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ACACIA SECONDARY SCHOOL

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"PHYSICS HOME PACKAGE"
FORM FOUR

1. Define *speed*, *velocity* and *acceleration.*

(a) A stone is released from rest at the top of a tall tower. Draw a distance-time graph of its free fall under gravity during the first 6 seconds. Show your table of values.

(b) A bullet, fired vertically upwards from a gun held 2 m above the ground, reaches its maximum height in 4 seconds. Calculate:

(i) the initial velocity of the bullet,

(ii) the total distance the bullet travels by the time it hits the ground. [$g = 10ms^{-1}$].

2. (a) A motorist, travelling at $90km/h$ applies his brakes and comes to rest with uniform retardation in 20 seconds. Calculate the retardation in m/s^2.

(b) A trolley starts from rest on an inclined plane and moves down it with uniform acceleration. After having moved a distance of 40 cm its velocity is $20\ cm/s$. Find its acceleration in:

(i) in cm/s^2 (ii) $in\ m/s^2$

3. (a) State the principle of conservation of momentum

(b) A car of mass $1000\ kg$ travelling at $36\ km/h$ is brought to rest over a distance of $20\ m$. Find (i) the average retardation (ii) the average breaking force in newtons.

(c) A resultant force of 12 N acts for 5 seconds on a mass of $2\ kg$. What is the change in momentum of the mass? What would be the change in momentum of a mass of $10\ kg$ under the same conditions?

4. A bullet of mass $0.006\ kg$ travelling at $120\ m/s$ penetrates deeply into a fixed target, and is brought to rest in 0.01 second. Calculate:

(i) the distance of penetration of the target,

(ii) the average retarding force exerted on the bullet.

5. (a) What is the relation between force and momentum?

(b) A rocket of total mass $5000\,kg$ of which $4000\,kg$ is propelled fuel is to be launched vertically. If the fuel is consumed at a steady rate of $50\,kg/s$, what is the least velocity of the exhaust gases if the rocket will just lift off the launching pad immediately after firing?

6. (a) What is meant by:

(i) the resultant (ii) the equilibrant of two or more forces?

(b) A garden roller is pulled with a force of 200 N acting at an angle of 50° with the ground level. Find the effective force pulling the roller along the ground.

(c) A $50\,g$ mass is placed on a straight air track sloping at an angle of $45°$ to the horizontal. Calculate in m/s^2 , the acceleration of the load as it slides down and also the distance it would move from rest in 0.20 second.

7. (a) State triangular and parallelogram law of vector addition

(b) (i) Find by drawing and also calculation the resultant of two forces each 5 N acting at a point at an angle of $60°$ with each other.

(ii) Three strings are attached to a small metal ring. Two of the strings make an angle of $70°$ and each is pulled with a force of 7 N. What force must be applied to the third string to keep the ring stationary?

8. (a) Two forces acting at a point make angles of $25°\ and\ 65°$ respectively with their resultant which is of magnitude 15 N. Find the magnitudes of the two component forces.

(b) A body is in equilibrium under the action of three forces. One force is $6\,N$ acting due East and one is $3\,N$ in a direction of $60°$ North of East. What is the magnitude and direction of the third force?

9. (a) (i) State the conditions that a number of parallel forces are said to be in equilibrium

(ii) Define Centre of gravity.

(b) (i) State and briefly explain three types of equilibrium

(ii) It is found that a uniform wooden plank 100 cm long and of mass $95\,g$ can be balanced on a knife-edge when a $5g$ mass is hung 10 cm from one end. How far is the knife-edge from the center of the wooden plank?

(c) A uniform tube of length 5 m and mass $9\,kg$ is suspended horizontally by two vertical wires attached at 50 cm and 150 cm respectively from the ends of the tube. Find the tension in each wire.

10. (a) A stone of mass $500\,g$ is thrown vertically upwards with a velocity of $15\,m/s$. Find

(i) the potential energy at the greatest height (ii) the kinetic energy on reaching the ground

$[Assume\ g = 10\,m/s^2]$

(b) Water is pumped through a horse-pipe at the rate of $75\,liters/\,min$ and issues from the nozzle with a velocity of $20\,m/s$. Find (i) the force of reaction on the nozzle in newtons.

(ii) the useful power of the pump in watts. (Assume 1 liter of water has a mass of $1\,kg$)

11. (a) Define the newton and the joule.

A mass of 8 kg is pulled by a force of 20 N along the smooth floor. Find:

(i) the acceleration (ii) the velocity after 4 seconds.

(iii) the distance travelled in 4 seconds (iv) the work done by the force

(b) A ball of mass 1 kg is dropped from a height of 7 m and rebounds to a height of 4.5 m. Calculate:

(i) its kinetic energy just before the impact;

(ii) its initial rebound velocity and kinetic energy. Account for the loss of kinetic Energy on impact.

12. (a) (i) Define velocity ratio and mechanical advantage

(ii) A common windlass is used to raise a 480 N load of earth from an excavation by the application of an effort of 200 N at right angles to the handle and crank. If the handle is 33 cm from the axis and the radius of the axle is 11 cm, find the velocity ratio and the mechanical advantage.

(b) (i) What do you understand by the efficiency of a machine?

(ii) A system of levers with a velocity ratio of 25 overcomes a resistance of 3300 N when an effort of 165 N is applied to it, calculate the mechanical advantage of the system and its efficiency.

13. (a) Define *work* and *power* . Name and define the SI unit of power.

(b) By using a block and tackle a man can raise a load of 720 N by an effort 200 N. Find

(i) the mechanical advantage of the method.

(ii) the man's useful power output if he raises the load through 10 m in 90 seconds.

14. (a) A box of mass 12 kg is pulled up a straight smooth incline at 30° to the horizontal , for a distance of 5 m . Calculate the work done.

(b) A man uses a rope to haul a packing case of weight 750 N up an inclined wooden plank of effective length 4.5 m and on to a platform 1.5 m high. The frictional force between case and plank is 200 N. Find:

(i) the effort he must exert on the rope (ii) the velocity ratio

(iii) the mechanical advantage (iv) the useful work done on the packing case in joules.

(c) Briefly explain why the efficiency of a machine is less than 100 percent.

15. (a) A tin containing 5000 $cm^3$of paint has a mass of 7 kg.

(i) If the mass of the empty tin, including the lid, is 0.5 kg calculate the density of the paint.

(ii) If the tin is made of a metal which has a density of 7800 kg/m^3 calculate the volume of the metal used to make the tin and the lid.

(b) (i) Define density and relative density.

(ii) An empty 60 liter petrol tank has a mass of 10 kg. What will be its mass when its full of liquid of relative density 0.72.

(c) The mass of a density bottle is $18\ g$ when empty, $44\ g$ when full of water and $39.84\ g$ when full of a second liquid, Calculate the density of the liquid.

16. (a) State law of floatation and Archimedes principle

(b) Explain briefly how hydrometer is used to measure the relative density of liquids.

(c) (i) What volume of brass of density $8.5\ g/cm^3$ must be attached to a piece of wood of mass $100\ g$ and density $0.2\ g/cm^3$ so that the two together will just submerge beneath water?

(ii) An ordinary hydrometer of mass $28\ g$ floats with 3 cm of its stem out of water. The area of cross-section of the stem is $0.75\ cm^2$. Find the total volume of the hydrometer and the length of the stem above the water surface when it floats in a liquid of relative density 1.4.

17. (a) A metal cube of side 2 cm weighs 0.56 N in air. Calculate:

(i) its apparent weight when immersed in white spirit of density $0.85\ g/cm^3$

(ii) the density of metal of which it is made.

(b) A cube made of oak tree and of side 15 cm floats in water with 10.5 cm of its depth below the surface and with its sides vertical. What is density of the oak tree?

18. (a) A block of wood of mass $24\ kg$ floats in water. The volume of the wood is $0.0032\ m^3$. Find: (i) the volume of the block below the surface of water;

(ii) the density of the wood. [$Density\ of\ water\ 1000\ kg/m^3$]

(b) A cube of wood of volume $0.2\ m^3$ and density $600\ kg/m^3$ is placed in a liquid of density $800\ kg/m^3$.

(i) What fraction of the volume of the wood would be immersed in the liquid?

(ii) What force must be applied to the cube so that the top surface of the cube is on the same level as the liquid surface?

19. (a) Define the following terms

(i) Surface tension (ii) Elasticity (iii) Capillarity (iv) Cohesion (v) Adhesion

(b)Why is it that a needle may float on clean water but sinks when some detergent is added to the water?

20. (a) Define the following terms

(i) Upper fixed point (ii) Lower fixed point (iii) Six's maximum and minimum thermometer

(b) Explain why a clinical thermometer have a narrow constriction in its bore just above the bulb.

(c) (i) List advantage and disadvantages of mercury and alcohol as thermometric liquid.

(ii) The ice and steam point on ungraduated thermometer are found to be $192\ mm$ apart. What temperature in $°C$ when the length of the mercury thread is $67.2\ mm$ above the ice point mark?

(iii) State three desirable physical properties of a thermometric liquid.

21. (a) Define the following terms

(i) Bimetallic strip (ii) thermometer (iii) Linear expansivity (iv) Anomalous expansion of water

(b) (i) Explain briefly the practical importance of thermal expansion

(ii) Explain briefly the biological importance of the anomalous expansion of water

(c) How does the density of water change as the temperature is lowered from $15°C$ to freezing point?

22. (a) (i) An iron tyre of diameter 50 cm at 15℃ is to be shrunk on to a wheel of diameter 50.35cm. To what temperature must the tyre be heated so that it will slip over the wheel with a radial gap of 0.5mm? (Linear expansivity of iron = $0.000012/K$).

(ii) A metal rod has a length of 100 cm at 200℃. At what temperature will its length be 99.4 cm if the linear expansivity of the material of the rod is $0.00002/K$?

(b) A steel tape of correct length at 15℃ is used to measure distance on a day when the temperature is 10℃. If the linear expansivity of steel is $11 \times 10^{-6}/K$, what is the error of measuring a distance of $20\ m$?

23. (a) State the following gas laws (i) Charles's law (ii) Boyle's law (iii) Pressure law

(b) (i) $125\ cm^3$ of gas are collected at 15℃ and $755\ mm$ of mercury pressure. Calculate the volume of the gas at $s.t.p$.

(ii) An empty barometer tube, 1 m long, is lowered vertically, mouth downwards, into a tank of water. What will be the depth of the top of the tube when the water has risen 20 cm inside the tube? (Atmospheric pressure may be assumed equal to 10.4 m head of water)

(iii) When tested in a cool garage at 12℃ a motor tyre is found to have a pressure of $190\ kPa$. Assuming the volume of the air inside remains constant, what would you expect the pressure to become after the tyre has been allowed to stand in the sun so that the temperature rises to 32℃ ? Atmospheric pressure $= 100\ kPa$ ($1\ kPa = 1000\ N/m^2$)

24. (a) State three methods of heat transfer and how heat is transferred.

(b) Briefly explain how land and sea breezes occur

(c) Explain briefly on how a Vacuum flask prevents heat transfer (heat loss and gain) of the liquid kept inside it.

25.(a) Define the following terms (i) Heat Capacity (ii) Specific Heat Capacity

(b) (i) How many joules of heat are given out when a piece of iron of mass $50\ g$ and specific heat capacity $460\ J/kgK$, cools from 80℃ to 20℃?

(ii) The temperature of $500\ g$ of a certain metal is raised to 100℃ and it is then placed in $200\ g$ of water at 15℃. If the final steady temperature rises to 21℃, calculate the specific capacity of the metal.

26. (a) A bath contains $100\ kg$ of water at 60℃. Hot and cold taps are then turned on to deliver $20\ kg\ per\ minute$ each at temperatures of 70℃ and 10℃ respectively. How long will it be before the temperature in the bath has dropped to 45℃ ? Assume complete mixing of the water and ignore heat losses.

(b) A piece of copper of mass $40\ g$ at 200℃ is placed in a copper calorimeter of mass $60\ g$ containing $50\ g$ of water at 10℃. Ignoring heat losses, what will be the final steady temperature after stirring? (Specific heat Capacity of copper $= 400\ J/kgK$.)

(c) A piece of lead of mass $500\ g$ and at air temperature falls from height of $25\ m$. What is rise in temperature of lead when striking the ground, its specific heat capacity is $130\ J/kgK$.

27. (a) Define the following terms

(i) Specific latent heat of vaporization (ii) Specific latent heat of fusion (iii) Regelation

(b) Calculate the heat required to convert 2 kg of ice at -12℃ to steam at 100℃. Given that Specific heat capacity of ice $= 21\ 00\ J/kgK$, Specific latent heat of ice = 336 000 J/kg Specific heat capacity of water = $4200\ J/kgK$, Specific latent heat of steam = 2260000J/kg.

(c) A refrigerator can convert 400 g of water at 20℃ to ice -10℃ in 3 hours. Find the average rate of heat extraction from the water in joules per second.

28. (a) Define the following terms

(i) Vapour pressure (ii) Saturated vapour pressure (iii) Unsaturated vapour pressure

(iv) Boiling point (v) Dew point (vi) Relative humidity

(b) Explain the difference between evaporation and boiling of liquid.

29. (a) (i) State laws of reflection of light

(ii) State laws of refraction of light

(b) (i) Mention four characteristics of an image formed by a plane mirror

(ii) What is the meaning of lateral inversion of an image formed by plane mirror?

30. (a) Define the following terms

(i) Principal focus of a spherical mirror (ii) The focal length of a spherical mirror

(iii) Center of curvature (iv) Radius of curvature (v) Conjugate foci

(vi) Real image (vii) Virtual image

(b) (i) State the principal of reversibility of light

(ii) Mention set of rules that are used for constructing images formed by spherical mirror

(iii)State the characteristics of image formed when object is placed between principal focus and pole of the spherical mirror.

31. (a) An object is placed $(i)20\ cm$ $(ii)4\ cm$ in front of a concave mirror of focal length 12 cm. Find the nature and position of the image formed in each case.

(b) A concave mirror produces a real image 1 cm tall of an object 2.5 mm tall placed 5 cm from the mirror. Find the position of the image and the focal length of the mirror.

(c) A convex mirror of focal length 18 cm produces an image on its axis, 6 cm away from the mirror. Calculate the position of the object.

32. (a) Define the following terms

(i) Refractive index (ii) Real depth (iii) Apparent depth (iv) Critical angle.

(v) Total internal reflection

(b) With the aid of a diagram briefly explain how the fish enjoys a 180° field of view in water

(c) Explain briefly how mirage occurs.

(d) Find the critical angle of the medium with refractive index 1.65

33. (a) What is pure spectrum ?

(b) In the formation of spectrum of white light by a prism

(i) which colour is deviated least?

(ii) which colour is deviated most?

34. (a) Define the following terms

(i) Pole of a magnet (ii) Consequent poles (iii) Magnetic field (iv) Neutral point

(b) State the first law of magnetism

(c) Mention three methods of magnetization and demagnetization of magnetic materials

35. (a) (i) What is the sure test of polarity of a magnet?

(ii) Differentiate between magnetic declination and angle of dip (inclination).

(b) State the function of magnetic keepers.

REFERENCES

1. Physic Fourth Edition A.F Abbott