June 2011

1. a) (i) What is a force? (1 mark)
(ii) Name two types of force, and for each describe a situation where it acts (4 marks)

b) A trolley of mass 0.2 kg moves down a plane inclined at 20° to the horizontal with uniform velocity.

(i) Explain how Newton's First Law of motion applies to the motion of this trolley. (2 marks)
(ii) Draw a diagram showing all the forces acting on the trolley. (3 marks)
(iii) Name any two of the forces whose resultant on the trolley is Zero (2 marks)

c) A uniform metre rule weighs 0.90N is supported on a knife edge placed at the 40 cm mark. It is found that the metre rule balances horizontally when a mass of weight 0.45 N is hung from the 15 cm mark.

(i) Draw a diagram of the metre rule balanced on the knife edge, showing all the forces acting, and the positions at which they act on the metre rule. (2 marks)
(ii) State the two conditions that must be fulfilled for the metre rule to be balanced and remain stationary (4 marks)
(iii) Calculate the moment of the mass about the knife edge (2 marks)

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2. a) A body A moves with a uniform velocity of 10m/s, while another body B moves from rest at the time with a uniform acceleration of $2m/s^2$.
Define the underlined words, stating the unit of each. (2 marks)

b) In an experiment to determine a value for the acceleration due to gravity (g) the time (t in seconds) for a steel ball to fall through various heights (h in metres) from rest was measured. The results of the experiment are given in the table below

h/m	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
t/s	0	0.14	0.21	0.25	0.29	0.32	0.35	0.38
t^2/s^2								

(i) Copy the table and complete the row for t^2/s^2 (2 marks)
(ii) Plot a graph of h (on the y-axis), and draw the best straight line from the origin through the points. (4 marks)
(iii) Write down the equation of motion on which the graph is based (1 mark)
(iv) Find the gradient of the graph (2 marks)
(v) Use the gradient and the equation of motion in (iii) above to obtain a value for the acceleration due to gravity (g). (2 marks)

c) A stationary gun of mass 500 Kg fires a shell of mass 1Kg with a velocity of 600m/s and recoils (moves backwards) as a result.

i) State the law of conservation of linear momentum and name another daily example where the law is observed. (3 marks)
ii) Explain why the gun moves backwards (2 marks)
iii) Calculate the initial recoil velocity. (2 marks)

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3. a) A large rubber ball which contains no air is dropped from a height, h, onto a hard surface. It bounces back to a height of $\frac{4}{5}h$

(i) State the law of conservation of energy. (2 marks)
(ii) Explain all the energy chances that take place while the ball falls and bounces (5 marks)
(iii) Why does the ball eventually stop bouncing? (2 marks)

b) Beri wants to fry some potatoes. She puts an empty sauce pan on a heating coil rated 1.2 KW When the sauce pan gets dry she pours in 0.5 Kg of oil. She then notices that after heating for 2 minutes 5 seconds, the temperature of the oil rises from 45°C to 120°C and remains constant at 120°C.
(i) Define heat capacity (1 mark)
(ii) Calculate the value of the specific heat capacity of oil using the above information. (2 marks)
(iii) Explain why the temperature of the oil remained constant at 120°C. (2 marks)

c) An inclined plane of length 4 m is used to raise a load of mass 20 kg through a vertical height of 1m. It is found that an effort of 80 N is necessary to move the mass up the slope at a constant speed.

(i) Calculate the work done by the effort (2 marks)

(ii) Calculate the useful work done on the load (2 marks)

(iii) Calculate the efficiency of this inclined plane as a system for raising loads (2 marks)

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4. (a) (i) Define the term density for a liquid and explain how it affects the pressure exerted by the liquid at a point in the liquid. (2 marks)

(ii) Describe how you would proceed to determine the density of an irregularly shaped stone in the physics laboratory. (5 marks)

(b) A civil engineer wishes to lay a regularly shaped block of dimensions 2m X 4m X 5m and mass 300 Kg under a bridge such that it exerts the least pressure on the ground. Calculate the least pressure that the block alone can exert on the ground. (4 marks)

(c) (i) State Hooke's Law. (1 mark)
(ii) Sketch a force – extension graph for a material that obeys Hooke's Law for loads ranging up to and beyond the elastic limit. Indicate the elastic limit on your graph. (3 marks)
(iii) The length of a wire that obeys Hooke's law increases from 80 mm to 83 mm when a mass of 0.30 kg is suspended on it. The length increases to 94 mm, when another mass is added to it. Find the additional mass on the wire. (5 marks)

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5. (a) (i) What is Brownian motion? (2 marks)
(ii) With the aid of a well labeled diagram, describe an experiment to show Brownian motion in a gas, and explain the observations (5 marks)

(b) Briefly explain each of the following observations using the molecular (kinetic) theory.
(i) A gas confined in a vessel exerts pressure on the walls of the vessel. (3 marks)

(ii) There is an increase in pressure when a gas is warmed inside a closed container. (2 marks)

(c) (i) Define absolute zero and state its value in degrees Celsius. (2 marks)

(ii) Sketch a graph of volume against temperature in Celsius for a fixed mass of gas, and indicate the position of absolute zero (3 marks)

(iii) Explain whether absolute zero is practically attainable. (3 marks)

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6. (a) Perspex is rubbed with cloth.

(i) State and explain what is observed when each of the Perspex and cloth are taken near the cap of a positively charged gold leaf electroscope. **(4 marks)**

(ii) The Perspex is now taken close to but not touching a suspended neutral pith ball. State and explain what happens and hence the subsequent observation when the Perspex touches the pith ball. **(4 marks)**

(iii) Describe with the aid of diagram how a metal ball on an insulating support can be charged negatively by induction. **(4 marks)**

(b) A charge of 2.4×10^{-4}C due to movement of electric charges is carried past a point in an electric circuit in 2.0×10^{-3} s.

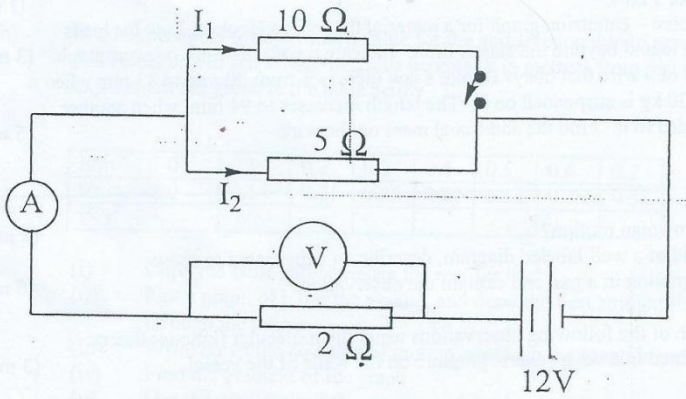
(i) Determine the size of the current in the circuit. **(2 marks)**

(ii) Determine the number of electrons that have passed through the point in this time. (The charge on an electron, $e = 1.6 \times 10^{-19}$ C) **(2 marks)**

(iii) If a p.d of 240 V is responsible for this movement of charges, calculate this work done in moving the electrons in 2×10^{-3} s **(2 marks)**

(iv) Hence, calculate the power involved. **(2 marks)**

7. (a) Figure 1 shows three resistors connected to a 12 V battery with meters A and V connected in their correct positions



(i) Name the meters A and V **(2 marks)**

(ii) Calculate the readings of meters A and V when the key K is open **(3 marks)**

(iii) Calculate the readings of meters A and V when K is closed **(5 marks)**

(b) In a modern power socket there are three cable terminals. One of the cables carries a switch and fuse. Name the three cables and specify the one on which each of the fuse and switch is connected. **(4 marks)**

(c) AES SONEL charges electrical energy in KWh

(i) What is the equivalence of 1 KWh in joules? **(2 marks)**

(ii) On an electric cooker is marked 4000W. Find the cost of using this cooker 5 hours daily for 30 days, if electricity costs 55Frs per unit. **(4 marks)**

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8. (a) Figure 2 shows a fixed steel rod and a free soft iron rod lying parallel to each other a short distance apart on a horizontal cardboard inside a solenoid (coil). The ends of the coil are connected to a battery rheostat and switch in series

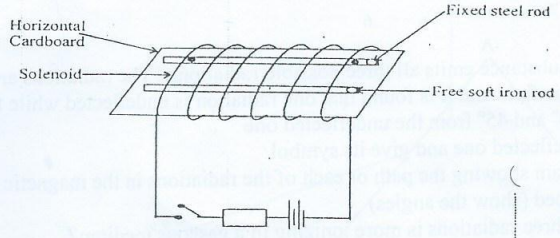

Figure 2

Copy the diagram with the switch closed and:

(i) indicate the current direction in each turn of the coil (1 mark)
(ii) draw in the magnetic field pattern of the coil indicating the field direction and polarity at each end of the coil. (3 marks)

Explain the following observations.
(iii) When the switch is closed, the soft iron rod rolls further away from the steel rod. (3 marks)
(iv) When the switch is opened, the soft rod rolls back into contact with the steel rod. (3 marks)

(b) Figure 3 shows a rectangular coil ABCD lying between the pole pieces of a permanent magnet with its plane parallel to the magnetic field.

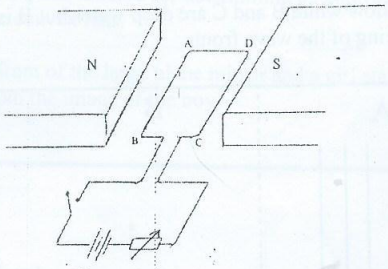

Figure 3

When the switch is closed,
(i) On which sides of the coil will a force act? Give your reason (3 marks)
(ii) state two ways of increasing the magnitude of the force without adding or replacing any component. (2 marks)
(iii) Name one device which is an application of a force on a current carrying conductor in a magnetic field. (1 mark)

(c) A transformer is required to operate a 6V appliance from the 240V mains supply.
(i) Determine the ratio of the secondary turns to the primary turns. (2 marks)
(ii) State two factors likely to be responsible for the efficiency of the transforms to be less than 100%. (2 marks)

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9. (a) A certain radioactive substance emits all three possible radiations. The radiations are allowed to pass through a magnetic field and it is found that one radiation is undeflected while the other two make angles of 60° and 45° from the undeflected one

(i) Name the undeflected one and give its symbol **(2 marks)**

(ii) Sketch a diagram showing the path of each of the radiations in the magnetic field as described (show the angles) **(3 marks)**

(iii) Which of the three radiations is more ionizing in a gaseous medium? Give a reason for your answer. **(2 marks)**

(b) The following readings were observed from a G.M. counter after every 2 minutes after it was switched on in a physics laboratory: 20, 25, 23, 26, 16.
A radioactive substance was next introduced in front of the counter and the following readings were observed after every 10 hours:

Counters per second	320	210	180	95	70	65
Time/hours	0	10	20	30	40	50

(i) Define background radiation and find its value from the information given. **(3 marks)**

(ii) Plot a graph of corrected count rate against time. **(6 marks)**

(iii) Determine the half life of the radioactive substance from your graph **(2 marks)**

(iv) State one use of half life of a named radioactive substance. **(2 marks)**

10. Plane wave fronts are generated from a source S in a ripple tank as shown in figure 4. The tank is made up of 3 sections A,B and C. A is shallow while B and C are deep water but B is separated from C by a barrier with a smaller opening than the spacing of the wave fronts.

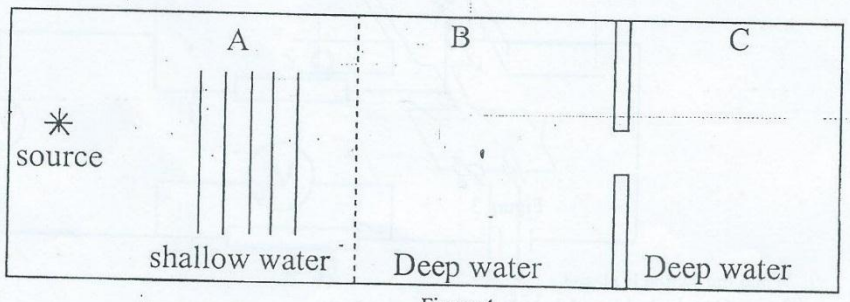

Figure 4

(a) (i) Copy all of the diagram and continue the waves to show what happens as the waves pass through sections. B and C. **(4 marks)**

(ii) Name the phenomena taking place in sections B and C and explain the nature of each. **(4 marks)**

(b) The trace of a sound note produced by a tuning fork is registered on a CRO. It reveals 6 vibrations made in 1.2×10^{-1} s and a vertical distance of 4 cm between crest and trough.

(i) Sketch a displacement time graph for the note indicating some values on the axes **(3 marks)**

(ii) Determine:
- the period **(2 marks)**
- the frequency **(2 marks)**
- the amplitude of the note **(2 marks)**

(iii) Given that the waves generated as a result of vibrations have a speed of 20 m/s; determine the wave length of the waves. **(2 marks)**

(c) State a daily experience that shows that the speed of sound in air is less than that of light. **(1 mark)**

11. (a) Figure 5. shows the arrangement used by a student to produce the spectrum of white light.

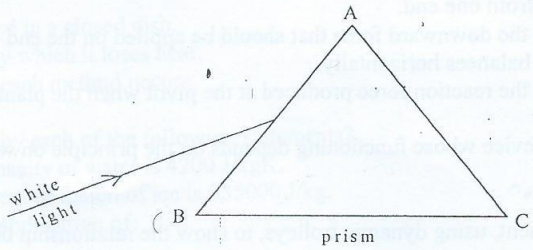

Figure 5

(i) Copy the diagram and show on it how the spectrum is formed, indicating clearly which colour is deviated least and which one most. **(4 marks)**

(ii) Is this spectrum pure or impure? Explain. **(2 marks)**

(iii) The speed o light in air is 3.0×10^8 m/s and the refactive index of water is 4/3. Determine the speed of light in water. **(2 marks)**

(b) (i) With the aid of labelled ray diagrams show how a convex lens can form a magnified real image and a magnified virtual image. **(4 marks)**

(ii) When the above real image is formed, the object is 20 cm in front of the lens, and the image is magnified four times. How far is the image from the lens? **(2 marks)**

(c) Describe and explain a quick method for determining an approximate value for the focal length of the convex lens. **(4 marks)**

(d) A boy stands 2 m in front of the large plane mirror and a girl stands 1 m behind him. How far is the girl from the image of the boy? **(2 marks)**

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