S 37 (a)

OXFORD LOCAL EXAMINATIONS

SCHOOL CERTIFICATE

FRIDAY, JULY 10, 1942

TIME ALLOWED—$1\frac{3}{4}$ HOURS

Physics I

[Not more than FIVE questions are to be answered; of these, at least TWO MUST BE from the section on Mechanics.

Answers should be illustrated by diagrams, wherever possible.]

[*Mathematical Tables and one sheet of Squared Paper will be provided.*]

Mechanics

1. Describe how you would set up a *simple mercury barometer*.

Either describe one experiment to show that the mercury column is supported by the pressure of the atmosphere, **or** give your reasons for believing that this statement is true.

Calculate the height of the mercury barometer on a day when the pressure of the atmosphere is 1,000,000 dynes per sq. cm.

[Density of mercury $= 13{\cdot}6$ gm./c.c.;
$g = 981$ cm./sec./sec.]

2. State the *Principle of Archimedes*, and describe an experiment to verify it for a floating body.

A cylindrical tube is loaded so as to float upright. When it is placed in a certain liquid, it floats with 10 cm. of the tube below the surface; when it is floated in water, the length below the surface is 12 cm. Find the specific gravity of the liquid, and explain your calculation.

Turn over.

3. Explain the terms *momentum*, *kinetic energy*, *power*.

A vehicle of mass 1 ton is travelling at 30 m.p.h. against a resistance of 200 lb. wt. Calculate (*a*) its momentum, (*b*) the horse-power developed.

4. Explain how you would use the *velocity-time graph* for a moving body to deduce (*a*) the acceleration at any instant, (*b*) the space described during any interval of the period for which the graph is drawn.

A stone is thrown vertically upwards with a velocity of 80 ft./sec. Plot a velocity-time graph for the first five seconds of the motion, and find from the graph the greatest height reached.

[$g = 32$ ft./sec./sec.]

Heat and Light

5. What is meant by the *coefficient of linear expansion* of a material?

Describe an experiment to show that the coefficient of linear expansion of iron is considerably less than that of brass.

Explain how changes of temperature affect the timekeeping of an ordinary pendulum clock, and show how a pendulum may be designed to enable a clock to keep good time at all temperatures.

6. Distinguish between the *conduction* of heat and its transference by *convection*.

Explain the parts played by each of these processes in (*a*) the transference of heat from the burning coke in the furnace of a central heating system to people sitting in a room containing hot-water pipes, (*b*) the cooling of the cylinders of an ordinary motor-car.

7. Define *calorie, thermal capacity, specific heat.*

An electric heater supplies heat at the rate of 100 calories per second to 1,000 gm. of a liquid of specific heat 0·8 contained in a copper vessel of mass 200 gm. The specific heat of copper is 0·1. Find the rise in temperature after five minutes.

8. (*a*) Draw a rough diagram showing the path of a ray of light which travels from air to glass and is refracted at the glass surface. Mark on this diagram the angles named *the angle of incidence* and *the angle of refraction.*

(*b*) State *the two laws of refraction.*

(*c*) Calculate the angle of incidence for which the angle of refraction is 30°, given that the refractive index of glass is 1·5.

9. What is meant by (*a*) *a real image,* (*b*) *a virtual image* ?

Draw a diagram showing how a single convex lens is used as a *simple microscope,* or *magnifying glass.*

State where the image, seen by the eye through the lens, should be situated if the glass is being used properly.

Magnetism and Electricity

10. What do you understand by the *pole strength* and the *magnetic moment* of a magnet ?

Describe how you would make a map of the *lines of force* due to the combined fields of the earth and of a short bar magnet laid horizontally in the magnetic meridian with its south-seeking pole pointing northwards. Give a diagram showing the kind of map you would obtain.

11. Describe the *gold leaf electroscope*, with the help of a diagram.

State, and explain clearly, what happens when you bring your hand near to, but not touching, the cap of a charged electroscope, and afterwards withdraw it.

12. State *Faraday's Laws of Electrolysis*.

Give a good diagram of the circuit you would use in an experiment to determine *the electrochemical equivalent* of copper.

A current is passed for some time through a copper voltameter in series with a water voltameter. The volume of hydrogen liberated, reduced to N.T.P., is 200 c.c., and the cathode of the copper voltameter has gained in weight by 0·57 gm. Calculate the *equivalent* (or *equivalent weight*) of copper.

[Density of hydrogen at N.T.P. = 0·00009 gm./c.c.]

13. Describe how you would measure the *resistance* of a wire using *Wheatstone's Bridge*.

Prove the formula you would use in calculating your result.

If you were supplied with a reel of metal wire of *specific resistance* 0·00004 *ohms per centimetre cube*, and area of cross-section 1 sq. mm., what length would you need to cut off in order to make a resistance of 2 ohms?

S 24

OXFORD LOCAL EXAMINATIONS

SCHOOL CERTIFICATE

TUESDAY, JULY 14, 1942

TIME ALLOWED—$2\frac{1}{4}$ HOURS

Geometry

[No credit will be given for any attempt at a question in Practical Geometry if any of the construction lines are erased. When parallels or perpendiculars are drawn, the method used must be stated.

The use of a straight edge or compasses must in all cases be indicated by a drawn straight line or arc; that is, any constructed point must be shown as the intersection of two lines, not as a dot on one line.

It is unnecessary to draw very exact figures except in questions 5 and 7.]

Mathematical Tables may NOT be used.

1. Prove that the three angles of a triangle are together equal to two right angles.

ABC is a triangle in which AB is greater than AC. K is taken between A and B such that $AK = AC$. Prove that if BK is greater than KC, then the angle at C is greater than three times the angle ABC.

2. Prove that a quadrilateral whose opposite angles are equal is a parallelogram.

Prove that the external bisectors of the angles of a parallelogram are the sides of a rectangle.

3. Prove that, if X is the middle point of the side BC of a triangle ABC,

$$AB^2+AC^2=2AX^2+2BX^2.$$

If AX is produced beyond X to G, so that $AX=XG$ and P is any point between A and G, prove that

$$AB^2+AC^2-PB^2-PC^2$$

is equal to twice the rectangle contained by GP and PA.

Turn over.

4. K and L are two points on the same side of a straight line BC and are such that the angles BKC and BLC are equal. Prove that the circle which passes through B, C, and K also passes through L.

On the sides AB and AC of a triangle ABC, equilateral triangles ABS and ACT are described so as to be entirely outside the triangle. Prove that the triangles TAB and CAS are congruent and that the points C, O, A, and T lie on a circle, O being the point of intersection of BT and CS.

(Only TWO of Questions 5, 6, 7 are to be attempted.)

5. Give a geometrical construction for a straight line of length $\sqrt{5}$ inches.

Construct a parallelogram with sides of 5 and $\sqrt{5}$ inches and area 8 square inches.

Explain briefly your construction, and measure the acute angle of the parallelogram.

6. Prove that the internal bisector of the angle A of the triangle ABC divides BC into two segments whose ratio is that of AB to AC.

D is the middle point of the side BC of a triangle ABC. The bisector of the angle ADB meets AB at S and the bisector of the angle ADC meets AC at T. Prove that ST is parallel to BC.

7. On three mutually perpendicular edges of a rectangular block which meet at A, lengths AB, AC, and AD are measured and are 3 inches, 4 inches, and 6 inches respectively. Find by drawing and measurement or by calculation the area of the triangle BCD. Give a brief explanation of your work.

Let ABCD be any quad^{l}

It is required to construct a Δ equal in area to ABCD

Construction.

Join AC.

Through D draw DE parallel to AC, meeting BA produced in E.

Join CE

Then BCE is the required Δ.

Proof.

The Δ's ADC, AEC are equal in area, being on the same base AC and between the same parallels AC, DE

Add to each the ΔABC

Then the quad^{l} ABCD = BCE in area Q.E.D.

Theorem 20.:-

The square drawn on the hypotenuse of a right angled triangle is equal to the sum of the squares on the other two sides