P5122 Nov.
WASSCE 2011
PHYSICS 2
$2\frac{3}{4}$ hours

2

Name:...

Index Number:..

THE WEST AFRICAN EXAMINATIONS COUNCIL
West African Senior School Certificate Examination

November 2011   PHYSICS 2 $2\frac{3}{4}$ hours

*Do **not** open this booklet until you are told to do so. While you are waiting, write your **name** and **index number** in the spaces provided at the top right-hand corner of this booklet and thereafter, read the following instructions carefully.*

*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 $1\frac{1}{4}$ 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 $1\frac{1}{2}$ hours.*

SECTION A
OBJECTIVE TEST
[50 marks]

$1\frac{1}{4}$ hours

1. Use **HB** pencil throughout.
2. If you have got a blank answer sheet, complete the top section as follows:
   (a) In the space marked Name, write in capital letters your **surname** followed by your **other names.**
   (b) In the spaces marked Examination, Year, Subject and Paper, write **'WASSCE'**, **'2011 Nov.'**, **'PHYSICS'** and **'2'** respectively.
   (c) In the box marked Index Number, write your **index number** vertically in the spaces on the left hand side. There are numbered spaces in line with each digit. Shade carefully the space with the same number as each digit.
   (d) In the box marked Paper Code, write the digits **512213** in the spaces on the left-hand side. Shade the corresponding numbered spaces in the same way as for your index number.
   (e) In the box marked Sex, shade the space marked **M** if you are male, or **F** if you are female.
3. If you have got a pre-printed answer sheet, check that the details are correctly printed, as described in **2** above. In the boxes marked Index Number, Paper Code and Sex, **reshade** each of the shaded spaces.
4. An example is given below. This is for a **male** candidate, whose **name** is **Chukwuma Adekunle Ciroma**, whose index *number* is **5251102068** and who is offering **Physics 2**.

THE WEST AFRICAN EXAMINATIONS COUNCIL

PRINT IN BLOCK LETTERS

Name: CIROMA CHUKWUMA ADEKUNLE   Examination: WASSCE   Year: 2011 NOV.
     Surname   Other Names

Subject: PHYSICS   Paper: 2

INDEX NUMBER	PAPER CODE	SEX
5	5	Indicate your sex by shading the space marked M (for Male) or F (for Female) in this box: M F
2	1	
5	2	
1	2	
1	1	
0	3	
2		
0		
6		
8		

INSTRUCTIONS TO CANDIDATES
1. Use grade **HB** pencil throughout.
2. Answer each question by choosing one letter and shading it like this: [A] [B] [C]
3. Erase completely any answers 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.

For Supervisors only.
If candidate is absent shade this space:

       © 2011 *The West African Examinations Council*   **Turn over**

Answer **all** *the questions.*

Each *question is followed by* **four** *options lettered* A *to* D. *Find out 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 phenomena causes capillarity of liquids in tubes of narrow bore?
  A.   Viscosity
  B.   Surface tension
  C.   Osmosis
  D.   Brownian motion

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

[A]   �®   [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 mass of an object can be measured using the following instruments **except**

  A.   spring balance.

  B.   lever.

  C.   metre rule.

  D.   beam balance.

2. A load of 80 N extends a spring by 8 *cm*. When the load is replaced by a copper block, the extension produced is 10 *cm*. Calculate the weight of the copper block, assuming that the elastic limit of the spring is **not** exceeded.

  A.   40 N

  B.   64 N

  C.   100 N

  D.   160 N

3. A sample of air weighing $1·32 \times 10^3$ N is confined in a room measuring $9·5\ m \times 5·0\ m \times 2·0\ m$. Calculate the density of the sample.   [$g = 10\ ms^{-2}$]

  A. $0·07\ kg\ m^{-3}$

  B. $0·72\ kg\ m^{-3}$

  C. $1·39\ kg\ m^{-3}$

  D. $13·89\ kg\ m^{-3}$

3001

4. A turkey stands and makes $4 \times 10^{-2} \, m^2$ of contact with the ground. If the pressure it exerts on the ground is $2.8 \times 10^3 \, Pa$, calculate its weight.

   A.   11·2 N

   B.   102·0 N

   C.   112·0 N

   D.   140·0 N

5.
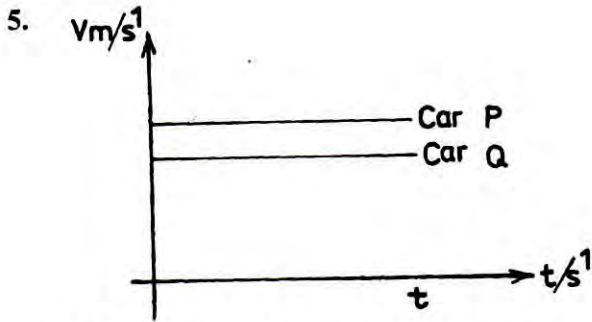
The graph above illustrates the motions of two cars **P** and **Q** over a period of time **t**. Which of the following statements about the motion of the cars is **correct**? **P**

   A.   accelerates faster than **Q**.

   B.   has more horse power than **Q**.

   C.   has the same acceleration as **Q**.

   D.   and **Q** increase their speeds steadily.

6. When a projectile is projected with an initial velocity U at an angle θ to the horizontal, the horizontal component of its velocity is

   A. $U \cos \theta$.

   B. $U \sin \theta$.

   C. $U \tan \theta$.

   D. $U \cot \theta$.

A body of mass 200 g moving at $15.0 \, ms^{-1}$ is accelerated to $25.0 \, ms^{-1}$ in a time of $10.0 \, s$.
Use the given data to answer questions **7** *and* **8**.

7. Determine the magnitude of the accelerating force.

   A.   0·2 N

   B.   2·0 N

   C.   20·0 N

   D.   200·0 N

8. Calculate the amount of work done on the body.

   A.   4.0 J

   B.   40.0 J

   C.   4,000.0 J

   D.   40,000.0 J

9. The magnitude of the resultant of two forces inclined at an angle of 30° is

    A.   greater than the magnitude of either force.

    B.   equal to the sum of the magnitudes of the two forces.

    C.   equal to the difference in the magnitudes of the two forces.

    D.   greater than the sum of the magnitudes of the two forces.

10. A uniform metre rule balances horizontally when it is pivoted at the 70 *cm* mark and a mass of 105 *g* is suspended at the 90 *cm* mark. Calculate the mass of the metre rule.

    A.   100.0 *g*

    B.   105.0 *g*

    C.   135.0 *g*

    D.   189.0 *g*

11. Which of the following motions is **not** simple harmonic?

    A.   The motion of a particle in a transverse wave

    B.   The vibrating prongs of a tuning fork

    C.   A simple pendulum swinging with large angular amplitude

    D.   The vertical vibrations of a mass at the end of a spring

12. A pendulum clock keeps a wrong time when the room temperature rises substantially. This observation is due to

    A.   an increase in the period as a result of an increase in the length of the pendulum.

    B.   a decrease in the period due to an increase in the length of the pendulum.

    C.   an increase in the period due to a decrease in the length of the pendulum.

    D.   a decrease in the period due to a decrease in the length of the pendulum.

13. Jet and rocket propulsions are based on

    A.   Newton's first law of motion.

    B.   Newton's second law of motion.

    C.   Newton's third law of motion.

    D.   Principle of moments.

14. When the average separation of the molecules of a fixed mass of an ideal gas is increased, there is corresponding average

    A.   increase in the rate of collisions.

    B.   decrease in pressure of the gas.

    C.   increase in kinetic energy of the gas.

    D.   decrease in the number of molecules.
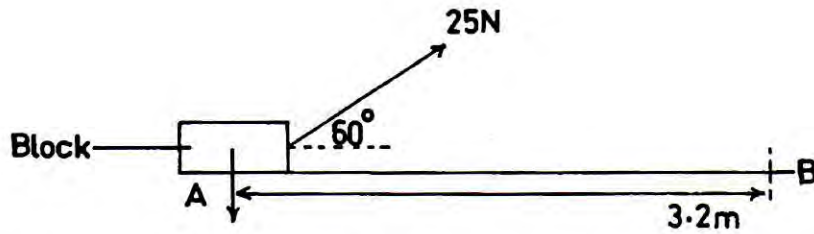
Study the diagram above and use the information provided to answer questions **15** *and* **16**.

15. Calculate the lifting force acting on the block.

   A.   12.5 N

   B.   21.7 N

   C.   25.0 N

   D.   43.3 N

16. Calculate the work done in moving the block to point **B**.

   A.   80.0 J

   B.   69.4 J

   C.   40.0 J

   D.   34.7 J

17. A student pulls a trolley with a horizontal force of 50.0 N through a distance of 1.5 km in 20 minutes. Calculate the average power of the student.

   A.   3.8 W

   B.   62.5 W

   C.   666.7 W

   D.   3750.0 W

18. When a bicycle is being ridden uphill, its mechanical advantage is

   A.   greater than 1.

   B.   less than 1.

   C.   equal to 1.

   D.   equal to its *V.R.*

19. The S.I unit of temperature is

   A.   *C.*

   B.   *F.*

   C.   *K.*

   D.   *A.*

Turn over

20. Which of the following applications is **not** related to thermal expansion?

   A. Sagging of telegraph wires

   B. Gaps between rails

   C. Anomalous expansion of water from $0°\,C$ to $4°\,C$

   D. Use of thermostat

21. An air bubble of volume $4 \times 10^{-6}\ m^3$, formed $5\ m$ below water surface, moves upward. Determine its volume just before it reaches the surface.
(Assume that the temperature remains constant, atmospheric pressure equals $10\ m$ of water)

   A. $0.80 \times 10^{-6}\ m^3$

   B. $1.33 \times 10^{-6}\ m^3$

   C. $2.67 \times 10^{-6}\ m^3$

   D. $6.00 \times 10^{-6}\ m^3$

22. An aluminium calorimeter without a lid and jacket is placed on a table. Boiling water is then poured into it. Which of the following processes will account for the cooling of the water?

   I. Conduction

   II. Evaporation

   III. Radiation

   IV. Convection

   A. I only

   B. I and II only

   C. II and III only

   D. I, II, III and IV

23. The quantity of heat required to raise the temperature of a unit mass of a substance by $1°\,C$ is known as

   A. specific heat capacity.

   B. latent heat of fusion.

   C. heat capacity.

   D. specific latent heat.

24. Which of the following equations does **not** represent a travelling wave?

   A. $y = A \sin(\omega t - \theta)$

   B. $y = A \sin 2\pi\left(\dfrac{t}{T} - \dfrac{x}{\lambda}\right)$

   C. $y = A \sin\left(\dfrac{T}{t} - x\right)$

   D. $y = A \sin \dfrac{2\pi}{\lambda}(vt - x)$

25. Which of the following diagrams **correctly** illustrates the passage of white light through a triangular glass prism?
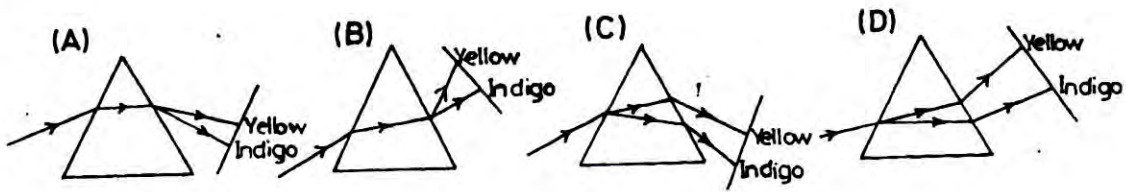
26. The refractive indices of water and glass with respect to air are $\frac{4}{3}$ and $\frac{3}{2}$ respectively. If the speed of white light in glass is $2.00 \times 10^8 \ ms^{-1}$, calculate its speed in water.
    A. $1.33 \times 10^8 \ ms^{-1}$
    B. $1.50 \times 10^8 \ ms^{-1}$
    C. $2.25 \times 10^8 \ ms^{-1}$
    D. $2.67 \times 10^8 \ ms^{-1}$

27. Optical fibres are based on the principle of
    A. total internal reflection.
    B. double refraction.
    C. diffraction.
    D. interference.

28. When an object is placed 12 cm from a converging lens, a real image four times its original size is produced. Calculate the focal length of the lens.
    A. 48.0 cm
    B. 16.0 cm
    C. 9.6 cm
    D. 3.0 cm

29. Which of the following statements about sound waves are **correct**?
    I.   In a uniform medium, the intensity of sound waves is directly proportional to the distance from the source.
    II. The amplitude of sound waves of given frequency and wave length is a measure of the energy of the waves.
    III. Pitch is the effect of frequency of sound waves on the human ear.

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

Turn over

30. For an astronomical telescope in normal adjustment, the distance between the lenses is
    A. $f_o - f_e$.
    B. $f_e + f_o$.
    C. $f_o \times f_e$.
    D. $2f_o - f_e$.

31. The pitch of a musical note depends on
    A. amplitude.
    B. frequency.
    C. intensity.
    D. quality.

32. Two sonometer wires, X and Y, have the same length. If the mass per unit length of X is $\frac{1}{9}$ that of Y, determine the ratio of the frequency of X to that of Y.
    A. $2 : 3$
    B. $3 : 2$
    C. $1 : 9$
    D. $3 : 1$

33. The first resonant length of the air column vibrating to a tuning fork in a closed tube is $26.25 \, cm$. Neglecting end correction, calculate the frequency of the fork.
    [Speed of sound in air $= 336 \, ms^{-1}$]
    A. $960 \, Hz$
    B. $640 \, Hz$
    C. $320 \, Hz$
    D. $160 \, Hz$

34. The derived unit for the universal gravitational constant **G** is
    A. $Nm^{-2} \, kg^{-2}$.
    B. $Nm^{-2} \, kg$.
    C. $Nm^2 \, kg^{-2}$.
    D. $Nm \, kg^{-2}$.

35. Static electricity is produced by either loss or gain of
    A. electrons.
    B. protons.
    C. neutrons.
    D. atoms.

36. An insulated negatively charged rod is held high above the cap of a positively charged electroscope. The rod is slowly moved down towards the cap until it is just above it. The leaves of the electroscope will be observed to slowly
    A. collapse completely.
    B. collapse and then diverge.
    C. attain maximum divergence.
    D. diverge and then collapse completely.

37. A total charge of 1.0 millicoulomb is stored by the capacitors in the circuit illustrated below. Calculate the value of **X**.
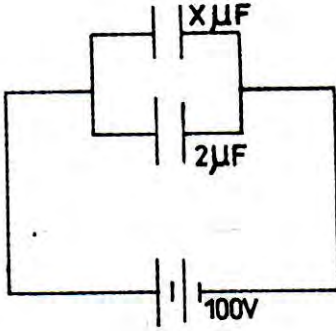
- A.   4.0 μF
- B.   6.0 μF
- C.   8.0 μF
- D.   10.0 μF

38. Electrical energy stored in a capacitor is given by the expression

- A. $\frac{1}{2}CV.$

- B. $\frac{1}{2}CQ^2.$

- C. $\frac{1}{2}QV.$

- D. $\frac{1}{2}\frac{Q}{C^2}.$

39. A 120 Ω resistor is connected across an *a.c.* having a maximum voltage of 283 *V*. Calculate the *rms* value of the current in the circuit.
- A.   3.3 A
- B.   2.4 A
- C.   1.7 A
- D.   0.6 A

40.
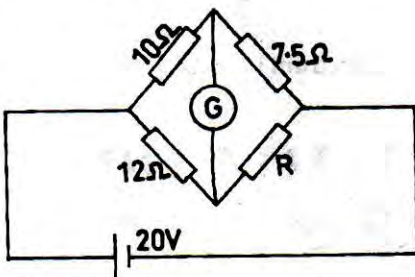
Use the circuit diagram above to determine the value of **R** at null deflection.
- A.   22 Ω
- B.   16 Ω
- C.   10 Ω
- D.   9 Ω

Turn over

41. Which of the following methods is the **most** effective for making a magnet?

    A. Single touch method
    B. Divided touch method
    C. Electrical method
    D. Hammering in the earth's magnetic field

42. Which of the following factors does **not** increase the strength of an induced *emf* in a solenoid? The

    A. cross-sectional area of the solenoid
    B. polarity of the magnet facing the solenoid
    C. speed at which the magnet moves
    D. number of turns of the solenoid

43. Two identical parallel conductors close to each other carry equal currents in the same direction. Which of the following statements is **not** correct?

    A. Each of the conductors will experience a force
    B. Each of the conductors can move
    C. The magnitudes of the forces on the conductors will be equal
    D. The two conductors will repel each other

44. In the wiring of houses, the switch is connected to the

    A. earth wire.
    B. live wire.
    C. neutral wire.
    D. earth and neutral wires bridged together.

45. A circuit consisting of a resistor R, an inductor L and a capacitor C in series is connected to an alternating current source. At resonance, the

    A. current is maximum.
    B. impedance is maximum.
    C. current is least.
    D. frequency is maximum.

46. Which of the following radiations is **not** part of the electromagnetic spectrum?

    A. Gamma ray
    B. Alpha particle
    C. X-ray
    D. Radio wave

47. Which of the following constituents of an atom enables matter to conduct electricity?

    A. Electrons
    B. Neutrons
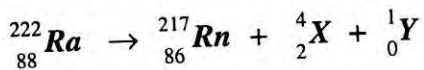   C. Protons
    D. Nucleus

48.
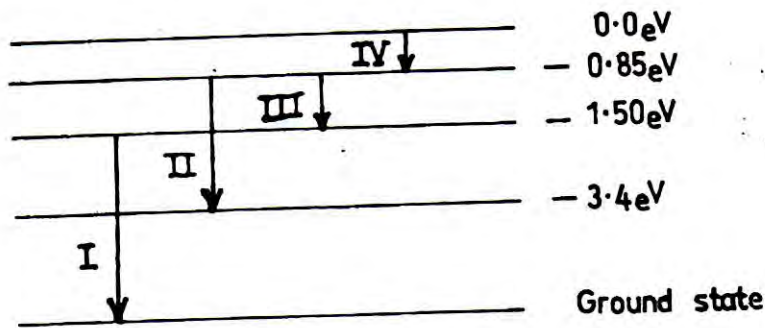
The diagram above illustrates some energy levels in an atom of hydrogen. Which of the transitions **I – IV** will produce an absorption spectra line in the hydrogen emission spectrum?

A. **IV**
B. **III**
C. **II**
D. **I**

49. Radium *(Ra)* disintegrates as illustrated in the equation below. Identify particles *X* and *Y*.

$$_{88}^{222}Ra \rightarrow \ _{86}^{217}Rn \ + \ _{2}^{4}X \ + \ _{0}^{1}Y$$

A. Alpha and beta
B. Beta and Alpha
C. Alpha and neutron
D. Neutron and beta

50. It is not very possible to determine, exactly and simultaneously, both the position and momentum of a particle. This statement is called the

A. Dalton's atomic theory.
B. de-Broglie's principle.
C. Heisenberg's uncertainty principle.
D. Wave-particle paradox.

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

ESSAY

[60 marks]

$1\frac{1}{2}$ hours

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 from this part.*

All *questions carry equal marks.*

1. A stone is projected vertically upward with a speed of $30\ ms^{-1}$ from the top of a tower of height $50\ m$. Neglecting air resistance, determine the time of flight on reaching the ground.
   [$g = 10\ ms^{-2}$]

2. A body of mass $0.5\ kg$ is thrown vertically upwards with a speed of $25\ ms^{-1}$. Calculate the potential energy of the body at the maximum height reached.
   [$g = 10\ ms^{-2}$]

3. List **two**:
   (a) types of waves, other than light, that can be plane polarized;
   (b) methods of polarizing an unpolarized light.

4. *(a)* What is *electrolysis*?
   (b) A current of $2A$ is passed through a copper voltameter for 5 minutes. Determine the mass of the copper deposited.
   [*Electrochemical equivalent* of copper $= 3.27 \times 10^{-7}\ kg\ C^{-1}$]

5. State **two**:
   (a) differences;
   (b) similarities
   between *thermionic* and *photoelectric* emission.

6. The table below shows the pointer reading of a spring balance when different weights are hung on it. Determine the value of *F*.

Weight / N	5	10	F
Pointer reading / cm	8	12	30

7. An x-ray tube operates at a potential of $2500\ V$. If the power of the tube is $750\ W$, calculate the current passing through the tube.

8. Using the kinetic theory, explain the rise of water in a glass capillary tube.

9. Explain briefly the principle of action of a discharge tube.

10. Write down the name of:
    (a) **two** particles used in explaining the wave nature of matter;
   *(b)* **one** device whose invention is based on the wave nature of matter.

Part I

[15 marks]

FOR CANDIDATES IN GHANA ONLY

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

All *questions carry equal marks.*

1. The initial and final speeds of a moving object are **u** and **v** respectively. If the acceleration of the object is **a** and its time of motion is **t**, show that the expression **v** = **u** + **at** is dimensionally correct.

2. Draw and label a $P - V$ diagram to illustrate the thermodynamic process in a diesel engine.

3. Two tuning forks of slightly different frequencies f_1 and f_2 are sounded together. Explain how audible beats are formed.

4. An engine transfers $2.00 \times 10^3 \, J$ of energy from a hot reservoir during a cycle and transfers $1.50 \times 10^3 \, J$ to a cold reservoir. Calculate the efficiency of the engine.

5. The formula $\left(P + \dfrac{a}{V^2} \right)(V - b) = RT$, represents van der Waal's equation. Explain how the extra terms $\dfrac{a}{V^2}$ and b account for the deviation from the ideal gas situation.

6. A satellite of mass M_s situated at a height h above the surface of the earth moves with a speed V_s in circular orbit around the earth. If the mass and radius of the earth are M_e and R_e respectively and the gravitational constant is G, write down an expression for the magnitude of the:
   (a) centripetal force needed to maintain the satellite in orbit.
   (b) gravitational field strength in the region of the satellite.

7. List **three** devices in everyday life which operate on the deflection of electric charges in a magnetic field.

8.
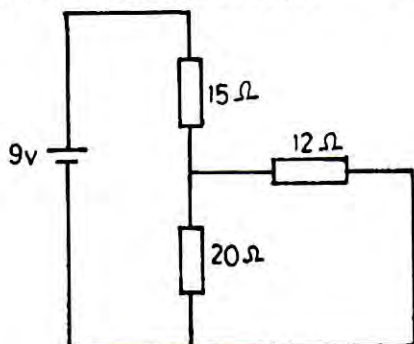
Using the Kirchhoff's rule, determine the current through **each** resistor in the diagram above.

9. State **three** properties of an intrinsic semiconductor.

10. With the aid of diagrams, explain what is meant by
    (a) forward bias;
    (b) reverse bias.

PART II

[45 marks]

FOR ALL CANDIDATES

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

All *questions carry equal marks.*

11. (a) (i) Explain *relative motion*. [2 marks]
       (ii) Two cars moving in opposite directions on the same straight road with velocities 80 $km \, h^{-1}$ and 60 $km \, h^{-1}$ respectively pass each other at a point. Determine the velocity of the first car relative to the second. [2 marks]

    (b) (i) Define *force*. [1 mark]
       (ii) Classify the following forces as either *contact forces* or *field forces*: push; tension; gravitational; electrostatic; reaction and magnetic. [3 marks]

    (c) A body starts from rest and travels in a straight line for 2 seconds with uniform acceleration of 1 ms^{-2}. It then travels at a constant speed for some time before coming to rest with a uniform retardation of 2 ms^{-2}. The total distance covered by it is 15 m.
       (i) Draw and label a velocity-time graph for the motion.
       (ii) Calculate the:
           (A) velocity attained after the first 2 seconds;
           (B) total time taken for the journey. [7 marks]

Turn over

12. *(a)* (i) What is *mechanical energy*? [2 marks

       (ii) A ball of mass M raised to a height H above the ground is allowed to fall freely towards the ground. Show that at a point T when it has fallen through a distance h, the total mechanical energy remains unchanged. [4 marks

  (b) (i) What is a *thermometric property*? [2 marks

       (ii) Copy and complete the table below

Thermometric substance	Thermometric property	Kind of thermometer
Mercury		Liquid-in-glass
		Platinium resistance
Gas	Pressure	
		Thermocouple

[3 marks

  (c) An inclined plane is used to raise a box 25.0 kg to the top of the plane by an effort of 180 N. Assuming the plane is 60 % efficient, calculate the:

    (i) mechanical advantage;

    (ii) velocity ratio;

    (iii) angle the plane makes with the horizontal.
        [$g = 10\ ms^{-2}$] [4 marks

13. *(a)* (i) Explain *interference of waves*. [2 marks

       (ii) With the aid of diagrams distinguish between *constructive* and *destructive* *interference* of transverse waves. [4 marks

  (b) A stretched wire under tension T produces a note of frequency 60 Hz when plucked. Calculate the frequency if the tension in the wire is increased by 125 %. [4 marks

  (c) The displacement of a plane progressive wave is given by the equation
$$y = 12.5 \sin (240\pi t - 0.50\pi x),$$
where the symbols have their usual meanings,
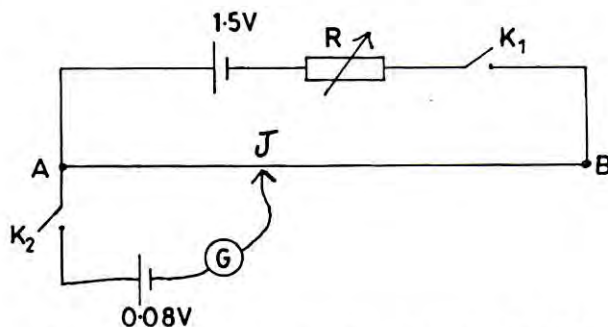y and x are in metres and t in seconds.
For the wave, determine the:

    (i) frequency;

    (ii) wavelength;

    (iii) speed. [5 marks

14. (a) State **two** advantages and **one** disadvantage of alkaline cells over lead-acid cells. [3 marks]

(b) Explain why High-Tension transmission of power is done with low current and high voltage. [3 marks]

(c)

The diagram above illustrates a uniform potentiometer wire **AB** of length 100 cm and resistance 2 Ω. A cell of e.m.f. 1.5 V and a variable resistor **R** are connected in series with **AB**. If **R** = 4 Ω and the key **K₁** is closed, calculate the

(i) current in the potentiometer circuit;

(ii) length **AJ** of the wire for which the galvanometer shows no deflection, when key **K₂** is also closed. [6 marks]

(d) A heating coil is rated at 70 W. Calculate the time it will take this coil to heat 1.4 kg of water at 30° C to 100° C.
[Specific heat capacity of water = $4200\ J\ kg^{-1}\ K^{-1}$] [3 marks]

15. (a) Can other elements besides uranium be used in nuclear fission reactions? Give a reason for your answer. [2 marks]

(b) A radioactive element has a half-life of 5 years. A detector placed near the element records an initial count rate of $4000\ min^{-1}$ as stated in the table below.

t / years	0	5	10	15	20
Count rate / min	4000				

(i) Copy and complete the table.

(ii) Plot a graph with count rate on the vertical axis and t on the horizontal axis.

(iii) Using the graph, determine the count rate at t = 12 years.

(iv) List **two** detectors of radioactive radiations. [8 marks]

(c)
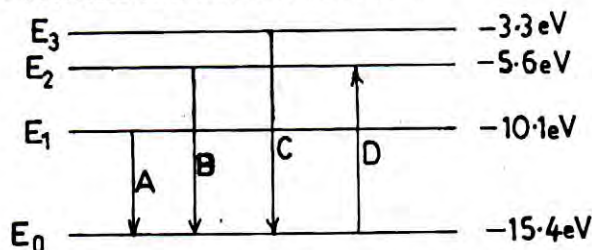
The diagram above illustrates the energy levels for a certain atom.

(i) Which of the transitions **A**, **B** and **C** produces radiation with the shortest wavelength? Give a reason for your answer.

(ii) An electron jumps from **E₀** to **E₂** by absorbing light energy. Calculate the wavelength of the light used.
[$h = 6.6 \times 10^{-34}\ Js$; $c = 3.0 \times 10^{8}\ ms^{-1}$; $1\ eV = 1.6 \times 10^{-19}\ J$] [5 marks]