P5122 WASSCE
November 2011
PHYSICS 2
Objective and Essay
2¾ hours

2

Name..

Index Number..

THE WEST AFRICAN EXAMINATIONS COUNCIL
West African Senior School Certificate Examination

November 2011   PHYSICS 2   2¾ hours

*Do **not** open this booklet until you are told to do so. While you are waiting, read and observe the following instructions carefully. Write your **name** and **index number** in ink in the spaces provided above.*

*This paper consists of **two** sections, A and B. Answer Section A on your Objective Test answer sheet and Section B in your answer booklet. Section A will last 1¼ hours after which the answer sheet will be collected. Do **not** start Section B until you are told to do so. Section B will last 1½ hours.*

SECTION A   1¼ hours
OBJECTIVE TEST
[50 marks]

1. Use **2B** pencil throughout.
2. On the pre-printed answer sheet, check that the following details are **correctly** printed:
   (a) In the space marked *Name*, check your **surname** followed by your **other names**.
   (b) In the spaces marked *Examination*, *Year*, *Subject* and *Paper*, check 'WASSCE November', '2011', 'PHYSICS', and '2' in that order.
   (c) In the box marked *Index Number,* your **index number** has been printed vertically in the spaces on the left-hand side, and each numbered space has been shaded in line with each digit. **Reshade** each of the shaded spaces.
   (d) In the box marked *Subject Code*, the digits 512213 are printed vertically in the spaces on the left-hand side. **Reshade** the corresponding numbered spaces as you did for your index number.
3. An example is given below. This is for a female candidate whose *name* is Fekameme Ama AKOLGO. Her *index number* is 7102143958 and she is offering *Physics* 2.

THE WEST AFRICAN EXAMINATIONS COUNCIL
ANSWER SHEET

PRINTED IN BLOCK LETTERS
Name: AKOLGO FEKAMEME AMA   GHA
Examination: WASSCE November   Year: 2011
Subject: PHYSICS   Paper: 2

INSTRUCTIONS TO CANDIDATES
1. Use grade 2B pencil throughout.
2. Answer each question by choosing one letter and shading it like this: ⊏A⊐ ▬▬ ⊏C⊐ ⊏D⊐ ⊏E⊐
3. Erase completely any answer you wish to change.
4. Leave extra spaces blank if the answer spaces provided are more than you need.
5. Do not make any markings across the heavy black marks at the right hand edge of your answer sheet.

INDEX NUMBER	SUBJECT CODE
7	5
1	1
0	2
2	2
1	1
4	3

Answer **all** *the questions.*

Each question is followed by four options lettered A *to* D. *Find the* **correct** *option for* **each** *question and shade in* **pencil** *on your answer sheet, the answer space which bears the same letter as the option you have chosen. Give only* **one** *answer to* **each** *question. An example is given below.*

Which of the following types of motion is produced by a couple?
A. Oscillatory
B. Rotational
C. Random
D. Translational

The correct answer is Rotational, *which is lettered* B, *and therefore answer space* B *would be shaded.*

⊏A⊐   ▬B▬   ⊏C⊐   ⊏D⊐   ⊏E⊐

Think carefully before you shade the answer spaces; erase completely any answer you wish to change.

Do all rough work on this question paper.

Now answer the following questions.

1. Which of the following factors affects the rate of diffusion of a gas?
   A. Number of atoms
   B. Mass of molecule
   C. Viscosity
   D. Surface tension

2. Two points Q and R in a room are specified by the coordinates $(0, 0, 0)$ and $(1, 1, 1)$, respectively. Determine the distance QR in metres.
   A. 1
   B. $\sqrt{2}$
   C. $\sqrt{3}$
   D. 3

3. The relative density of ice is 0.9. This statement implies that when a given mass of ice melts the
   A. volume of water formed would be 0.9 times that of the ice.
   B. volume of water formed would be 0.9 more than that of the ice.
   C. mass of water formed would be 0.9 times that of the ice.
   D. mass of water formed would be 0.9 less than that of the ice.

4. The pressure at a point in a liquid depends on the
   I. cross-sectional area of the vessel containing the liquid.
   II. depth below the surface of the liquid.
   III. density of the liquid.

   Which of the statements above are **correct**?
   A. I and II only
   B. I and III only
   C. II and III only
   D. I, II and III

5. Which of the following statements about viscosity is **correct**?
   A. Engine oil is less viscous than water.
   B. Viscosity is a property of liquids only.
   C. Viscosity increases with rise in temperature.
   D. Glycerine is more viscous than water.

6. The motion of a body is uniform when
   A. there is change in the direction of the body.
   B. the speed of the body remains constant.
   C. the rate of change of the velocity of the body is constant.
   D. both the speed and direction of the body remain constant.

7.
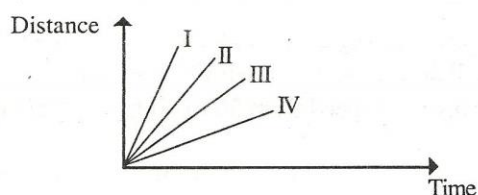
In which of the following distance-time graphs drawn above is the motion slowest?
   A. I
   B. II
   C. III
   D. IV

8. The area under a velocity-time graph represents
   A. final speed attained.
   B. acceleration.
   C. total distance covered.
   D. work done.

9. Which of the following quantities is a scalar quantity?
   A. Magnetic field
   B. Electric field intensity
   C. Electric potential
   D. Magnetic flux density

10. Two forces of magnitudes 30 N and 40 N act at an angle of 90° to each other. Calculate the magnitude of their resultant.
   A. 10.0 N
    B. 20.0 N
    C. 35.0 N
    D. 50.0 N

11. The energy in a light beam travels through space in concentrated packets called
    A. electrons.
   B. photons.
    C. protons.
    D. neutrons.

Turn over

4

12. A uniform half-metre rule AB is balanced horizontally on a knife edge placed 20 cm from A and with a mass of 30 g at A. Calculate the mass of the rule.
   A. 20 g
   B. 30 g
   C. 120 g
   D. 160 g

13. A body executing a simple harmonic motion has an angular speed of 2 rads s^{-1} and maximum displacement of 5 cm. Determine the magnitude of its acceleration.
   A. 0.1 m s^{-2}
   B. 0.2 m s^{-2}
   C. 0.4 m s^{-2}
   D. 0.5 m s^{-2}

14. A force acts on a body of mass 20 kg and changes its speed from 20 to 30 m s^{-1}. Calculate the magnitude of the impulse.
   A. 200 N s
   B. 400 N s
   C. 600 N s
   D. 1000 N s

15. The absolute zero is the temperature at which
   A. water freezes.
   B. molecular activity ceases.
   C. the states of matter co-exist in equilibrium.
   D. water has minimum volume.

16. Which of the following sources of energy is non-renewable?
   A. Petroleum
   B. Sun
   C. Wind
   D. Tidal waves

17. The moment of a force has the same dimensions as those of
   A. efficiency.
   B. momentum.
   C. power.
   D. work.

18. A body 150 kg is raised through a vertical height of 5 m in 100 s by a machine. If the efficiency of the machine is 80 %, calculate the input power. [$g = 10$ m s^{-2}.]
   A. 9.60 W
   B. 60.00 W
   C. 75.00 W
   D. 93.75 W

19.

Ice wrapped in wire gauze not melted

water boiling at top
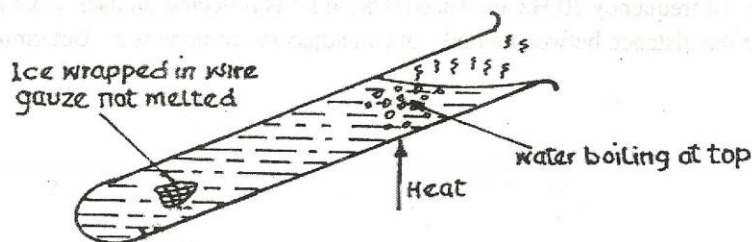
Heat

The diagram above illustrates the set-up for an experiment on heat conduction. The experiment demonstrates that
A.   ice is a poor conductor of heat.
B.   water is a poor conductor of heat.
C.   water can boil at any temperature.
D.   ice is denser than water.

20.   The following concepts are methods of heat transfer **except**
A.   conduction.
B.   convention.
C.   convection.
D.   radiation.

21.   A given mass of gas at a pressure of 400 Pa has a temperature of 30 °C. If its volume remains constant, calculate the pressure at 40 °C.
A.   533.3 Pa
B.   413.2 Pa
C.   387.2 Pa
D.   300.0 Pa

22.   A metal of mass 200 g is heated from 60 °C to 75 °C. Calculate the quantity of heat supplied.
[*Specific heat capacity of the metal* = 400 J kg^{-1} K^{-1}.]
A. 1.08×10^7 J
B. 1.20×10^6 J
C. 1.08×10^4 J
D. 1.20×10^3 J

23.

2m   8m   Effort

120 N
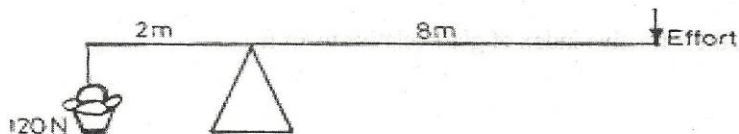
In the lever system illustrated above, the effort required to keep the bar in horizontal equilibrium is
A.   60 N.
B.   30 N.
C.   15 N.
D.   12 N.

24.   Which of the following devices applies Pascal's principle?
A.   Lift pump
B.   Force pump
C.   Hydraulic press
D.   Syringe

Turn over

25. A progressive wave of frequency 20 Hz and speed 0.60 m s^{-1} is reflected on itself from a rigid boundary such that the distance between a node and an adjacent antinode is x. Determine the value of x.
    A. 0.1200 m
    B. 0.0600 m
    C. 0.0150 m
    D. 0.0075 m

26. When light from a source is propagated through a gas
    I.   certain wavelengths are absorbed.
    II.   an emission line spectrum results.
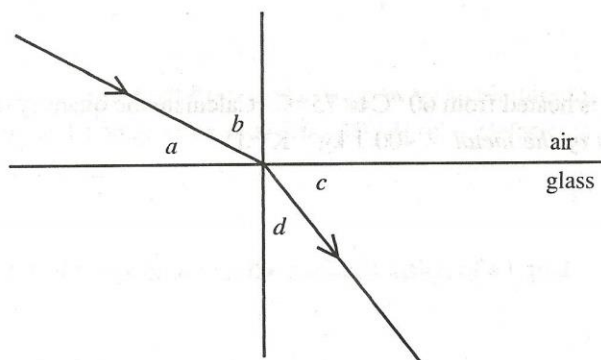   III. dark lines are observed.

    Which of the statements above are **correct**?
    A. I and II only
    B. I and III only
    C. II and III only
    D. I, II and III

27. A concave mirror of radius of curvature 20 cm forms an erect image 15 cm from the mirror. Calculate the distance of the object from the mirror.
    A. 60.0 cm
    B. 30.0 cm
    C. 8.5 cm
    D. 6.0 cm

28.

In the diagram above, the refractive index of glass relative to air is

A. $\dfrac{\sin a}{\sin c}$.

B. $\dfrac{\sin a}{\sin d}$.

C. $\dfrac{\sin b}{\sin d}$.

D. $\dfrac{\sin b}{\sin c}$.

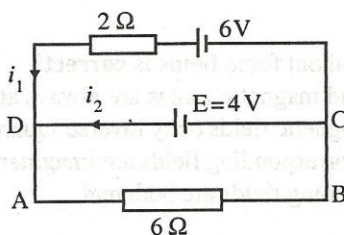29. Total internal reflection of light occurs in a medium when the
    A. angle of incidence for a ray in the denser medium is greater than the critical angle.
    B. angle of incidence for a ray in the denser medium is equal to the critical angle.
    C. angle of incidence for a ray in the denser medium is less than the critical angle.
    D. ray is travelling from a less dense medium to a denser medium.

30. Which of the following characteristics of the image formed by a diverging lens are **correct**?
   A. Virtual and diminished
   B. Real and diminished
   C. Virtual and magnified
   D. Real and magnified

31. Light from an illuminated object passes through a converging lens and is reflected along its original path to form an image at the same position as the object by a plane mirror placed just behind the lens. If the distance between the object and the plane mirror is 20 cm, determine the focal length of the lens.
   A. 40 cm
   B. 20 cm
   C. 10 cm
   D. 5 cm

32. The advantage of the Galilean telescope over the astronomical telescope is that in the Galilean telescope, the
   A. final image is sharper.
   B. angular magnification is greater.
   C. field of view is wider.
   D. final image is erect.

33. A singer emits a note of frequency 200 Hz. Calculate the wavelength of the note.
   [*Speed of sound in air* = 340 m s^{-1}.]
   A. 17.0 m
   B. 6.0 m
   C. 1.7 m
   D. 0.6 m

34. *Echo* is a phenomenon that shows that sound waves
   A. are mechanical.
   B. are longitudinal.
   C. can be polarized.
   D. can be reflected.

35. Which of the following statements about force fields is **correct**?
   A. Electrostatic, gravitational and magnetic forces are always attractive.
   B. Electric, gravitational and magnetic fields obey inverse square laws.
   C. Field lines are real but their corresponding fields are imaginary.
   D. Field lines and their corresponding fields are both real.

36. Which of the following statements about a satellite is/are **correct**? A satellite
   I. describes a circle about the earth if its escape velocity is 8 km s^{-1}.
   II. cannot escape from the earth's surface with a velocity less than 8 km s^{-1}.
   III. describes an ellipse about the earth if its escape velocity is greater than 11 km s^{-1}.

   A. I only
   B. II only
   C. I and II only
   D. II and III only

Turn over

37. Which of the following expressions represents *escape velocity*?

    A. $\dfrac{2GM}{R^2}$

    B. $\sqrt{\dfrac{2GM}{R^2}}$

    C. $\sqrt{\dfrac{2GM}{R}}$

    D. $\dfrac{2GM^2}{R^2}$

38. Which of the following observations occurs when a glass rod is rubbed with silk?
    A.   Electrons from the glass are transferred to the silk.
    B.   Protons from the silk are transferred to the glass.
    C.   Electrons from the silk are transferred to the glass.
    D.   Protons from the glass are transferred to the silk.

39. Two point charges of 1.0 µC and 1.5 µC are 5.0 cm apart. Calculate the magnitude of the force between them. $[(4\pi\varepsilon_o)^{-1} = 9.0 \times 10^9 \, \text{N m}^2 \, \text{C}^{-2}]$
    A.   2.7 N
    B.   5.4 N
    C.   6.7 N
    D.   7.0 N

40. Two parallel plates separated by 15.0 mm have a potential difference of 2.0 kV between them. Calculate the electric field intensity between the plates.
    A. $1.3 \times 10^5 \, \text{N C}^{-1}$
    B. $3.0 \times 10^4 \, \text{N C}^{-1}$
    C. $7.5 \times 10^3 \, \text{N C}^{-1}$
    D. $4.5 \times 10^3 \, \text{N C}^{-1}$

41.

Using *Kirchhoff's first law* for electrical circuits, the current in the 6 Ω resistor in the diagram above will be
    A. $i_1 + i_2$.
    B. $i_1 - i_2$.
    C. $2i_1$.
    D. i_2.

42. Four lamps labelled P(110 V, 100 W), Q(240 V, 60 W), R(250 V, 40 W) and S(300 V, 25 W) are switched on for the same duration. Which of the lamps consumes the highest amount of electrical energy?
    A. P
    B. Q
    C. R
    D. S

43. Which of the following statements about a magnetic field is **not** correct?
    A.   A magnetic field is a region in which magnetic force is experienced.
    B.   The resultant magnetic field of two fields is zero at neutral points.
    C.   A magnetic field is produced by electric charges in motion.
    D.   The magnetic field around a bar magnet is of uniform strength.

44. The efficiency of a transformer can be increased by
    A.   making the core with soft magnetic material.
    B.   increasing the eddy current.
    C.   increasing the resistance of the copper coil.
    D.   increasing the primary voltage.

45. The current in the primary coil of an ideal transformer is 2.5 A. If the primary coil has 50 turns and the secondary 250 turns, calculate the current in the secondary coil.
    A.   0.2 A
    B.   0.5 A
    C.   5.0 A
    D.   10.0 A

46. A resistor, an inductor and a capacitor are connected in series to an *a.c.* supply. At resonance, the impedance of the circuit is
    A.   maximum.
    B.   equal to zero.
    C.   equal to the resistance in the circuit.
    D.   equal to the reactance in the circuit.

47. When temperature of an intrinsic semiconductor is increased above room temperature it will have
    A.   more electrons than holes.
    B.   more holes than electrons.
    C.   no electrons crossing the forbidden band.
    D.   equal numbers of electrons and holes.

48. The energy of the ground state of a hydrogen atom is –13.6 eV. Calculate the energy associated with the third energy level.
    A.   –4.54 eV
    B.   –1.51 eV
    C.   +4.53 eV
    D.   +40.80 eV

49. A nuclide **X** of atomic number 92 and mass number 235 decays to a nuclide **Z** by emitting two beta-particles and one alpha particle. Which of the following **correctly** represents **Z**?

    A. $^{231}_{88}Z$

    B. $^{231}_{90}Z$

    C. $^{233}_{88}Z$

    D. $^{231}_{92}Z$

50. The radiation emitted by a radioactive sample has momentum, a fairly high penetrating power and can be deflected by a magnet. The radiation is **most** likely to be
   A. an alpha particle.
   B. a beta particle.
   C. gamma ray.
   D. x-ray.

END OF OBJECTIVE TEST

DO NOT TURN OVER THIS PAGE
UNTIL YOU ARE TOLD TO DO SO.

YOU WILL BE PENALIZED SEVERELY IF YOU ARE
FOUND LOOKING AT THE NEXT PAGE BEFORE
YOU ARE TOLD TO DO SO.

SECTION B   1½ hours
ESSAY
[60 marks]

Answer **eight** *questions in all*: **five** *questions from Part* I *and* **three** *questions from Part* II.
No marks will be awarded for answering questions **not peculiar** *to your country.*

PART I
[15 marks]
FOR CANDIDATES IN NIGERIA, SIERRA LEONE AND THE GAMBIA
Answer any **five** *questions. All questions carry equal marks.*

1. A projectile is released with a speed u at an angle θ to the horizontal. With the aid of a diagram, show that the time of flight is equal to

$$\frac{2u\sin\theta}{g},$$

where g is the acceleration of free fall.

2. List **three** situations in which polarized glasses are used.

3. A ray of light is incident on an air-glass boundary at an angle θ. If the angle between the partially reflected ray and the refracted ray is 90°, calculate angle θ given that the refractive index of glass is 1.54.

4. A mass of 11.0 kg is suspended from a rigid support by an aluminium wire of length 2.0 m, diameter 2.0 mm and Young's modulus 7.0×10^{11} N m^{-2}. Determine the extension produced. [$g = 10$ m s^{-2}; $\pi = 3.142$.]

5. Explain the effect of temperature on the surface tension of a liquid.

6. (*a*) Explain *diffusion*.

    (*b*) Give **one** reason why the rate of diffusion is higher in gases than in liquids at the same temperature.

    (*c*) State the effect of density on the rate of diffusion.

7. In electroplating an iron spoon with gold, state which material should be made the
    (*a*) anode,

    (*b*) cathode,

    (*c*) electrolyte.

8. (*a*) Mention the principle upon which the lighting in fluorescent tubes operate.

    (*b*) List **two** factors on which the colour of light from a fluorescent tube depend.

8. An electron travelling at 1.2×10^7 m s^{-1} enters a uniform magnetic field at right angles to the field. If the diameter of the resulting path of the electron is 20 cm, calculate the magnitude of the magnetic flux density. [$e = 1.6 \times 10^{-19}$ C; $m_e = 9.1 \times 10^{-31}$ kg]

9. Distinguish between *metals*, *insulators* and *semiconductors* in terms of the band theory.

10. Explain why conductivity of an elemental semiconductor increases when it is doped with either a Group III or V element.
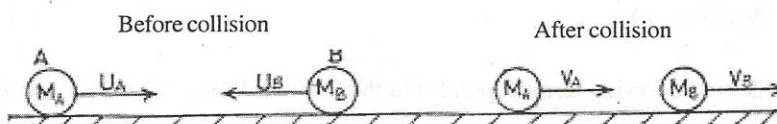
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PART II

[45 marks]

FOR ALL CANDIDATES

Answer any **three** *questions. All questions carry equal marks.*

</div>

11. (*a*) State the *principle of conservation of linear momentum.*   [2 marks]

    (*b*)

Two bodies *A* and *B* act mutually on each other as illustrated above. If their final velocities are V_A *and* V_B respectively,
    (i)   obtain expressions for their respective impulses I_A and I_B,
    (ii) use the expressions for I_A and I_B to show that linear momentum is conserved.
                                                                                          [6 marks]

    (*c*) Two forces 20.0 N and 50.0 N act at a point and at angle of 120° to each other.
    (i)   Draw a force diagram for the system.
    (ii) Calculate the magnitude and direction of the resultant force.
                                                                                          [7 marks]

12. (*a*) List **three** effects of heat on matter.   [3 marks]

    (*b*) Explain the following observations:
    (i)   a thick glass cup cracks when boiling water is poured into it but the same cup would not crack when immersed in a bath of cold water which is then heated to boiling point;
                                                                                          [4 marks]
    (ii) a cat runs with difficulty on a highly polished floor.   [2 marks]

    (*c*) (i)   State the *pressure law.*   [2 marks]
    (ii) A bottle is corked when the air in it is at 20 °C and 76 cm Hg. The bottle is heated until the pressure is increased by 69 cm Hg. Calculate the final temperature of the air in °C.
                                                                                          [4 marks]

13. (a) State the *laws of reflection*. [3 marks]

(b) (i) With the aid of a ray diagram, show how a convex mirror forms a virtual image. [3 marks]

(ii) A concave mirror of focal length 10 cm forms an erect image at a distance of 20 cm from the mirror. Calculate the object distance. [3 marks]

(c) A transparent rectangular glass prism of height 8.0 cm has a black spot inside it. When viewed vertically from the top, the spot appears 4.0 cm deep and 1.82 cm deep when the prism is inverted. Calculate the
(i) position of the black spot from the first observation,
(ii) refractive index of glass. [6 marks]

14. (a) Explain the following observations in relation to static electricity.
(i) In earthing a charged conductor by touching, electrons instead of protons flow into or out of the Earth.
(ii) A direct current (*d.c.*) cannot pass through a parallel plate capacitor. [3 marks]

(b) State **two** differences between *electric potential* and *electric field intensity*. [2 marks]

(c) What is a
(i) shunt?
(ii) multiplier?
(iii) pure capacitive circuit? [6 marks]

(d) An alternating signal $V = 25\sin 100\pi t$ is applied to a pure capacitive circuit. If the root-mean-square current I_{rms} through the circuit is 15 mA, calculate the
(i) capacitive reactance,
(ii) capacitance. [4 marks]

15. (a) Distinguish between *photoelectrons* and *thermoelectrons*. [2 marks]

(b) (i) Define *nuclear binding energy*. [2 marks]
(ii) Calculate the binding energy per nucleon for the lithium isotope $^{7}_{3}\text{Li}$. [4 marks]

[*Mass of* $^{7}_{3}\text{Li}$ = 7.018 u; *mass of* $^{1}_{1}\text{H}$ = 1.008 u; *mass of neutron* = 1.009 u; 1 u = 931 MeV]

(c) Explain
(i) excitation as used in atomic physics, [2 marks]
(ii) how the bombardment of uranium with neutron could lead to nuclear fission chain reaction. [5 marks]

END OF PAPER

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                                                                                                                [3 marks]

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                                                                                                                [6 marks]

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                                                                                                                [4 marks]

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1 u $= 931$ MeV]

(c)   Explain
(i)   excitation as used in atomic physics,   [2 marks]
(ii)   how the bombardment of uranium with neutron could lead to nuclear fission
chain reaction.   [5 marks]

END OF PAPER

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