

Mechanics.—For Class D, and for Civil Service Senior (Old and New Regulations) and Junior. Time allowed: 3 hours.

1. Define "acceleration," and explain what is meant by saying that the acceleration due to gravity is 32 ft. per second per second. If a body fall from rest for 12 seconds, how far will it fall? How far does it fall in the 12th second? If it starts with a velocity of 30 ft. per second downwards, how far will it fall in 12 seconds?

2. State Newton's laws of motion, and give some facts in illustration. Deduce a method of measuring force.

3. A particle slides down a smooth inclined plane whose inclination to the horizon is 30° : show that it takes twice as long to descend a given vertical distance as a particle falling freely under gravity.

4. Show how to find the magnitude of the resultant of two forces acting at a point. Show how to find the resultant of any number of forces acting at a point.

5. ABCD is a square, and E, F are the middle points of BC, CD; forces represented in magnitude and direction by AE, BF and DA act at a point: prove that the resultant is represented by $\frac{1}{2}$ AC.

6. Prove that the algebraical sum of the moments of two forces which meet in a point about any point in their plane is equal to the moment of their resultant about the same point.

7. Having given the centre of gravity of a body, and also the centre of gravity of part of it, find the centre of gravity of the remainder.

One of the four triangles into which a parallelogram is divided by its diagonals is taken away. Find the centre of gravity of the remainder.

8. Find the relation of the power to the weight in a system of heavy pulleys, each of which hangs by a separate string attached to the supporting beam.

There are 4 pulleys in this system, and the mechanical advantage is 8 when the weight is 1 cwt: find the weight of each pulley, the pulleys being all equal.

9. Explain the meaning of specific gravity of a substance. Describe a method of finding the specific gravity of a solid. Find the specific gravity of standard gold which is a mixture of 11 parts by weight of pure gold and one of copper, the specific gravity of pure gold being 19.3 and of copper 8.9.

10. Explain how the pressure of a liquid alters with the depth below the surface.

If the atmospheric pressure be 15 lb. a square inch, and the pressure 20 ft. down in water is 25 lb., what will be the pressure at a depth of 40 ft.?

11. Find the conditions of equilibrium of a body floating and partially immersed in a fluid of uniform density.

A cube, each edge of which is 8 in., floats in water; a weight of 200 oz. placed on it is just sufficient wholly to immerse it: find the weight of the cube.

12. State Boyle's law, and describe an experiment for proving it.

13. Describe the construction and action of Smeaton's air-pump.

Physics.—For Class D, and for Civil Service Senior (Old Regulations) and Junior. Time allowed: 3 hours.

1. Define the terms "Unit quantity of heat," "Specific heat," "Capacity for heat," and "Latent heat of fusion." How would you determine the specific heat of copper?

200 grams of mercury, at a temperature of 50°C ., are poured into a cavity in a large block of ice. If the specific heat of mercury be 0.03, how much ice will be melted.

2. What do you understand by the coefficient of cubical expansion of a substance? Describe the volume changes experienced by a mass of ice when its temperature is slowly raised from -10°C . to 120°C .

3. Describe experiments to illustrate the fact that substances with high emissive powers are also good absorbers of radiant heat.

4. How has the velocity of sound in air been determined? Point out the possible sources of error in the method you describe, and indicate how errors may be eliminated.

5. On what do the intensity and the pitch of a musical note depend? Mention experiments in support of your statements.

6. Describe two methods whereby the intensity of two sources of light may be compared.

7. State the laws of reflection of light, and draw a diagram to explain the formation of the image of a small luminous object, placed half-way between the centre of curvature and the principal focus of a concave mirror.

8. What is meant by the magnetic meridian at a given point upon the Earth's surface? How can the position of the magnetic meridian be ascertained?

9. Explain why the current from a zinc-copper pair, in dilute sulphuric acid, rapidly weakens when electrical communication is established, and describe the construction of two forms of cell in which this defect is remedied.

Magnetism and Electricity.—For Civil Service Senior (New Regulations). Time allowed: 3 hours

1. Define the terms "Unit magnetic pole," "Strength of a magnetic pole," and "Moment of a magnet." How may the moments of two magnets be compared?

2. What do you understand by the magnetic elements at a given place? Explain carefully how any one of the magnetic elements may be accurately determined.

Find the total magnetic force at a place where the horizontal component is 0.18 dyne and the dip 45° .