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LEAVING CERTIFICATE EXAMINATION, 1954.

PHYSICS.—HONOURS.

MONDAY, 21st JUNE—MORNING, 10 TO 12.

Not more than *six* questions to be answered.
One question *at least* must be answered from each section.

SECTION I.

1. A hollow metal sphere, of mass 400 grammes, floats in brine of specific gravity 1·03 so that three-eighths of the volume of the sphere is above the surface. Find the volume of the sphere. What is the least weight of aluminium which, when attached to the sphere, would keep the whole totally submerged in the brine?
[Specific gravity of aluminium=2·6.]

[66 marks.]

2. A boat has a speed of 8 miles per hour in still water. It has to cross from a point A on one bank of a river to a point B on the opposite bank, a distance of 3 miles. The river flows at 5 miles per hour in a direction at right angles to AB. Indicate by means of a diagram the direction in which the boat should be steered in order to travel from A to B along the straight line AB and calculate the time it takes.

[66 marks.]

3. An engine pumps 1000 lb. of water per minute to a height of 100 feet through a pipe of cross-sectional area 8 square inches. Find (i) the work done against gravity per minute, in foot-lbs., (ii) the velocity of the water as it emerges from the pipe, (iii) the horse-power of the engine, neglecting losses due to friction.
If the diameter of the pipe were halved, how would this change in diameter affect the momentum and kinetic energy of the water, assuming that there is no change in the mass of water pumped per minute?

[1 cubic foot of water weighs 62½ lbs.]

[67 marks.]

SECTION II.

4. State the laws of refraction of light. Define index of refraction.
Describe an accurate method of finding the refractive index of a transparent liquid. Explain the theory of your method.
A ray of light meets a horizontal axis at a point P and makes an angle of 30° with the axis. A rectangular slab of glass 10 cms. thick is interposed perpendicularly to the axis in the path of the ray. If the index of refraction of glass is 5/3, find how far from P the ray strikes the axis.

[66 marks.]

5. Prove a formula for the focal length of a convex lens in terms of u, v, where u, v, represent the distances of object and image, respectively, from the lens.

Describe how to find the radius of curvature of a concave mirror.

Describe, also, how to find the focal length of a convex lens (i) by using a plane mirror, (ii) by using a concave mirror.

Indicate by means of a diagram how a convex lens forms an imaginary image.

[66 marks.]

6. Describe how a reasonably pure spectrum of sunlight may be obtained.

Describe the spectrum and mention any characteristics of the parts of it which are not visible.

What are absorption spectra ? Explain the presence of lines in the solar spectrum.

How does the spectrum of a luminous gas differ from the solar spectrum ?

[67 marks.]

SECTION III.

7. Define (i) magnetic dip, (ii) magnetic declination.

Describe how (*a*) the magnetic dip, (*b*) the magnetic declination at a given place may be measured.

Give a general account of the variations in dip and declination over the earth's surface. How are these variations explained ?

[66 marks.]

8. Using a positively charged rod, describe how you would charge an electroscope (*a*) positively, (*b*) negatively.

A positively charged insulated sphere is lowered into an insulated metal can so that the sphere (i) does not touch, (ii) touches, the inside of the can. In each case give an account of the distribution and nature of the resulting charges, and describe how you would demonstrate the truth of your answer. How are these phenomena explained ?

Mention a practical application of the results of this experiment.

[66 marks.]

9. Starting from the definition of the absolute unit of current, show that for a tangent galvanometer with its coil in the plane of the magnetic meridian the current i, in absolute units, is given by $i=\frac{Hr}{2\pi n}\tan\theta$, where r is the mean radius of the coil, n the number of turns in the coil, θ the mean deflection of the needle, and H the horizontal component of the earth's magnetic field.

A current of 1·5 amps in the coil of a tangent galvanometer, the coil being in the plane of the magnetic meridian, causes a deflection of 20° in the needle of the galvanometer. What current will cause a deflection of 35° in the needle ? In the case in which the deflection is 35° what is the strength of the magnetic field, acting at right angles to the plane of the coil, which will restore the needle to the zero position?

[67 marks.]

10. Describe the accumulator.

Describe, also, the changes that take place in the accumulator (*a*) when it is being charged, (*b*) when current is being drawn from it. Explain how a knowledge of the density of the electrolyte indicates the condition of the accumulator with regard to charge. Between what limits, approximately, should the density be kept?

[67 marks.]