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NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION
PHYSICS - PAPER1
NOV - 2001

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Section A (20 marks)

For each of the items (i) – (x) choose the correct answer from among alternative and write its letter beside the item number. Each item carries 1 mark.

(i) A stop clock P, a millisecond timer Q a centisecond timer R are used for the measurement of time. Which of the following lists the three in their order of accuracy.

A. PQR B. QPR C. QRP D. RPQ E.RQP

(ii) A gearwheel X is used to turn another gearwheel Y. X has 15 teeth and Y has 5 teeth. When Y makes 6 revolutions X has made.

A. 6 revolutions B. 2 revolutions C. 3 revolutions
D. 5 revolutions E. 18 revolutions

(iii) The radiating power of different surfaces may be compared by means of

A. Hopes apparatus B. conductivity apparatus
C. bimetallic strip apparatus D. Leslie's cube experiment E. convection experiment

(iv) A liquid at 100°C is as hot as a piece of metal at

A. 100°F B. 98.4°F C. 212°F D. 200° F
E. 32°F

(v) A material which allows some light to pass through it but one cannot see through it is said to be
A. transparent B. transluscent C. luminous
D. opaque E. colourless

(vi) The positive pole of a dry cell is made of
A. carbon rod B. zinc can C. ammonium chloride
D. copper rod E. manganese dioxide

(vii) A freely suspended bar magnet always comes to rest
A. with either the N – pole or the S – pole pointing North
B. in an East- West direction
C. with its S – poles pointing North and its N-pole pointing South.
D. with its pole pointing in the North-South direction with its N-pole pointing North and its S-pole pointing South

(viii) Which of the following are inner planets?
A. Mercury and Venus B. Jupiter and Mars
C. Saturn and Venus D. Neptune and Uranus
E. Pluto and Mars

(ix) One use of gamma–rays (γ –rays) is to
A. treat neurotics B. treat black spots
C. heal fractures D. kill cancer cells
E. join broken hands

(x) The conductions in a semi conductor material is due to

A. doping B. extrinsic conduction C. intrinsic conduction
D. Motion of charges E. movement of holes and electrons.

2. Match the item in list A with the response in list B by writing the letter of the correct response beside the item number .Each item carries 1 mark

List A	List B
(i) Vernier callipers	A Are force multipliers
(ii) Smell travels so quickly	B Require fuel to do work
(iii)Convection currents	C Polar caps at the top and bottom
(iv) Mars	D Thick atmosphere with no oxygen
(v) levers	E As a protection to thieves in shaving salons.
(vi) Curved mirrors	F Are reflectors and can cause shallow pool visualization
(vii)Refractive index	G Musical instruments use them to give notes of different frequency
(viii) Vibrations	H Cause volcanoes
(ix) Combing hair in a clear dry day	I A thin stream of water bends towards it and a ping –pong ball on a table is attracted
(x) X-rays and γ-rays	J Tiny sparks of electricity are observed
	K A product of some radioactive elements
	L Travel at a speed of light, have short wavelength and form part of an electromagnetic spectrum
	M A ratio of speed of light in air to that in a media
	N The ratio of speed of light in air to that in a media
	O Heat travels from hot parts to cold parts
	P Movement of water round a central heating system
	Q Heading of lengths and thickness
	R measuring lengths to accuracy of 0.01
	S Gases have to be kept in containers
	T Fast moving gas molecules diffuse to take as much space as possible.

SECTION B (60marks)

Answer ALL questions in this section

(a) (i) Define centre of gravity

(ii) Explain why racing cars should have wide wheel tracks

(b) State conditions for stable, unstable and neutral equilibrium and give one example of each condition

(c) (i) Why should a mechanic choose a long spanner to undo a tight nut?

(ii) A uniform half –metre rule is pivoted at its 30 cm mark. A mass of 50 g hung at the 45 cm mark keeps the rule horizontal. Determine the mass of the half metre rule

4. (a) (i) Explain the pressure of a gas in terms of the kinetic theory of gases.

(ii) How is diffusion explained by the kinetic theory of gases?

(b) (i) State Charles's Law

(ii) Sketch the graph of volume against temperature for a perfect gas

c) (i) What is the absolute zero of temperature?

(ii) 150 cm^3 of dry gas at 30°C was heated until its volume became 450cm^3. What was the final temperature?

5. (a) (i) Name, draw and mention one use of the three different types of diverging lenses?

(b) Where should an object be placed such that its image as formed by a converging lens will be

(i) at infinity (ii) of the same size (iii) erect?

(c) A nail 6.0 cm long is placed 15 cm away from a convex lens of focal length 10.0 cm. The nail is stuck perpendicular to the optical axis of the lens. Determine the positions and height of the nail

.

6 (a) State four characteristics of a highly sensitive galvanometer

(b) (i) What are eddy currents?

(ii)Give two advantages of eddy currents

(c) (i) Explain how a moving–coil galvanometer can be converted into an ammeter and into a voltmeter.

7. (a) (i) Distinguish between mechanical and electromagnetic waves

(ii) Explain why a duck remains floating at the same place as a wave passes by the water in a lake

(b) (i) What are ultrasonic vibrations?

(ii) An FM radio station broadcasts electromagnetic waves at frequency of 125 M Hz. The radio waves have a wavelength of 2.4 metres. Calculate the speed of the radio waves

(c) Gamma ray busters are objects in the universe that emit pulses of gamma rays with high energies. The frequency of the most enegetic bursts has been measured at round 3.0×10^{21} Hz.

(i)What is the wavelength of these gamma rays?
(ii)What could be their period?

8. (a) Define the terms

(i) half life (ii) atomic number

(b) Name the three fundamental particles of which atoms of an element are composed. How are these particles distributed in the atom of an element whose atomic number is 3 and mass number7?

(c) A radioactive nucleus is denoted by the symbol $_{88}X^{226}$

Write down the compositions of the nucleus at the end of the following stages of disintegration
(i) emission of an alpha ($\propto$) particle
(ii) further emission of beta (β) particle
(iii) further emission of a gamma radiation

SECTION C (20 marks)

Answer TWO (2) questions from this section.
9 (a) Explain the terms potential energy and kinetic energy giving one example of each.

(b) A pendulum bob of mass 50g is pulled aside to a vertical height 20 cm from the horizontal and then released. Find
(i) the maximum potential energy of the bob
(ii) the maximum speed of the bob

(c) (i) Suppose the length of the thread of the pendulum in discussion was 1.0 m, what could its periodic time of oscillation be?

(ii) State the principle applied by the pendulum experiment.

10. (a) Sketch the magnetic field patterns due to a current passing through
(i) a long straight wire (ii) a circular coil
(iiii) a long solenoid
Indicate clearly the direction of current and magnetic field.

(b) Explain briefly how the domain theory of magnetism is used to differentiate a magnetic material from a magnet

(c) (i) Describe how sounds are transmitted by telephones,explaining the actions of both transmitter and receiver.

(ii) What additional equipment is needed to ensure good communication over long distance?

11. (a) Define the following and give one of each
(i) Capacitor (ii) Diode

(b)

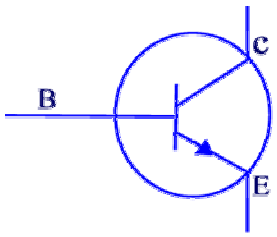


Fig 1

Use the sketch above (Fig. 1) to answer the following:
(i) What does each symbol represent?
(ii) What type of device does the sketch represent?
(iii) Write down the current relation for the device
(iv) Give two common uses of the device

(c) Draw a sketch circuit for voltage amplification and name the different components used.

Solutions scheme

SECTION A
(All questions to be answered)

1. – Multiple choice items
(i) C (QRP)
(ii) C (3 revolutions – 15 ÷ 5)
(iii) D (Leslie's cube experiment)
(iv) C (212^{o} F)
(v) B (translucent)
(vi) A (carbon rod)
(vii) E (with its N – pole ……)
(viii) A (Mercury and Venus)
(ix) D (kill cancer cells)
(x) E (movement of hole and electrons)

2. – Matching items
(i) R (Measuring lengths ……)
(ii) T (Fast moving …….)
(iii) P (Movement of water …….)
(iv) C (Polar caps ……..)
(v) A (Are force multipliers)
(vi) E (As a protection …….)
(vii) N (The ratio of speed of light in air to …….)
(viii) G (Musical instruments …….)
(ix) J (Tiny sparks ……)
(x) L (Travel at a speed …….)

SECTION B
(All questions to be answered)

3. (a) (i) Centre of gravity is defined as the point in a body through which the whole weight can be considered to act.
(ii) Racing cars should have wide wheel tracks so that the centre of gravity of the car is low and as close to the ground as possible. This makes the racing car very stable and does not overturn easily.

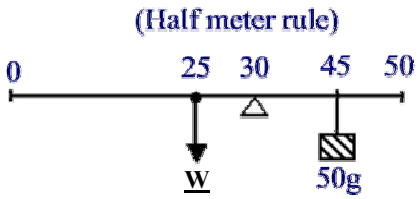
(b) For stable equilibrium, a body returns to its original position when tilted, that is, when it is displaced slightly from its equilibrium position. *(In this case the centre of gravity of the body remains within the body even when tilted and returns to its original position)*

In unstable equilibrium, the body does not return to its original position when tilted, that is, when it is displaced slightly from its equilibrium position. *(In this case the centre of gravity moves outside the body when tilted and it ends up lower after tilting)*

In neutral equilibrium, when the body is displaced from its original position it remains at rest. *(In this case the centre of gravity of body remains at the same height even though it is moved)*

(c) (i) By using a long spanner a mechanic will have to use only a small force but is able to exert a big moment required to undo a tight nut. This is because the load arm is big.

(ii)



The weight of the ruler acts through its centre of gravity which at the centre of the uniforms ruler (at 25 cm mark)

Left hand arm = 30-25 = 5cm
Right hand arm = 45-30 = 15 cm
For equilibrium,

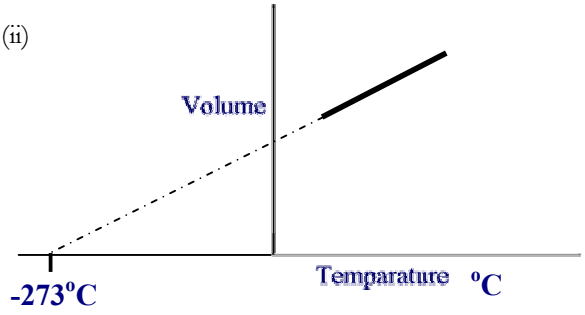
Clockwise moments = anti clockwise moments
50 x g x 15 = m x g x 5
m = 50 x 3 = 150 grams
Mass of the half meter rule is 150 gram

4. (a) (i) According to kinetic theory, when gas molecules bounce off the wall of a container they exert a force on the wall. The force exerted per unit area of the container is the pressure exerted by the wall.

(ii) According to kinetic theory, gas molecules move about at high speeds throughout the volume of a container so when some gas molecules are introduced at one corner of a container they will fly about in the container and spread out. This is diffusion.

(b) (i) Charle's Law states that if the volume (V) and temperature (T) of a given quantity of any gas are allowed to change while keeping its pressure constant, then its volume will change in direct proportion to its temperature measured in Kelvin degrees. ($T \propto V$ or T/V = constant)

(ii)



(c) (i) Absolute zero of temperature is the temperature at which a perfect gas would occupy zero volume and exert zero pressure. It is known as zero degrees Kelvin and is -273 degrees Centigrade.

(ii) $V_1 = 150$, $V_2 = 450$,
$T_1 = 30°C = (30 + 273)\ K = 303\ K$
$T_2 =$? (To find)

By Charles law

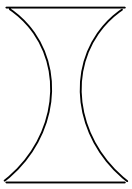
$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{150}{303} = \frac{450}{T_2}$$

$$T_2 = \frac{450}{150} \times 303 = 909\ K$$

$T_2 = (909 - 273)\ °C = 636°C$
The final temperature was 636°C

5. (a) (i) Diverging Lenses:

	TYPES OF DIVERGING LENSES		
1. Name	Biconcave	Plano-concave	Diverging meniscus
2. Drawing			
3. Use	Projector lantern	Telescopes	Spectacles

(ii) Images formed by all diverging lenses are virtual images.

(b) (i) For an image to be formed at infinity the object must be placed at the focus of the converging lens.

(ii) For an image of the same size to be formed the object must be placed at twice the focal length of the converging lens.

(iii) For an erect image to be formed the object must be placed between the focus and the pole the converging lens.

(c) $h_o = 6cm$
$u = 15cm$
$f = 10cm$
$v =$ To find image distance
$h_i =$ To find image height

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{15} + \frac{1}{v} = \frac{1}{10}$$

$$\frac{1}{v} = \frac{1}{10} - \frac{1}{15} = \frac{15-10}{150} = \frac{5}{150}$$

$$v = \frac{150}{5} = 30\ cm$$

Magnification

$$= \frac{h_i}{h_o} = \frac{v}{u}$$

$$\frac{h_i}{6} = \frac{30}{15}$$

$$h_i = \frac{30}{15} \times 6$$

$$h_i = 12cm$$

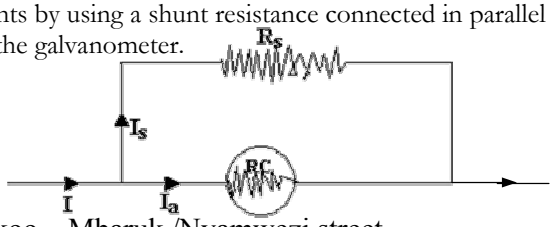
The image will be 30 cm away from the lens and will be magnified twice to a height of 12 cm.

6. (a) Four characteristics of a highly sensitive galvanometer are:

(i) Large number of turns in the coil
(ii) Very thin suspension with small turning force
(iii) Magnet with high magnetic flux
(iv) Uniform variation with current
(v) Large deflection for a small current
(vi) Quick response to small changes in current

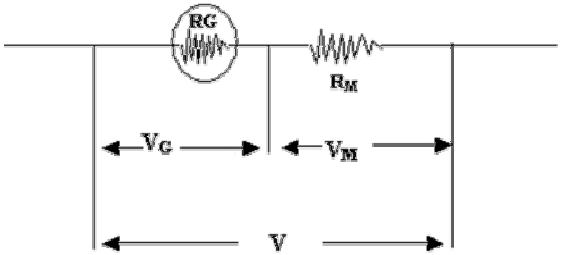
(b) (i) Eddy currents are currents induced inside the body of a thick conductor when changing magnetic field is linked inside it.
(ii) Two advantages of eddy currents are:
(I) Provides damping for sensitive galvanometers when its ends are shorted.
(II) Provides heating when metals have to be heated to very high temperatures such as in melting.

(c) (i) A moving coil can be converted to measure currents by using a shunt resistance connected in parallel with the galvanometer.



I

(II) It can be converted into a voltmeter by connecting a multiplier resistance in series with the galvanometer.



7. (a) (i) Distinguishing characteristics of mechanical and electromagnetic waves are among the following:

1. Mechanical waves need a medium through which to travel while electromagnetic waves can travel through vacuum.
2. The speed of electromagnetic waves is lower in a medium while that of longitudinal waves is higher.
3. Electromagnetic waves are transverse waves while mechanical waves are mostly longitudinal waves.

(ii) As a wave travels through a medium, it carries with it energy from the source. But the particles of the medium only vibrate in their own place. So the duck only moves up and down as the water molecules vibrates as the wave passes by.

(b) (i) Ultrasonic vibrations are those that produce waves that travel at a speed greater than that of sound.

(ii) Data : f = 125 MHz = 125 x 10^6 Hz

λ = 2.4 m

speed = f x λ

= 125 x 10^6 x 2.4 m/s

= 300 x 10^6 = 3 x 10^8 m/s

Speed of radio waves is 3 x 10^8 m/s

(c) Data : f = 3.0 x 10^{21} Hz

given c = 3. 0 x 10^8 m/s

(i) c = f x λ

So $\lambda = \frac{c}{f} = \frac{3x10^8}{3x10^{21}}$ m

= 10^{-13} m

Wavelength of gamma rays is 10^{-13} m

(ii) $f = \frac{1}{T}$

so $T = \frac{1}{f}$

$T = \frac{1}{3x10^{21}}$ sec = 3.3 x10^{-22} s

The period of the gamma rays would be 3.3 x 10^{-22}

8. (a) (i) Half life is the time required to change an amount of radioactive material to half the original amount through radioactive decay.

(ii) Atomic number is the number of protons in the nucleus of an element.

(b) (I) Three fundamental particles making up an atom are: protons, neutrons and electrons.

(II) If atomic number is 3 and mass number is 7, there will be 3 protons, 3 electrons and 7 - 3 = 4 neutrons.

(c) A nucleus $_{88}X^{226}$ will change as follows:

(i) After emission of an alpha particle it will become $_{86}Y^{224}$

(ii) After another emission of a beta particle it will become $_{87}Z^{224}$

(iii) A further emission of gamma radiation will not change the nucleus and will remain $_{87}Z^{224}$

SECTION C

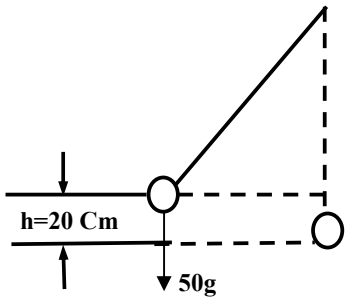
(Any two questions to be answered)

9. (a) (I) Potential energy is the energy stored in a body due to its state or position. For example, energy is required to stretch a rubber band and this energy can be released if the rubber band is let go. The energy contained in a stretched rubber band is elastic potential energy.

(II) Kinetic energy is the energy due the motion of a body and is defined as equal to $\frac{1}{2}mv^2$ where v is the velocity of the body and m is its mass. When a car crashes into a wall and causes damage the energy required to do the damage comes from the kinetic energy of the car.

9 (b) m = mass = 50g = 50 x 10^{-3} kg

h = height = 20cm = 20 x 10^{-2} m



(i) Maximum potential energy of the bob
= mgh
= 50 x10^{-3} x 9.8 x 20 x 10^{-2}J
=9.8 x 10^{-2} J

(ii) By principle of conservation of energy:
Maximum potential energy gained by the bob = Maximum kinetic energy achieved

$mgh = \frac{1}{2} mv^2$

$v = \sqrt{2gh}$

$= \sqrt{2 \times 9.8 \times 2 \times 10^{-2}}$ m/s

So maximum speed of the bob = 0.63m/s

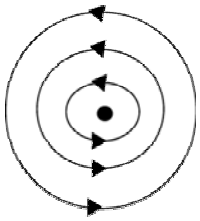
(c) (i) If length = l = 1.0 m,

Use: $T = 2\pi \sqrt{\frac{\ell}{g}} = 2\pi\sqrt{\frac{1}{9.8}} =$

The periodic time for a 1.0 m pendulum is 2 sec

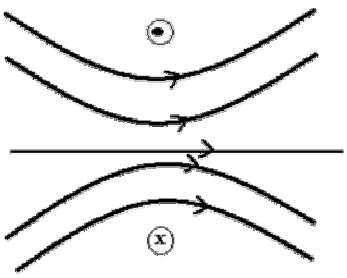
(ii) The principle applied in the pendulum experiment is the principle of conservation of energy.

10. (a) (i)



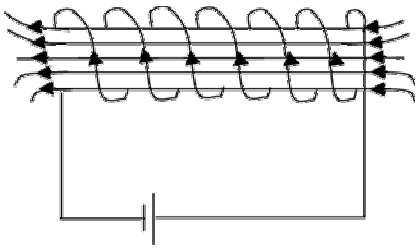
Magnetic field for Current passing through the centre out of the paper.

(ii)



Magnetic field due to a circular coil (whose cross section has been drawn). The cross section shows that in the top part of the coil the current is coming out of the paper and at the bottom it is going into the paper. The direction of the magnetic field will be as shown by the arrows.

(iii)



Magnetic field due to current flowing through a long solenoid. The field will be parallel and pointing in one direction inside the coil.

(b) According to the domain theory, all magnetic materials are composed of compactly packed regions called domains each of these regions acts as a magnet.

A magnet is a material in which the majority of the domains are arranged or aligned in the same direction so that the material has an overall magnetisation and always behaves as a magnet.

A magnetic material is one that contains domains that are not normally aligned but can become aligned in one direction if an external magnetic field is applied and hence can become a magnet.

(c) (i) In a telephone, sounds are transmitted electrically after spoken sound waves in air are converted by a transmitter to similar variation in current that flows in the transmitting wires. At the other end the receiver converts the electrical signals into sound waves which are heard.

In a transmitter, the sound of the speaker vibrates a diaphragm which produces a change in resistance of an electrical circuit. This change in resistance varies the current in the circuit with the same frequency as that of the spoken sound. The variable electrical signal from the transmitter flows through the transmitting wires and reaches the other end where it enter a receiver.

A receiver consists of a coil surrounded by a magnet. The variable current signal from the transmitter flows through this coil and causes it to vibrate because of the force exerted when the current flows in the magnetic field. The moving coil is attached to a wide flexible surface which vibrates according to the current in the coil and causes the air above it to vibrate and produces a sound that is heard by the speaker. This sound is similar to the sound that was originally spoken at the other end.

(ii) Transformers are required so as to reduce energy losses in the transmission wires. A step up transformer is required to step up the transmitter voltage and a step down transformer is required at the receiver.

11. (a) (i) A capacitor is a device that can store electrical energy by storing charges in an electric field. A capacitor is used when a smooth DC voltage is required from a rectified AC voltage. It stores charge when the voltage is increasing and releases it when the voltage is decreasing.

(ii) A diode is a device that passes current in one direction only. Four diodes when used in a bridge circuit can be used to get a full wave rectification of an AC voltage to DC voltage.

(b) (i) B – represents Base
C – represents Collector
E – represents Emitter
(ii) The device represented in the sketch represents a transistor
(iii) Current relation for a transistor is:

$$I_E = I_C + I_B$$

(iv) Two common uses of a transistor are: 1) As amplifiers in music systems and 2) As switches in computer circuits.

(c) Circuit for a voltage amplifier.