

The University of the State of New York

REGENTS HIGH SCHOOL EXAMINATION

PHYSICS

Tuesday, June 17, 1958 — 1:15 to 4:15 p.m., only

Name of pupil.....Name of school.....

Part I

Answer all questions in this part.

*Directions (1-19):* Write on the line at the right of *each* statement or question the *number* preceding the word or expression that, of those given, best completes the statement or answers the question. [19]

- 1 Which instrument depends for its operation on the unequal expansion of different metals? (1)aneroid barometer (2)calorimeter (3)hygrometer (4)thermostat 1.....
- 2 When the filament of an incandescent lamp is heated, it emits (1)electrons (2)neutrons (3)positive ions (4)protons 2.....
- 3 A lampshade vibrates in response to a certain musical pitch. This phenomenon is called (1)beats (2)forced vibrations (3)overtones (4)resonance 3.....
- 4 Which of the following radiations has the shortest wavelength? (1)infrared light (2)ultraviolet light (3)visible light (4)X-rays 4.....
- 5 The kilowatt may be expressed in units of (1)foot-candles (2)foot-pounds (3)kilotons (4)horsepower 5.....
- 6 Isotopes of an element differ in (1)atomic number (2)mass number (3)numbers of planetary electrons (4)numbers of protons 6.....
- 7 When a bullet is shot from a gun, both the bullet and the gun acquire the same (1)acceleration (2)energy (3)momentum (4)velocity 7.....
- 8 If the angle between two concurrent forces is  $30^\circ$ , the numerical value of their resultant must be (1)equal to their difference (2)equal to their sum (3)greater than either force (4)greater than their sum 8.....
- 9 When sunlight falls on a soap bubble, bright bands of color are seen. This is caused by (1)dispersion (2)interference (3)pigments in the soap (4)refraction 9.....
- 10 Starting from rest, a cylinder rolls down an inclined plane a distance of 6 cm. in the first second. The *total* distance it will roll in 2 seconds is (1) 12 cm. (2) 24 cm. (3) 36 cm. (4) 48 cm. 10.....
- 11 The velocity at which the hammer of a pile driver will strike the head of a pile after 1.5 seconds of free fall is (1) 16 ft./sec. (2) 32 ft./sec. (3) 48 ft./sec. (4) 64 ft./sec. 11.....
- 12 The paths of charged particles are observed by use of the (1)cyclotron (2)Geiger-Muller tube (3)scintillation counter (4)Wilson cloud chamber 12.....

[1]

[OVER]

PHYSICS — *continued*

- 13 An alternating current which produces heat at the same rate as a direct current of 2 amperes has an effective value of (1) 1.414 amperes (2) 2 amperes (3) 2.82 amperes (4) 4 amperes 13.....
- 14 The quantity of charge that is stored in a capacitor (condenser) is measured in (1) amperes (2) coulombs (3) henries (4) volts 14.....
- 15 To compare the efficiencies of two machines performing the same job, it is only necessary to know their (1) actual mechanical advantages (2) ideal mechanical advantages (3) speeds (4) wasted energies 15.....
- 16 A piece of string which can support up to 1500 grams without breaking is used to lift a 1000-gram weight. When the weight is lifted quickly, the string breaks. The best explanation for the breaking of the string is that (1) a force in excess of 500 grams has been applied to accelerate the weight (2) the weight increases with altitude (3) the mass of the object increases as its velocity increases (4) the potential energy of the weight increases as it is lifted 16.....
- 17 When both are falling freely, a 2-pound stone has the same acceleration as a 1-pound stone because the (1) mass of the 2-pound stone is twice that of the 1-pound stone (2) gravitational pull on each is equal (3) momentum of each is equal (4) maximum velocity has been reached 17.....
- 18 The *electron* current in a wire is toward the north. If a compass is placed above the wire, the N-pole of the compass will be deflected toward the (1) north (2) east (3) south (4) west 18.....
- 19 The useful work accomplished by a certain machine equals the work needed to overcome friction. The efficiency of the machine is (1) 0% (2) 33% (3) 50% (4) 100% 19.....

*Directions (20–27):* Write on the line at the right of *each* statement the term that, when inserted in the blank, will correctly complete the statement. [8]

- 20 A fuse is connected in ... with the electrical devices in a circuit. 20.....
- 21 When a book is held one foot from a clear, incandescent lamp, it receives ... times as much light as when held five feet from the same lamp. 21.....
- 22 The heat of vaporization of alcohol is 204 calories per gram. To vaporize 20 grams of alcohol at its boiling point requires ... calories. 22.....
- 23 An ammeter is a galvanometer with a resistance connected in ... with the galvanometer coil. 23.....
- 24 A 5-ohm resistor and a 10-ohm resistor are connected in series to a source of current. If the current through the 5-ohm resistor is 4 amperes, the current through the 10-ohm resistor is ... ampere(s). 24.....
- 25 An inclined plane is 20 feet long and 5 feet high. If friction is neglected, the force needed to move a 300-pound truck up the plane is ... lb(s). 25.....
- 26 A fish and a fisherman each pull on opposite ends of a fish line with 5-pound forces. The tension in the line is ... lb(s). 26.....
- 27 A certain radioactive element has a half-life of 40 days. A sample of this element weighs 8 milligrams. At the end of 80 days ... milligrams of the element will remain. 27.....

PHYSICS — *continued*

*Directions (28–38):* In *some* of the following statements the italicized term makes the statement incorrect. For each *incorrect* statement, write on the line at the right the term that must be substituted for the italicized term to make the statement correct. For each *correct* statement, write the word *true* on the line at the right. [11]

- |       |   |         |
|-------|---|---------|
| 28    | The rate of evaporation of a liquid from an open vessel increases as the <i>temperature</i> increases.        | 28..... |
| 29    | The calorie is the heat required to raise the temperature of one gram of water one degree <i>centigrade</i> . | 29..... |
| 30    | The cyclotron may be used to accelerate <i>protons</i> .  | 30..... |
| 31    | Waves that can be polarized must be <i>longitudinal</i> .   | 31..... |
| 32    | The current in the armature of an operating direct current motor is <i>direct</i> .                           | 32..... |
| 33    | As a rocket moves away from the earth, its <i>weight</i> decreases.   | 33..... |
| 34    | Chromatic aberration is due to the <i>dispersion</i> of white light as it passes through a convex lens.       | 34..... |
| 35    | The index of refraction of glass for red light is <i>greater than</i> that for blue light.                    | 35..... |
| 36    | The coefficient of expansion of all <i>liquids</i> is approximately the same.                                 | 36..... |
| 37–38 | A 240-ohm lamp and a 120-ohm resistor are connected in parallel in a 120-volt circuit.                        |         |
| 37    | The voltage drop across the lamp is <i>twice</i> the voltage drop across the resistor.                        | 37..... |
| 38    | The current through the lamp is <i>one-half</i> the current through the resistor.                             | 38..... |

*Directions (39–50):* Write on the line at the right of *each* statement the term (*increases, decreases, remains the same*) that, when inserted in the blank, will make the statement true. [12]

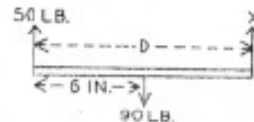
- |    |   |         |
|----|---|---------|
| 39 | As the diameter of a copper wire increases, its electrical resistance . . . .                                 | 39..... |
| 40 | As the temperature of a gas increases, the average kinetic energy of its molecules . . . .                    | 40..... |
| 41 | As heat is added to boiling water in an open vessel, the temperature of the water . . . .                     | 41..... |
| 42 | As more resistors are added in series to a 120-volt line, the voltage drop across each resistor . . . .       | 42..... |
| 43 | As an object approaches the focal point of a convex lens, the size of the image formed . . . .                | 43..... |
| 44 | As the voltage applied to an electrical appliance increases, its wattage . . . .                              | 44..... |
| 45 | As the speed of rotation of the armature of an electric motor increases, the back e.m.f. . . . .              | 45..... |
| 46 | As the frequency of radio waves increases, the velocity of the waves . . . .                                  | 46..... |
| 47 | As the number of turns of a coil of wire increases, its inductance . . . .                                    | 47..... |
| 48 | As the pressure on ice increases, the melting point of the ice . . . .  | 48..... |
| 49 | As the time required to stop a moving object decreases, the force exerted in stopping it . . . .              | 49..... |
| 50 | As the inductance of a resonant (oscillatory) circuit decreases, the natural frequency of the circuit . . . . | 50..... |

Part II

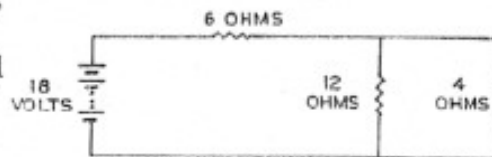
Answer five questions from this part.

[Show all numerical work; give units with all answers where the unit is not specified in the question.]

- 1 a A block and tackle having an ideal mechanical advantage of 6 and an efficiency of 60% is used to lift a 432-pound piano.
- (1) Find the actual mechanical advantage. [2]
  - (2) Find the effort force actually required to lift the piano. [2]
  - (3) How much work must be done by the men pulling the rope (work input) to raise the piano a vertical distance of 30 feet? [3]
- b The diagram at the right shows a system of three parallel forces in equilibrium. Find the distance between the 50-pound force and the unknown force  $X$ . [3]



- 2 a The following questions refer to the diagram at the right. [Assume that the battery and all connecting wires have negligible resistance.]

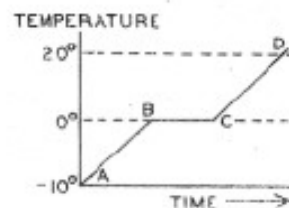


- (1) Find the combined resistance of the 12-ohm and 4-ohm resistors. [2]
- (2) Find the current in the 6-ohm resistor. [2]
- (3) Find the potential drop across the 12-ohm resistor. [2]

- b An incandescent lamp is connected to a voltage source.

- (1) Make a labeled diagram showing how you would connect a voltmeter and an ammeter in this circuit to determine the resistance of the lamp. [2]
- (2) When a tungsten-filament lamp is used, the resistance of the lamp increases as the voltage increases. Explain. [2]

- 3 a A sample of ice at a temperature of  $-10^{\circ}\text{C}$ . was placed in a room where the temperature was  $20^{\circ}\text{C}$ . Readings of a thermometer were taken at periodic intervals until the temperature reached point  $D$ , as shown on the graph at the right. The following questions refer to this graph:



- (1) Identify the section of the graph ( $AB$ ,  $BC$ , or  $CD$ ) which indicates
  - (a) the water warming [1]
  - (b) the ice warming [1]
  - (c) the ice melting [1]

- (2) Explain why the temperature does *not* rise in section  $BC$  even though the substance is receiving heat from its surroundings. [2]

- b How many calories of heat are required to change 100 grams of water at  $20^{\circ}\text{C}$ . to steam at  $100^{\circ}\text{C}$ .? [2]

- c At  $20^{\circ}\text{C}$ . a steel beam is 40 feet long. What will be the length of the beam when the temperature is  $-10^{\circ}\text{C}$ .? [Coefficient of expansion of steel is 0.000013 per degree centigrade.] [3]

[4]

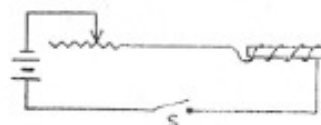
[OVER]

PHYSICS — continued

- 4 a In a physics experiment a lamp is placed three feet from a screen. A convex lens is placed between the lamp and the screen, forming an image which is twice the size of the object.
- (1) Find the distance from the lamp to the lens. [2]
  - (2) Find the focal length of the lens. [2]
- b Draw a ray diagram to show how a real, enlarged image is produced by a convex lens. Label the object, image, and principal focus. [3]
- c The velocity of electromagnetic waves is 300,000 km./sec. What is the frequency of a radio wave whose wavelength is 10 meters? [2]
- d Compare the frequencies of visible light with those of radio waves. [1]

- 5 a An electric broiler is rated 960 watts at 120 volts.
- (1) Find the resistance of the broiler when it is operating at its rated voltage. [2]
  - (2) How many calories of heat are generated by the broiler when it is operated for five minutes? [1 watt-second = 0.24 calories.] [2]

b A boy made an electromagnet by winding some insulated copper wire around an iron core. The diagram at the right shows the electromagnet in a circuit with a battery and a rheostat.



- (1) How would the strength of the electromagnet be affected if the iron core were removed? [1]
  - (2) How would the strength of the electromagnet be affected if the resistance at the rheostat were increased? [1]
  - (3) At the same voltage the strength of the electromagnet is *not* appreciably affected if the number of turns is doubled by using twice the length of the same wire. Explain. [2]
  - (4) When switch *S* is opened, a spark is seen. However, when the core is removed and switch *S* is opened, the spark is not so bright as before. Explain. [1, 1]
- 6 a A 3000-pound car accelerates uniformly from rest to a speed of 40 ft./sec. in 8 seconds.
- (1) Find the acceleration. [2]
  - (2) Find the distance traveled in 8 seconds. [2]
- b The 3000-pound car climbs a hill at a uniform speed of 40 ft./sec. in 30 seconds. The vertical height of the hill is 100 feet.
- (1) What is the change in the potential energy of the car? [2]
  - (2) What is the change in the kinetic energy of the car while it is climbing the hill? Explain. [1, 1]
  - (3) What is the horsepower developed as the car climbs the hill? [2]

- 7 a Graphite, cadmium, and concrete are materials used in a nuclear reactor. State the purpose of each of *two* of these materials. [2]
- b When an atom of  ${}_{92}\text{U}^{238}$  emits an alpha particle, a new element is formed. What is the atomic number *and* the mass number of the new element formed? [2]
- c Describe a simple laboratory procedure to demonstrate each of *three* of the following: [6]
- (1) Two tuning forks have the same pitch.
  - (2) A beam of light consists of a single color.
  - (3) A beam of light is polarized.
  - (4) One of two minerals is the more radioactive.

[5]

[OVER]

PHYSICS — *concluded*

- 8 a A transformer is designed to step up 120 volts to 2400 volts.
- (1) If there are 400 turns in the primary winding, how many turns are there in the secondary winding? [1]
  - (2) If the transformer is 90% efficient, what will be the current in the primary when the secondary is supplying power at a rate of 288 watts? [3]
- b Explain *three* of the following on the basis of physical principles: [6]
- (1) A transformer which operates properly at 120 volts a.c. draws excessive current when connected to a 120-volt d.c. line.
  - (2) A 120-volt lamp in series with a capacitor (condenser) will *not* operate when connected to 120 volts d.c., but will operate when connected to 120 volts a.c.
  - (3) In order to receive different radio stations, the capacitance of the tuning condenser is varied.
  - (4) A diode is used to rectify alternating current.
  - (5) As the grid voltage of a triode becomes more negative with respect to the cathode, the plate current decreases.