

SC5122&1

WASSCE 2019

PHYSICS 2&1

Essay and Objective

2¾ hours

2&1

Name

Index Number.....

THE WEST AFRICAN EXAMINATIONS COUNCIL

**West African Senior School Certificate Examination
for School Candidates**

SC 2019

PHYSICS 2 & 1

2¾ hours

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

*This booklet consists of **two** papers. Answer Paper 2 which comes first, in your answer booklet and Paper 1 on your Objective Test answer sheet. Paper 2 will last 1½ hours, after which the answer booklets will be collected. Do **not** start Paper 1 until you are told to do so. Paper 1 will last 1¼ hours.*

Answer **eight** questions in all; **five** questions from Part I and **three** questions from Part II.

PART I
[15 marks]

Answer any **five** questions from this part.

All questions carry equal marks.

1. (a) What is a *blackbody*?
(b) Write an equation for the total energy, E , radiated at all wavelengths per unit area per unit time at temperature T .
2. (a) What is meant by *dimensions of a physical quantity*?
(b) The speed, c , of longitudinal waves in a stretched wire is given by the equation $c = \sqrt{\frac{E}{\rho}}$, where E is the Young's modulus for the material of the wire and ρ is its density. Show that this equation is dimensionally correct.
3. (a) When is a satellite said to be in a parking orbit?
(b) State **two** uses of satellites.
4. The permitted strain on a steel wire of diameter 1.0 mm is 1.0×10^{-3} . Calculate the **maximum** load that could be placed on the wire.
[Young's modulus for steel = $2.0 \times 10^{11} \text{ N m}^{-2}$, $\pi = 3.142$]
Stress
Strain
5. State **three** advantages of Fibre Optics.
Stress
6. What is meant by a laser being
(a) monochromatic?
(b) coherent?
(c) collimated?
7. (a) Explain the term *doping*.
(b) Draw a *p-n* junction diode connected in the forward bias mode.

$$E = \frac{mv^2}{2}$$

Answer **three** questions from this part.

All questions carry **equal** marks.

8. (a) (i) What is meant by the term *terminal velocity*?
- (ii) State **three** factors that affect the terminal velocity of a body in a liquid.
- (iii) Given that for a uniformly accelerated motion,
 $s = \left(\frac{v+u}{2}\right)t$ and $v = u + at$,
 where the symbols have their usual meanings, derive **two** other Newton's equations of motion.
- [9 marks]
- (b) (i) A bus travelling at 30 m s^{-1} along a straight road passes a stationary taxi cab. The cab begins to move 5 s later with a uniform acceleration of 2 m s^{-2} in the same direction as the bus. Calculate the
- (α) time taken by the cab to catch up with the bus.
- (β) distance the cab had travelled to catch up with the bus.
- [6 marks]
9. (a) (i) Explain the statement, *the specific heat capacity of water is $4200 \text{ J kg}^{-1} \text{ K}^{-1}$* .
- (ii) State **three** ways in which the high specific heat capacity of water is important.
- [5 marks]
- (b) An aluminium can of mass 100 g contains 200 g of water at 15°C . The can with its contents is placed in a freezer at -5°C . Calculate the quantity of heat that has to be removed from the water and the can for their temperature to fall to -5°C .
 [Specific heat capacity of water = $4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$, specific latent heat of ice = 340 J g^{-1} , specific heat capacity of aluminium = $0.9 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$, specific heat capacity of ice = $2.0 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$]
- [5 marks]
- (c) (i) What is a *machine*?
- (ii) State the relationship between the mechanical advantage, velocity ratio and efficiency of a machine.
- (iii) Draw and label a block and tackle system of velocity ratio 5.
- [5 marks]
10. (a) (i) Explain the term *parallax* as used in Optics.
- (ii) Define the *principal focus of a converging lens*.
- (iii) Using a ray diagram, illustrate the production of a virtual image using a converging lens.
- [7 marks]
- (b) (i) Define a *wave*.
- (ii) Arrange the following waves in **increasing** order of wavelength: visible light, radio waves, infrared waves, x-rays, microwaves and ultraviolet waves.
- [4 marks]

- (c) Two open organ pipes of lengths 50 cm and 50.9 cm give beats of frequency 6.0 Hz, when sounding their fundamental notes together. Neglecting end corrections, calculate the velocity of sound in air. [4 marks]

11. (a) (i) Define *static electricity*.
 (ii) State **two** practical uses of static electricity.
 (iii) Given two identical uncharged metal spheres, **A** and **B**, mounted on insulating supports, an ebonite rod and a piece of fur, describe with the aid of diagrams, how sphere **A** could be charged positively and sphere **B** negatively. [9 marks]

- (b) (i) Define *mutual induction*.
 (ii) A transformer supplies 12 V when connected to a 240 V mains. If the transformer takes 1.1 A from the mains to light ten 12 V, 24 W lamps arranged in parallel, calculate
 (α) the efficiency of the transformer;
 (β) the cost of supplying power for 10 hours at GH¢ 5.00 per kW h. [6 marks]

12. (a) (i) Define *half-life* of a radioactive element.
 (ii) Sketch a graph of the relation $N = N_0 e^{-\lambda t}$ and indicate the half-life. The usual meanings of the symbols are implied.
 (iii) The initial number of atoms in a radioactive element is 6.0×10^{20} and its half-life is 10 hours. Calculate
 (α) the number of atoms which have decayed in 30 hours.
 (β) the amount of energy liberated if the energy liberated per atom decay is 4.0×10^{-13} J. [7 marks]

- (b) (i) What are *nucleons*?
 (ii) Define the *binding energy* of an atom.
 (iii) Given that the mass of a proton is 1.0073 u, the mass of a neutron is 1.0087 u and the mass of a helium nucleus is 4.0015 u, calculate
 (α) the binding energy of the helium nucleus;
 (β) the binding energy per nucleon of helium.
 [1 u = 931 MeV] [8 marks]

END OF ESSAY TEST

$$\frac{N}{N_0} = \frac{1}{2^{10/10}}$$

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.**

**WHILE YOU ARE WAITING, READ THE FOLLOWING
INSTRUCTIONS CAREFULLY.**

PAPER 1
OBJECTIVE TEST
[50 marks]

1¼ hours

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', 'SC 2019', 'PHYSICS', and '1' 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 512113 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 Mariam Esi KWAO. Her *index number* is 7102143958 and she is offering *Physics 1*.

**THE WEST AFRICAN EXAMINATIONS COUNCIL
ANSWER SHEET**

PRINT IN BLOCK LETTERS		GHA
Name: <u>KWAO MARIAM ESI</u>		
Examination: <u>WASSCE</u>	Year: <u>SC 2019</u>	
Subject: <u>PHYSICS</u>	Paper: <u>1</u>	

INSTRUCTIONS TO CANDIDATES

1. Use grade 2B pencil throughout.
2. Answer each question by choosing one letter and shading it like this: A B 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	
7	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
0	0 1 2 3 4 5 6 7 8 9
2	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
4	0 1 2 3 4 5 6 7 8 9
3	0 1 2 3 4 5 6 7 8 9
9	0 1 2 3 4 5 6 7 8 9
5	0 1 2 3 4 5 6 7 8 9
8	0 1 2 3 4 5 6 7 8 9

SUBJECT CODE	
5	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
2	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
3	0 1 2 3 4 5 6 7 8 9

For Supervisors only
If candidate is absent
shade this space

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.

A series LC circuit has capacitance $50 \mu\text{F}$ and inductance of $500 \mu\text{H}$. Calculate the frequency at which the circuit will resonate. [$\pi = 3.142$]

- A. 6365 Hz
- B. 3183 Hz
- C. 1006 Hz
- D. 503 Hz

The correct answer is 3183 Hz, which is lettered B, and therefore answer space B would be shaded.

A B C D

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

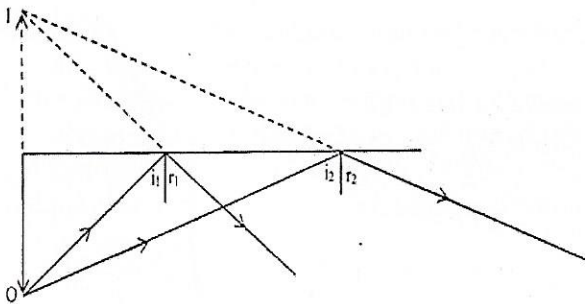
Do all rough work on this question paper.

Now answer the following questions.

1. The time rate of increase in velocity is called
 - A. momentum.
 - B. acceleration.
 - C. speed.
 - D. force.
2. Which of the following quantities is a vector?
 - A. Momentum
 - B. Energy
 - C. Speed
 - D. Volume
3. In an elastic collision, momentum is conserved as well as
 - A. kinetic energy.
 - B. potential energy.
 - C. speed.
 - D. velocity.
4. The induced current in a coil always flows in a direction so as to oppose the change causing it. This statement is known as
 - A. Lenz's law.
 - B. Faraday's law.
 - C. Ampere's law.
 - D. Coulomb's law.

5. Which of the following instruments can be used to compare the magnitudes of charges on two given bodies?
- The electrophorus
 - Ebonite rod
 - Proof plane
 - Gold-leaf electroscope
6. A body of mass 2 kg is released from a point 100 m above the ground level. Calculate its kinetic energy 80 m from the point of release. [$g = 10 \text{ m s}^{-2}$]
- 200 J
 - 600 J
 - 900 J
 - 1600 J
7. Which of the following waves is **not** mechanical?
- Sound waves
 - Radio waves
 - Water waves
 - Waves in pipes
8. A loaded spring is set in simple harmonic motion. The force that tends to restore the load to its equilibrium position is
- elastic.
 - gravitational.
 - frictional.
 - adhesive.
9. Which of the following situations **cannot** produce total internal reflection? A light ray travelling from
- water to air.
 - air to water.
 - water to kerosene.
 - glass to water.
10. The vacuum in a thermos flask reduces heat loss resulting from
- radiation only.
 - radiation and convection only.
 - conduction only.
 - conduction and convection only.

11.



The diagram above represents an experimental set-up for verifying

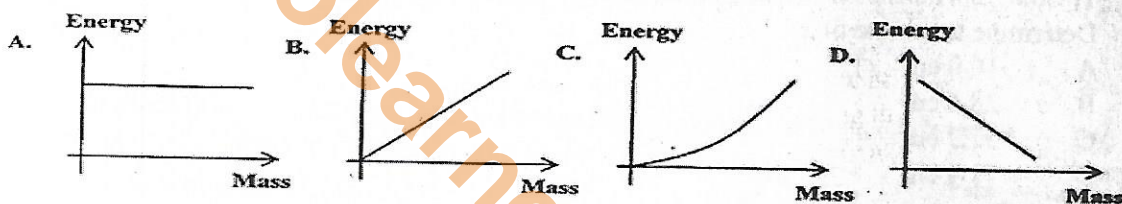
- laws of refraction.
- laws of reflection.
- mirror formula.
- lens formula.

12. Which of the following statements about a moving object is **correct**?
- There must always be a resultant force acting on it.
 - At a steady speed, the resultant force acting on it must be equal to zero.
 - At a steady speed, the air resistance on it must be equal to zero.
 - When accelerating, the resultant force acting on it must be equal to zero.
13. The efficiency of a transformer is 100 %. Which of the following equations would be **correct**?
- $N_s I_s = N_p I_p$
 - $N_s I_p = N_p I_s$
 - $I_s E_s = I_p E_p$
 - $N_p E_p = N_s E_s$
14. A freshly demagnetized bar magnet is placed in East-West direction to ensure that,
- magnetic domains remain randomly arranged.
 - magnetic domains are orderly aligned.
 - it is affected by the earth's magnetic field.
 - the magnetic domains are within the earth's field.
15. Which of the following graphs **correctly** represents the plot of the charge Q against the potential difference V in a capacitor?



16. A small amount of air is introduced into the vacuum above the mercury in a mercury barometer tube. The mercury level falls because the air molecules
- increase the pressure above the mercury.
 - decrease the pressure above the mercury.
 - cool the mercury and make it contract.
 - heat the mercury and make it lighter.
17. Calculate the quantity of heat needed to change 60 g of ice at $0.0\text{ }^\circ\text{C}$ to water at $80.0\text{ }^\circ\text{C}$.
 [Specific latent heat of fusion of ice = $3.36 \times 10^5\text{ J kg}^{-1}$,
 specific heat capacity of water = $4.2 \times 10^3\text{ J kg}^{-1}\text{ K}^{-1}$]
- 4.80 kJ
 - 20.16 kJ
 - 22.17 kJ
 - 40.32 kJ
18. The wire of a platinum resistance thermometer has a resistance of $3.5\ \Omega$ at $0\text{ }^\circ\text{C}$ and $10.5\ \Omega$ at $100\text{ }^\circ\text{C}$. Calculate the temperature of the wire when its resistance is $7.5\ \Omega$.
- $25\text{ }^\circ\text{C}$
 - $36\text{ }^\circ\text{C}$
 - $57\text{ }^\circ\text{C}$
 - $78\text{ }^\circ\text{C}$
19. A transverse wave of frequency 9 Hz travels 4.5 m in 0.6 s. Calculate the wavelength of the wave.
- 0.30 m
 - 0.83 m
 - 1.20 m
 - 3.33 m

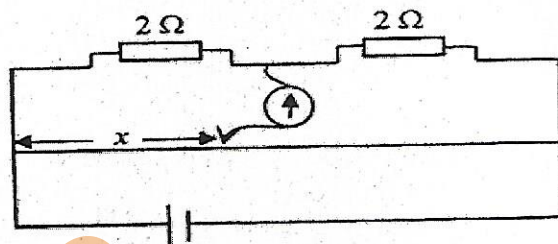
20. The speed of sound is **least** in which of the following media?
- Brass
 - Water
 - Wood
 - Air
21. Which of the following characteristics of waves can be demonstrated using a ripple tank?
- Reflection
 - Refraction
 - Diffraction
- I only
 - II only
 - I and II only
 - I, II and III
22. Which of the following graphs gives the **correct** relationship between energy and mass when mass is converted to energy?



23. An 800 kg car moving at 80 km h^{-1} collides with a 1200 kg car moving at 40 km h^{-1} in the same direction. If the cars stick together, calculate their common speed.
- 8 km h^{-1}
 - 40 km h^{-1}
 - 56 km h^{-1}
 - 60 km h^{-1}
24. The mass of an object is doubled while the force acting on it is halved. The resulting acceleration of the object is
- quartered.
 - halved.
 - doubled.
 - quadrupled.
25. The maximum and minimum thermometer reads the
- maximum temperature during the day and minimum temperature at night at all times.
 - maximum temperature at night and minimum temperature during the day at all times.
 - maximum temperature during the day and minimum temperature at night from the time it was last reset.
 - maximum temperature at night and minimum temperature during the day from the time it was last reset.
26. An a.c. generator can be converted to a d.c. generator by replacing the
- commutator with an armature.
 - armature with a commutator.
 - commutator with slip rings.
 - slip rings with a commutator.

27. Which of the following statements is the **correct** reason for which soft iron is used in making the armature of an electric bell? Soft iron
- loses its magnetism easily.
 - is not easily magnetized.
 - retains its magnetism for a long time.
 - is a diamagnetic material.

28.



The diagram above illustrates a metre bridge circuit under balanced condition. Determine the value of x .

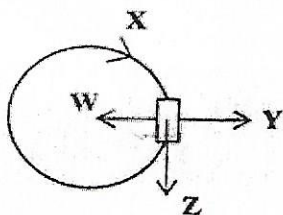
- 10.0 cm
 - 28.6 cm
 - 57.2 cm
 - 71.4 cm
29. Which of the following devices is used for storing electric charge?
- Ammeter
 - Potentiometer
 - Capacitor
 - Transformer

An electron of mass 9.1×10^{-31} kg moves with a speed of 2.0×10^6 m s⁻¹ round the nucleus of an atom in a circular path of radius 6.1×10^{-11} m. Use this information to answer questions 30 and 31.

30. Determine the angular speed of the electron.
- 8.55×10^3 rad s⁻¹
 - 9.11×10^{13} rad s⁻¹
 - 5.22×10^{15} rad s⁻¹
 - 3.28×10^{16} rad s⁻¹
31. Calculate the centripetal force acting on the electron.
- 6.0×10^{-8} N
 - 3.0×10^{-14} N
 - 1.3×10^{-26} N
 - 7.7×10^{-47} N
32. A device consumes 100 W of power when connected to a 120 V source. Calculate its resistance.
- 12000 Ω
 - 20 Ω
 - 144 Ω
 - 1.2 Ω

33. Which property of a wave remains constant when the wave travels from one medium into another?
- Wavelength
 - Velocity
 - Frequency
 - Amplitude
34. The anomalous expansion of water occurs in the range
- $0\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$.
 - $0\text{ }^{\circ}\text{C}$ to $4\text{ }^{\circ}\text{C}$.
 - $4\text{ }^{\circ}\text{C}$ to $100\text{ }^{\circ}\text{C}$.
 - $-4\text{ }^{\circ}\text{C}$ to $0\text{ }^{\circ}\text{C}$.
35. A ray of light travelling from a rectangular glass block of refractive index 1.5 into air, strikes the block-air boundary at an incident angle of 30° . Calculate the angle of refraction.
- 19.5°
 - 20.0°
 - 45.0°
 - 48.6°
36. A rectangular piece of iron measuring $4\text{ cm} \times 3\text{ cm}$ at $20\text{ }^{\circ}\text{C}$ is heated until its temperature increases by $100\text{ }^{\circ}\text{C}$. Calculate the new area of the metal.
[Linear expansivity of iron = $1.2 \times 10^{-5}\text{ K}^{-1}$]
- 12.0346 cm^2
 - 12.0288 cm^2
 - 12.0173 cm^2
 - 12.0144 cm^2
37. Two bodies of masses 3.0 kg and 2.0 kg are 50 cm apart. Calculate the force of attraction between them. [$G = 6.67 \times 10^{-11}\text{ N m}^2\text{ kg}^{-2}$]
- $1.3 \times 10^3\text{ N}$
 - $2.3 \times 10^3\text{ N}$
 - $5.0 \times 10\text{ N}$
 - $1.6 \times 10^{-9}\text{ N}$

38.

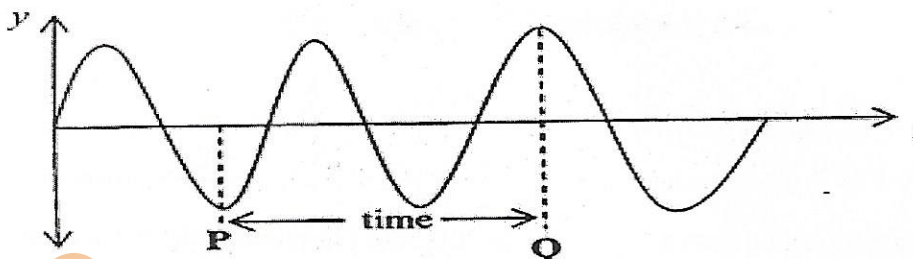


The diagram above illustrates an object moving in a circular path at constant speed. Which of the arrows **correctly** indicate the direction of linear velocity?

- W
- X
- Y
- Z

39. Which of the following thermometers is used to measure the temperature of the human body?
- Alcohol-in-glass thermometer
 - Gas thermometer
 - Platinum resistance thermometer
 - Thermocouple

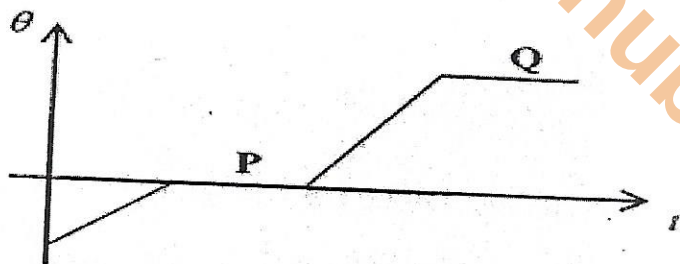
40.



In the diagram above, the time taken to trace a wave between P and Q is

- 1 period.
 - $1\frac{1}{4}$ periods.
 - $1\frac{1}{2}$ periods.
 - 2 periods.
41. Which of the following components does **not** serve as a safety device in electrical circuits?
- Fuse
 - Switch
 - Earth wire
 - Connecting wires
42. Which of the following liquids has the **highest** surface tension?
- Cold water
 - Hot water
 - Oily water
 - Soapy water
43. The nucleon and proton numbers of a neutral atom of an element are 238 and 92 respectively. Determine the number of neutrons in the atom.
- 330
 - 165
 - 146
 - 119
44. An instrument used to measure relative humidity is the
- hydrometer.
 - pyrometer.
 - manometer.
 - hygrometer.
45. The area under a velocity-time graph represents
- acceleration.
 - moment.
 - distance.
 - speed.

46. Which of the following statements about a neutral atom is correct? The
- number of electrons is equal to that of neutrons.
 - number of neutrons is equal to that of protons.
 - number of protons is equal to that of electrons.
 - core is composed of electrons and protons.
47. The property that is **not** exhibited by sound waves is
- diffraction.
 - interference.
 - polarization.
 - reflection.
48. When ultraviolet light is incident on the surface of certain metals, particles are emitted. These particles are called
- protons.
 - photons.
 - photoelectrons.
 - positrons.
49. Niels Bohr drew certain conclusions about the structure of the atom. Which of the following statements is one of those conclusions?
- Within an atom, there are certain allowed orbits.
 - All of the orbits represent the same amount of energy.
 - The orbit with the least energy is the farthest from the nucleus.
 - The allowed orbits contain the same number of electrons.
- 50.



The graph above illustrates the variation of temperature with time for a solid that is being heated. Which processes take place at the segments P and Q respectively?

- Melting and boiling
- Condensation and evaporation
- Freezing and evaporation
- Evaporation and solidification

END OF PAPER