Candidate's Examination Number _____

THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
FORM TWO SECONDARY EDUCATION EXAMINATION

0031 **PHYSICS**

Time: 2:30 Hours **Friday, 28th November 2014 a.m.**

Instructions

1. This paper consists of sections A, B, and C.
2. Answer **all** questions in the spaces provided.
3. **All** writing must be in blue or black ink **except** drawings which must be in pencil.
4. **All** communication devices and calculators are **not** allowed in the examination room.
5. Write your **Examination Number** at the top right corner of every page.
6. Where necessary the following constants may be used:
   (i) Acceleration due to gravity, $g = 10$ m/s^2
   (ii) Density of water = 1 g/cm^3 or 1,000 kg/m^3

1. For each of the items (i) – (xx), choose the correct answer among the given alternatives and write the letter in the box provided.

(i) The study of matter in relation to energy is called
A Chemistry B Physicists
C Biology D Physics. **D**

(ii) The force which causes wear and tear between machine parts is known as
A friction B torsional
C repulsive D magnetic. **A**

(iii) As one goes far away from the Earth, the density of air
A becomes bigger B becomes less
C remains constant D increases twice. **B**

(iv) A ferry boat floats in seawater because its density is
A greater than that of water B smaller than that of water
C the same as its weight D greater than its weight. **B**

(v) Study Figure 1 below.

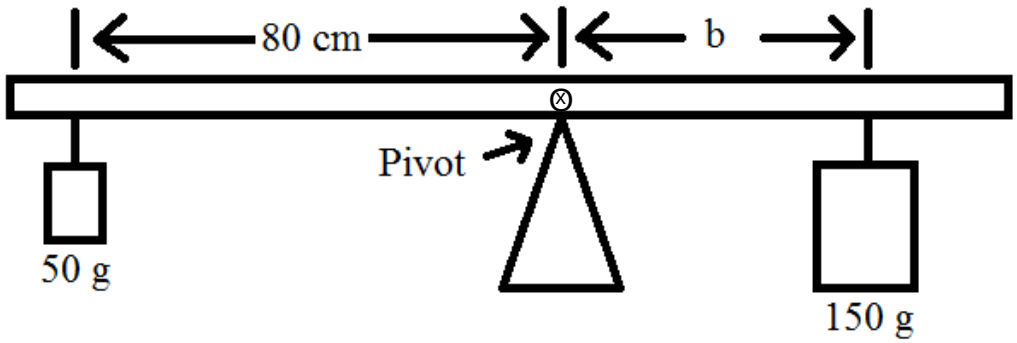


Figure 1

How far from the pivot must the 150 g mass be placed for the system to be in equilibrium? **D**

Sum of anticlockwise moments = Sum of clockwise moments
Left Force × Left Distance = Right Force × Right Distance
Left Mass × g × Left Distance = Right Mass × g × Right distance
Left Mass × Left Distance = Right Mass × Right distance

$$50\ g \times 80\ cm = 150\ g \times b$$

$$\frac{50\ g \times 80\ cm}{150\ g} = b$$

$$\frac{50\ \cancel{g} \times 80\ cm}{150\ \cancel{g}} = b$$

$$\frac{80\ cm}{3} = b$$
$$26.7\ \text{cm} = b$$

A 16.7 cm B 17.6 cm
C 36.6 cm D 26.7 cm.

(vi) A patient who is to get an injection when a nurse applied a small force to push a needle feels much pain on his skin due to
A very high pressure B very low pressure
C blunt of the needle tip D small applied force. **A**

(vii) The suspended magnetic needle always comes to rest with its axis in a vertical plane called
A geographic meridian B magnetic meridian
C geographic declination D magnetic declination. **B**

(viii) As the angle between two plane mirrors increases, the number of images formed
A decreases B increases
C remains constant D goes to infinite. **A**

(ix) Which of the following materials does not allow light to pass through
A glass B tinted glass
C clear plastics D human bodies **D**

(x) To view objects that are out of direct vision we can use a
A telescope B microscope
C periscope D slide projector. **C**

(xi) The process by which water soaks through the cells of rice and beans is called:
A capillarity B cohesion
C diffusion D osmosis. **D**

(xii) Which of the following is a property of mercury as a thermometric liquid?
A Boils at 78°C B Boils at 360°C
C Wets glass D Expands rapidly **B**

(xiii) The area under a velocity-time graph represents
A distance B speed
C acceleration D deceleration **A**

(xiv) If the pitch of a micrometer screw gauge is 0.5 mm, then its thimble has
A 10 equal divisions B 100 equal divisions
C 50 equal divisions D 500 equal divisions **C**

(xv) Which of the following is a magnetic material?
A Copper B Cobalt
C Zinc D Brass. **B**

(xvi) An electrostatic machine which produces an unlimited supply of sparks by induction is called

A a gold leaf electroscope B an electrophorus
C a generator D a speedometer.

B

(xvii) The quantity of electric current caused by excess electrons is called

A coulomb B electric charge
C electric current D electrification.

This question isn't very clear, but it asks for a **quantity**. There are two quantities in the multiple choice options. Electric charge is a derived quantity. Electric charge is a measure of the difference between the number of protons and number of electrons in an object. An object with more protons than electrons will be positively charged while an object with more electrons will be negatively charged. Electric current is one of the fundamental quantities of physics. Electric current is the flow of electric charge. I believe that the answer should be electric charge since the question mentions excess electrons, but I'm not positive.

(xviii) Which of the following is not a sustainable source of energy?

A Sun B generator
C wind D sea waves

B

(xix) A temperature of 68°C is equivalent to

$$
\begin{aligned}
T_f &= \frac{9°\text{F}}{5°\text{C}} T_C + 32°\text{C} \\
T_f &= \frac{9°\text{F}}{5°\text{C}} 68°\text{C} + 32°\text{F} \\
T_f &= \frac{9°\text{F}}{5\cancel{°\text{C}}} 68\cancel{°\text{C}} + 32°\text{F} \\
T_f &= 122.4°\text{F} + 32°\text{F} \\
T_f &= 154.4°\text{F}
\end{aligned}
$$

A 20°F B 45°F
C 154.4°F D 90.4°F.

C

(xx) "Action and reaction are equal in magnitude but opposite in direction." This statement refers to

A the law of inertia B Newton's second law of motion
C the principle of moments D Newton's third law of motion.

D

Candidate's Examination Number _____

SECTION B (40 Marks)

2. Match each item in **List A** with a correct response in **List B** by writing its letter below the number of the corresponding item in the table provided.

LIST A		LIST B
(i)	Measures how much the position has changed.	A. Gravitational acceleration.
(ii)	Measures the net change in position.	B. Average speed.
(iii)	Rate of change of distance.	C. Acceleration.
(iv)	Rate of change of displacement.	D. Uniform acceleration.
(v)	The constant rate of change of displacement.	E. Free-fall motion.
(vi)	Rate of change of velocity.	F. Distance.
(vii)	Motion under the effects of gravity.	G. Speed.
(viii)	Measures the rate at which position changes.	H. Speed in metres.
		I. Velocity.
		J. Uniform velocity.
		K. Displacement.

LIST A	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
LIST B	F	K	G	I	J	C	E	I

3. Complete each of the following statements by writing the correct answer in the space provided.

   (i) The product of mass and velocity of a body is called linear momentum.

   (ii) Claw hammers and pairs of scissors are in which class of levers? class 1

   (iii) Weight has the same SI unit as force.

   (iv) An instrument used to measure pressure of a gas is known as a barometer.

   (v) The tendency of a liquid to rise in narrow tubes is called capillary action.

4. (a) Define the following terms as applied in measurements and give two examples:

   (i) Fundamental quantities are independent quantities that describe the physical world which cannot be described as a combination of other base quantities. Two examples of fundamental quantities are mass and time. (Other fundamental quantities are electric current, thermodynamic temperature, amount of matter, luminosity, and distance.)

   (ii) Derived quantities are quantities that can be made from a combination of the fundamental quantities. Two examples of derived quantities are speed and force. Speed is equal to distance over time and force is equal to mass times distance per time per time.

(b) Figure 2 shows a graduated cylinder containing water before and after a stone is immersed.

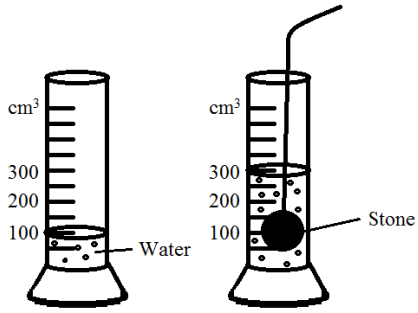


Figure 2

If the mass of the stone is 50 g, calculate the

(i) Volume of the stone.

Volume = 300 cm^3 – 100 cm^3

Volume = 200 cm^3

(ii) Density of the stone.

Density = Mass / Volume

Density = 50 g / 200 cm^3

Density = 0.25 g/cm^3

5. (a) (i) List two characteristics of images formed by plane mirrors.

Virtual

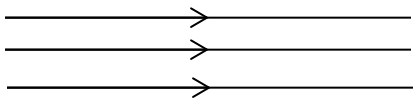
Laterally Inverted

(ii) Give a reason why the sky appears blue during a clear sunny day?

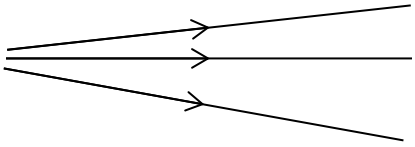
The sky appears blue because blue light has shorter wavelengths than other colours and as a result it is scattered by molecules in the air.

(b) Draw the diagram of each of the following:

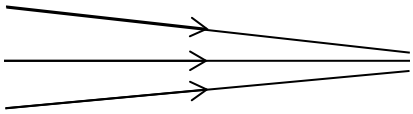
(i) Parallel rays of light.



(ii) Divergent rays of light.



(iii) Convergent rays of light.



6. (a) Define the following terms as used in Physics and give their SI units:

(i) Work is the product of force and the distance moved in t he direction of the force. The SI unit of force is the newton (N).

(ii) Energy is the ability to do work. The SI unit of energy is the joule (J).

(b) A man lifts a load of 20 kg through a height of 4 m in 10 seconds. Calculate the:

(i) Work done.

$$Work = Force \times Distance$$

$$Work = Mass \times g \times Distance$$

$$Work = 20\ kg \times 10\ \frac{m}{s^2} \times 4\ m$$

$$Work = 800\ \frac{kg\ m^2}{s^2}$$

$$Work = 800\ J$$

(ii) Power developed by the man

$$Power = \frac{Work}{Time}$$

$$Power = \frac{800\ J}{10\ s}$$

$$Power = \frac{80\cancel{0}\ J}{1\cancel{0}\ s}$$

$$Power = 80\ \frac{J}{s}$$

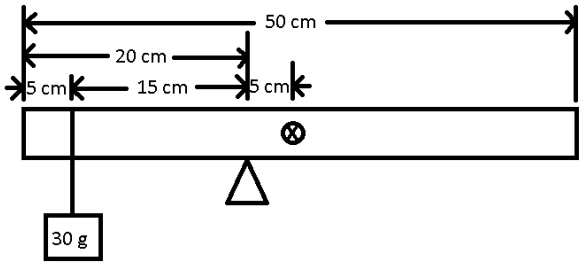
$$Power = 80\ W$$

SECTION C (40 Marks)

7. (a) (i) State the principle of moments The principle of moments states that the moment of force about a point is equal to the product of the force and the perpendicular distance between the line of action of the force and the point.

(ii) A uniform half metre rule is freely pivoted at the 20 cm mark and it balances horizontally when a body of mass 30 g is hung at 5 cm mark from one end. Calculate the mass of the rule.

It is a half metre rule, so the length is 0.5 m or 50 cm.
The problem states that the rule is uniform, so the centre of mass will be at ½ of the length. Therefore the centre of mass is at 25 cm.



$$Sum\ of\ anticlockwise\ moments = Sum\ of clockwise\ moments$$

$$Force\ left \times distance\ left = Force\ right \times distance\ right$$

$$mass\ left \times g \times distance\ left = mass\ right \times g \times distance\ right$$

$$mass\ left \times distance\ left = mass\ right \times distance\ right$$

$$30\ g \times 15\ cm = mass_{ruler} \times 5\ cm$$

$$\frac{30\ g \times 15\ cm}{5\ cm} = mass_{ruler}$$

$$90\ g = mass_{ruler}$$

(b) (i) What is meant by equilibrium? Equilibrium occurs when the sum of the forces and the sum of the moments acting on an object are equal to zero.

(ii) List three applications of equilibrium in daily life.
Heavy items are packed at the bottom of a bus to improve stability.
Racing cars are built low to the ground with their wheels far apart to improve stability.
Bunsen burners have very heavy bases to improve stability.

8. (a) Define the following terms:

(i) Inertia Inertia is the tendency for a body to not change its motion unless it is acted upon by a force.

(ii) Impulse An impulse is the change in momentum of a body when a force has been applied to it. The SI unit of impulse is the Newton second (Ns).

(b) (i) Give two practical examples where impulse and momentum play an important role.
A practical application of impulse is the use of airbags in new cars. Airbags distribute the impulse a person experiences during an accident over a longer time, which means that the force on the person is smaller.
An example of momentum is the game of pool, where the momentum of the cue ball is used to impart momentum to other balls.

(ii) A tennis ball of mass 120 g moving at a speed of 10 m/s was brought to rest by one player in 0.02 seconds. Calculate the average force applied by the player.

$$
\begin{aligned}
Impulse &= change\ in\ momentum \\
F \times t &= m_f \times v_f - m_i \times v_i \\
F &= \frac{m_f \times v_f - m_i \times v_i}{t} \\
F &= \frac{120\ g \times 0\frac{m}{s} - 120\ g \times 10\frac{m}{s}}{0.02\ s} \\
F &= \frac{\cancel{120\ g \times 0\frac{m}{s}} - 120\ g \times 10\frac{m}{s}}{0.02\ s} \\
F &= \frac{-120\ g \times 10\frac{m}{s}}{0.02\ s} \\
F &= -60000\frac{g\ m}{s^2} \\
F &= -60000\frac{g\ m}{s^2} \times \frac{1\ kg}{1000\ g} \\
F &= -60\cancel{000}\frac{\cancel{g}\ m}{s^2} \times \frac{1\ kg}{1\cancel{000}\ \cancel{g}}
\end{aligned}
$$

(In the step above we are converting from grams to kilograms so that our answer can be in SI units.)

$$F = -60\ \frac{kg\ m}{s^2}$$

$$F = -60\ N$$

9. (a) (i) What is the function of a rheostat in an electric circuit?
A rheostat is used in electric circuits to provide variable resistance.

(ii) List four factors that affect the resistance of a conductor.
(i) conductivity of the material
(ii) length
(iii) thickness
(iv) temperature

(b) Study the circuit diagram in Figure 3, then answer the questions that follow:

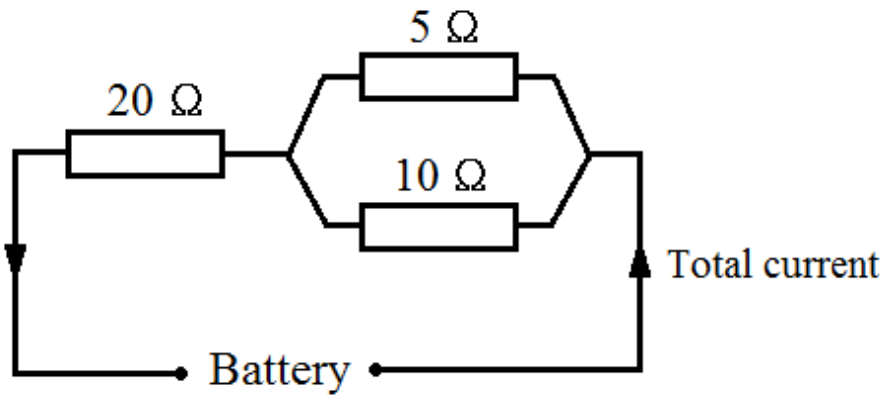
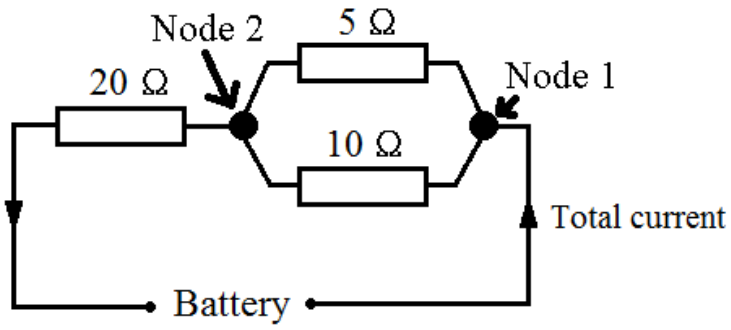


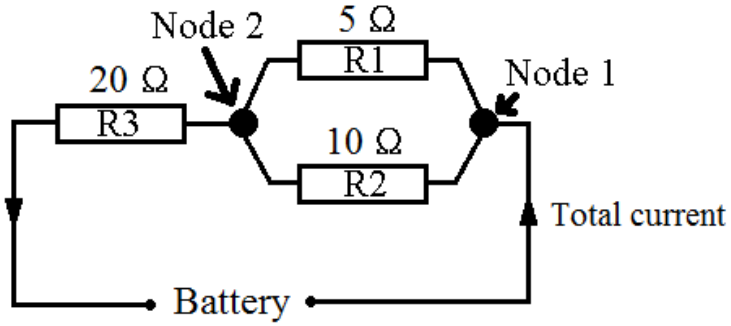
Figure 3

If the current flowing in 5 Ω resistor is 2 A, calculate the
(i) Current flowing in the 10 Ω resistor.

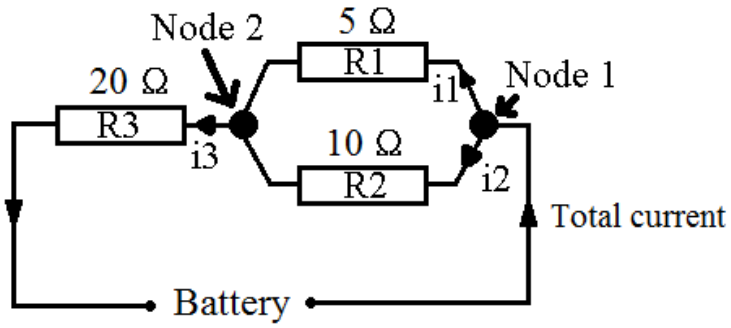
When solving circuit problems it is helpful to add labels. First we will label several nodes. Nodes are parts of a circuit in between components. In the figure below we label two nodes where the circuit branches and then comes back together.



We will also label the resistors R1 (the 5 ohm resistor), R2 (the 10 ohm resistor) and R3 (the 20 ohm resistor).



The current going through resistors R1, R2, and R3 will be i1, i2, and i3, respectively.



R1 (the 10 ohm resistor) is in parallel with R2 (the 5 ohm resistor). Therefore the potential difference across both resistors must be the same.

$$p.d.(10\ \Omega\ resistor) \quad = \quad p.d.(5\ \Omega\ resistor)$$

$$i2 \times r2 = i1 \times r1$$

$$i2 \times 10\ \Omega = 2\ A \times 5\ \Omega$$

$$i2 = \frac{2\ A \times 5\ \Omega}{10\ \Omega}$$

$$i2 = \frac{2\ A \times 5\ \cancel{\Omega}}{10\ \cancel{\Omega}}$$

$$i2 = 1\ A$$

(ii) Potential difference (p.d.) across the 20 Ω resistor.

The sum of the current flowing into a node is the same as the sum of the current flowing out of the node. Using this equation on Node 2 lets us solve for i3, the current flowing through the 20 ohm resistor.

$$Current\ out\ of\ Node\ 2 = Current\ into\ Node\ 2$$

$$i3 = i1 + i2$$

$$i3 = 2A + 1A$$

$$i3 = 3A$$

The potential difference across a resistor is equal to the product of the current and resistance.

$$p.d. = i3 \times r3$$

$$p.d. = 3\ A \times 20\ \Omega$$

$$p.d. = 60\ V$$

10. (a)(i) Define the term pressure and give its SI unit.
Pressure is the force acting normally on a surface per unit area.
The SI unit of pressure is the pascal (Pa).

(ii) Why are dams constructed thicker at the bottom than at the top?
Dams are constructed thicker at the bottom than at the top because pressure due to the water increases as depth increases.

(b) (i) List three applications of hydraulic presses.

(i) hydraulic brakes

(ii) forging and punching metals

(iii) lifting heavy objects like cars

(ii) A hydraulic brake has a force of 1000 N applied to a piston whose area is 50 cm^2. Calculate the pressure transmitted throughout the liquid.

$$Pressure = \frac{Force}{Area}$$

$$Pressure = \frac{1{,}000\ N}{50\ cm^2}$$

Now we will convert the squared centimetres to squared metres so we are working with SI units.

$$Pressure = \frac{1{,}000\ N}{50\ cm^2} \times \frac{100\ cm}{1\ m} \times \frac{100\ cm}{1\ m}$$

$$Pressure = \frac{1{,}000\ N}{5\cancel{0}\ \cancel{cm^2}} \times \frac{100\ \cancel{cm}}{1\ m} \times \frac{10\cancel{0}\ \cancel{cm}}{1\ m}$$

$$Pressure = 200{,}000\ \frac{N}{m^2}$$

$$Pressure = 200{,}000\ Pa$$