0.18 A, and hence determine the resistance of the material. (2 marks)
- (c) Figure 4 shows four lamps connected in a circuit

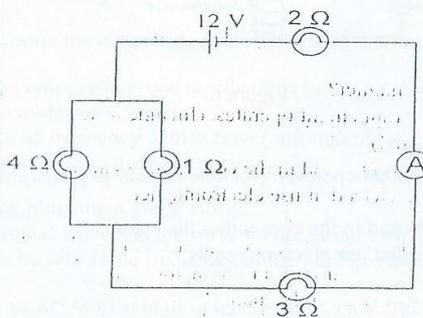


Figure 4

- (i) Calculate the effective resistance of the two lamps connected in parallel. (2 marks)  
 (ii) Calculate the total resistance in the whole circuit. (1 mark)  
 (iii) Calculate the rate at which energy is dissipated in the 3Ω lamp. (4 marks)  
 (iv) Calculate the p.d. across the 4Ω lamp. (1 mark)  
 (v) State two advantages of connecting lamps in parallel rather than in series. (2 marks)

8.8 (a) Figure 5 shows a conductor carrying a d.c. current upwards through a vertically placed cardboard.

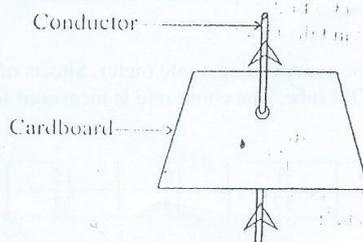


Figure 5

- (i) Copy the figure and draw the magnetic flux pattern around the conductor. (2 mark)  
 (ii) On a separate diagram draw the magnetic flux pattern around two close conductors each carrying currents vertically upwards. Indicate the direction of the force between the two conductors. (3 marks)

- (b) Figure 6 shows an arrangement that can be used to investigate how electromagnetic forces vary with current.

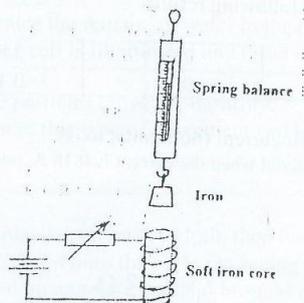


Figure 6

- (i) What is an electromagnet? (1 mark)
  - (ii) Explain how the arrangement operates. (Include in your explanation how measurements are taken; how current is varied). (5 marks)
  - (iii) Explain why soft iron is used in the core rather than steel. (2 marks)
  - (iv) Name two other devices that use electromagnets. (2 marks)
- (c) A transformer connected to a 240 V a.c. mains used to light a 12 V, 36-W lamp.
- (i) What current does the lamp need to light correctly? (2 marks)
  - (ii) What current is drawn from the mains? (2 marks)
  - (iii) State any assumption you made in your calculation. (1 mark)

- 7 (a)  $^{12}_6\text{C}$  and  $^{14}_6\text{C}$  are both isotopes of carbon. The second isotope,  $^{14}_6\text{C}$ , is radioactive and decays by beta emission.
- (i) What are isotopes? (1 mark)
  - (ii) Write down one similarity and one difference between the two isotopes. (2 marks)
  - (iii) What sub-atomic particle has the same nature as the beta particle? (1 mark)
  - (iv) What part of the atom emits the beta particle? Explain how this is possible? (2 marks)
  - (v) Draw a diagram to show the nature of tracks that the beta particles would produce in a cloud chamber, and explain their nature. (2 marks)

- (b) A source of gamma radiation is pointed at a GM tube connected to a rate meter. Sheets of lead of different thicknesses are placed between the source and the GM tube. The count rate is measured for each sheet and the results recorded in a table.

Thickness of lead sheet /mm	0	5	10	15	20
Count rate /counts/sec	76	57	43	32	24

- (i) Plot a graph of count rate (y - axis) against thickness (x - axis). (5 marks)
- (ii) What thickness of lead is needed to half the intensity of the gamma radiation? Show how you obtain your value. (2 marks)
- (iii) A similar source emits gamma rays at the rate of 120 counts/sec. It is to be transported in a lead container, and the emission of gamma rays from the container must not exceed 15 counts/sec. What minimum thickness of container is required? (3 marks)
- (iv) It is suggested that placing the lead container in a strong electric field would further reduce the gamma emission. State whether this is true and explain your answer. (2 marks)

10. (a) (i) Draw labelled graphs to illustrate the meaning of the words: amplitude, wavelength, and period. (3 marks)  
(Word definitions are not required).  
(ii) Describe an experiment to show that sound waves cannot travel through a vacuum but light can. (5 marks)

- (b) Figure 7 shows how water waves behave after passing through an aperture.

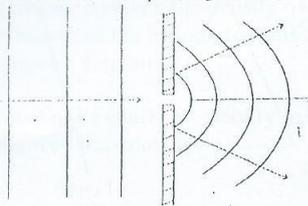


Figure 7

- (i) State the name of this effect. (1 mark)  
(ii) State two factors that determine the magnitude of this effect on the incoming water wave. (2 marks)
- (c) Sound waves are associated with compressions and rarefactions in the air through which they travel.  
(i) Explain the meaning of the underlined words. (2 marks)  
(ii) Sound waves from a source of frequency 510 Hz travel through air at a speed of 340 m/s. Calculate the distance from one compression to the nearest rarefaction. (2 marks)
- (d) A sound wave can be produced by plucking a guitar string.  
(i) Differentiate between the sound wave and the wave on the guitar string itself. (2 marks)  
(ii) Briefly describe three ways by which the frequency of the note produced by a guitar can be increased. (3 marks)

11. (a) (i) What is meant by the term refractive index? (1 mark)  
(ii) A swimmer standing by the edge of a pool of water observes that the swimming pool looks shallower than it really is. Draw a labeled ray diagram that explains her observation. (4 marks)
- (b) Some flat fish (locally called "cover pot") have their both eyes facing vertically upwards.  
(i) Name the phenomenon that enables such fish to see objects below them in water. (1 mark)  
(ii) Draw a labelled ray diagram to show how this is possible. (2 marks)

(c) Figure 8 shows a set up used to produce a pure spectrum of white light.

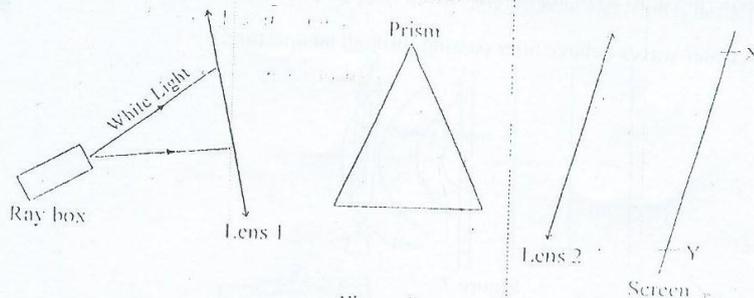


Figure 8

- (i) Copy the figure and complete the paths of the two rays to show how the pure spectrum is formed. (3 marks)
  - (ii) Name the radiations immediately beyond X and Y on the screen and state how each of the radiations could be detected. (4 marks)
  - (iii) What do you call the distance between the ray box and Lens 1? (1 mark)
- (d) A simple lens camera is to be used to take a snap short of a 1.8 m tall soldier, standing 5 m away from the camera lens. After all adjustments the film is found to be 100 mm away from the lens. Calculate the height of the image that will be formed on the film? when the shutter is eventually opened. (4 marks)