Section A. Attempt all questions (55 marks)

1.

a) ..... is an example of a scalar quantity?
i) Velocity. ii) Force. iii) Volume. iv) Acceleration. **(1mark)**

b) ..... is an example of a vector quantity?

i) Mass. ii) Force. iii) Volume. iv) Density. **(1mark)**

2.

a) A scalar quantity:

i) always has mass. ii) is a quantity that is completely specified by its magnitude. iii) shows direction. iv) does not have units. **(1mark)**

b) A vector quantity

i) can be a dimensionless quantity. ii) specifies only magnitude. **(1mark)**

iii) specifies only direction. iv) specifies both a magnitude and a direction.

3.

a) The difference between speed and velocity is: (**1mark)**

i) Speed has no units. ii) Speed shows only magnitude, while velocity represents both magnitude (strength) and direction. iii) They use different units to represent their magnitude. iv) Velocity has a higher magnitude.

b) The resultant magnitude of two vectors:

i) Is always positive. ii) Can never be zero. iii) Can never be negative. iv) can be zero. **(1mark)**

4. Which of the following is not true.

i) Speed can be negative. ii) Velocity can be negative. iii) Velocity is a vector. iv) Speed is a scalar. **(1mark)**

5.

a) Define impulse **(1mark)**
b) derive its relation to linear momentum of the body on which it acts.

(2marks)

6. State the conditions for equilibrium of a rigid body under the action of coplanar forces. **(2marks)**

7. A monochromatic light is incident on one refracting face of a prism of refracting angle 60^0, made of glass of refractive index 1.50. Calculate the least angle of incidence on the first refracting face for the ray to emerge

grazing the second refracting face. **(3 marks)**

8.

a) Define the time of flight and range as applied to projectile motion. **(2 marks)**

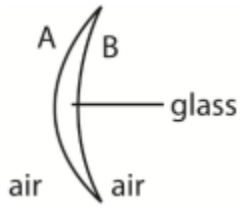
b) A projectile is fired in air with a speed u ms^{-1} at an angle θ to the horizontal. Find the time of flight of the projectile. **(2marks)**

9. Match elements in **the column A** with their meanings or uses in **the column B** as they are used in electric circuits. **(7.5 marks)**

[Use Numbers and letters]

Column A	**Column B**
1. Electric charge	**A.** A circuit with two or more branches for the current to flow
2. Insulator	**B.** A material that electrons can move through
3. Conductor	**C.** Flow of electrons through a conductor
4. Electroscope	**D.** Made up of series and parallel circuits
5. Electric current	**E.** Device to break a circuit
6. Resistance	**F.** Poor conductor of electricity
7. Battery	**G.** Unit for measuring rate of electron flow in a circuit
8. Circuit	**H.** Having too many or too few paths for the current
9. Series circuit	**I.** A temporary source of electric current
10. Parallel circuit	**J.** Rate at which a device converts electrical energy to another form of energy.
11. Complex circuit	**K.** having one path for electric current
12. Volt	**L.** Physical property of a body that allows it to interact with other bodies
13. Ampere	**M.** Device that detects electric charges
14. Switch	**N.** Opposition to the flow of electricity
15. Power	**O.** Electric circuit where current flows through all parts of the circuit
	P. Unit to measure electric potential difference

10. The figure below is a glass convex lens in air with surfaces A and B having radii of curvature 10cm and 15cm respectively.



If the refractive index of the glass material is 1.50. Calculate the power of the lens. **(3marks)**

11.

a) State the principle of conservation of mechanical energy. **(1mark)**

b) Show that a stone thrown vertically upwards obeys the principle of conservation of mechanical energy. **(3marks)**

12.

a) Define energy degradation **(1 mark)**

(b) What is the major difference between a d.c. motor and a.c. generator?

(1mark)

(c) Describe with the aid of a diagram the mode of action of a simple d.c. generator. **(4marks)**

(d) Sketch the output (graph of electromotive force with time) of a d.c. generator. **(1mark)**

13.

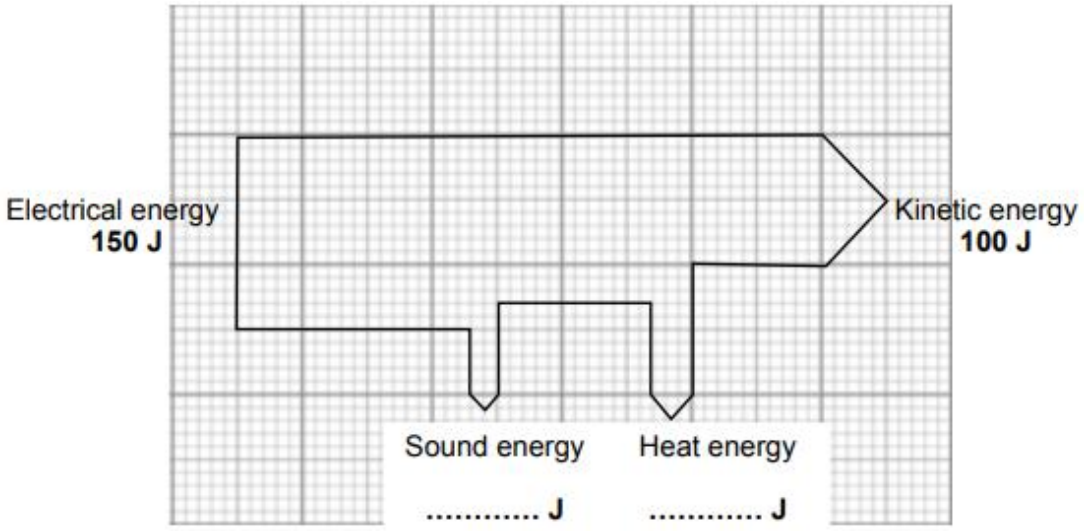
a) Use a table to give three differences between renewable and non-renewable energy sources **(3 marks)**

b) List those energy sources that are fossil fuels. **(1.5 marks)**

c) What main advantage do fossil fuels have over the renewable energy resources? **(1 mark)**

d) What are two main disadvantages of fossil fuels compared to renewable energy? **(2 marks)**

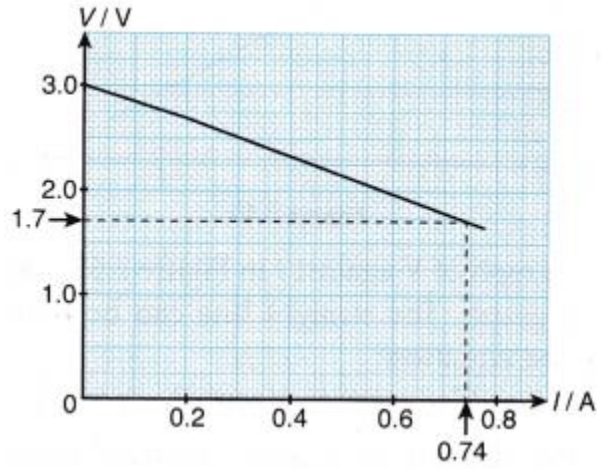
14. Here is a Sankey diagram showing information about the energy transfers for the fan.



a) Complete the Sankey diagram to show the amounts of sound and heat energy transferred. **(2marks)**

b) Calculate the percentage efficiency of the fan. **(2marks)**

15. The graph below shows the results of an experiment to determine the e.m.f. and the internal resistance of a cell. **(3marks)**



From the graph, determine the e.m.f. of the cell and its internal resistance.

Section B. Attempt ONLY THREE questions (45 marks)

16.

a) Derive an expression (Formula) for the focal length of a combination of two thin converging lenses in contact, in terms of their focal lengths. **(4marks)**

b) Draw a ray diagram to show how two converging lenses, one of long focal length, f_1, and the other of shorter focal length, f_2, can be arranged to make an astronomical telescope in normal adjustment. **(3marks)**

c) Derive the expression (Formula) for the magnifying power of the telescope in this setting. **(3marks)**

d) The objective of a compound microscope has focal length of 2.0cm while the eyepiece has a focal length of 5.0cm. An object is placed at 2.5cm in front of the objective. The distance of the eyepiece from the objective is adjusted so that the final image is 25cm in front of the eyepiece. Find the distance between the objective and the eyepiece. **(3marks)**

e) State two differences between compound microscopes and telescopes. **(2marks)**

17.

a) i) Define a couple of forces **(1mark)**

ii) State the principle of moments **(2marks)**

b) A rod mass 8kg and 2m long is balanced horizontally by two inextensible string tied vertically to the end A and B of the rod when a mass of 20kg hangs 0.5m from A. Find the tensions in the strings at A and B. (take g = $10ms^{-2}$) **(3marks)**

c) A mass of 5.0kg is suspended from the end A of a uniform beam of mass 1kg and length 1.0m. The end B of the beam is hinged in a wall. The beam is kept horizontal by a rope attached to A and a point C, in the wall at a height 0.75m above B.

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

ii) Calculate the tension in the rope. **(3marks)**

iii) Calculate the force exerted by the hinge on the beam? **(2marks)**

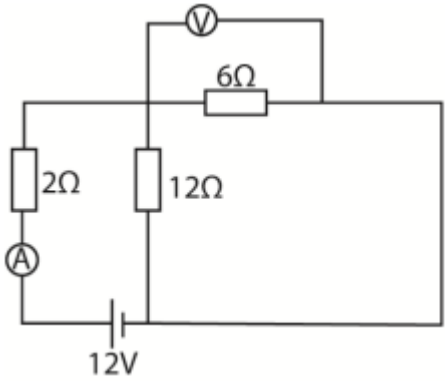
iv) Determine the direction of the force exerted by the hinge on the beam? **(2marks)**

18.

(a) (i) Define a volt. **(1mark)**

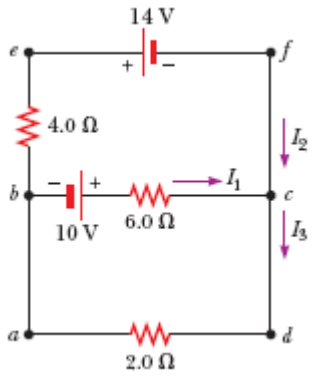
(ii) Derive the formula for the combined resistance of three resistors in parallel. **(4marks)**

(iii)



In the circuit above, the battery has negligible internal resistance. Find the ammeter and voltmeter readings **(4marks)**

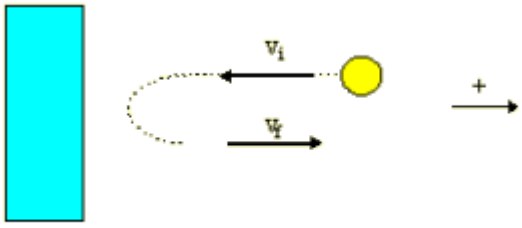
b) Use Kirchhoff's laws to find the currents in the following circuits **(6marks)**



19.

a) Use a three-column table to compare perfectly elastic collision, inelastic collision, and perfectly inelastic collision (three comparisons) **(3marks)**

b) A ball of mass 0.5 kg with speed 15.0 m/s collides with a wall and bounces back with a speed of 10.5 m/s.



If the motion is in a straight line, calculate

(i) the initial momentum **(2marks)**

(ii) the final momentum and **(2marks)**

(iii)the impulse **(2marks)**

(iv) If the wall exerted an average force of 1000N on the ball, how long did the collision last? **(2marks)**

b) A 50 kg skater is travelling due east at a speed of 3 m/s. A 70.0kg skater is moving due south at a speed of 7m/s. They collide and stick together after the collision, managing to move off at an angle θ south of east with a common speed υ_f. Find (a) the angle θ and (b) the speed υ_f, assuming that friction can be ignored. **(4marks)**

20.

a) i) Describe with the aid of a labelled diagram, the use, parts, principle of working, and the nature of the image given by a projection lantern (Slide projector). **(5marks)**

ii) A projector produces an image of area $2m^2$ on a screen placed 5m from the projection lens. If the area of the object slide is $8cm^2$, calculate the focal length of the projection lens. **(3marks)**

b) (i) With the aid of labelled diagram, describe the essential parts of a photographic camera. **(3 marks)**

(ii) Explain how chromatic and spherical aberration are minimized in a photographic camera. **(4marks)**