higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T600**(E)**(A5)T

NATIONAL CERTIFICATE

ENGINEERING PHYSICS N5

(15070115)

5 April 2018 (X-Paper)
09:00–12:00

This question paper consists of 7 pages and a formula sheet of 3 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
ENGINEERING PHYSICS N5
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Start each answer with the formula and the substituted values.
5. Each final answer must be rounded off to THREE decimal numbers.
6. The formula sheet is NOT necessarily complete. Read through it quickly before you start answering the questions.
7. Write neatly and legibly.

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QUESTION 1

1.1 Define the following terms:

1.1.1 Osmosis (2)

1.1.2 Candela (2)

1.1.3 Adhesion (1)

1.1.4 Cohesion (1)

1.1.5 Law of diffusion of gases (2)

1.1.6 Boyle's law (2)

1.1.7 Surface tension (2)

1.2 Calculate the magnetic flux intensity in a conductor carrying a current of 12 A:

1.2.1 At a point that is 400 mm from the straight conductor (2)

1.2.2 At the centre of the circular wire with a radius of 140 mm (2)

1.2.3 Within a solenoid which is 0,5 m long and has 1 200 turns/m (3)

1.3 Calculate the emf of each of the following:

1.3.1 A French jet with a wingspan of 14 m flies at 1 200 km/h at right angles across the earth's magnetic field of 10^{-6} Wb/m^2

1.3.2 A coil consists of 100 turns and is moved over a magnet at 20 oscillations per second from a place where the magnetic flux is 24×10^{-4} Wb to a place where the flux is 2×10^{-4} Wb.

(2 × 2) (4)

[23]

QUESTION 2

2.1 A 3,5 m round copper bar has a deformation of 0,3 when the load applied is 50 kN. The copper bar has a diameter of 40 mm.

Calculate the following:

2.1.1 The change in length

2.1.2 The cross-sectional area of the copper bar

2.1.3 The stress of the copper bar

2.1.4 The Young's modulus of the copper bar

(4 × 2) (8)

2.2 Give ONE use of each of the following:

2.2.1 Convex lens

2.2.2 Kundt's tube

2.2.3 Tourmaline crystal

(3 × 1) (3)

2.3 State THREE things that happen when light strikes on a surface. (3)

2.4 Name TWO artificial sources of light. (2)

2.5 An object is placed at a distance of 300 mm from a concave mirror with a focal length of 140 mm.

Calculate the following:

2.5.1 The position of the image from the mirror (3)

2.5.2 The power of the lens (2)

2.5.3 The height of the image if the size of the object is 80 mm (2)

[23]

QUESTION 3

3.1 6 m^3 of gas at a pressure of 1,6 kPa and at 30 °C is compressed adiabatically in accordance with the formula $PV^{1.4}$ = constant until the pressure is 5,2 kPa.

Calculate the following:

3.1.1 New volume

3.1.2 Mass of the gas if the gas constant R = 180 J/kg.K

(2 × 3) (6)

3.2 Study the diagram in FIGURE 1 below of the experiment to prove Boyle's law, and answer the questions.

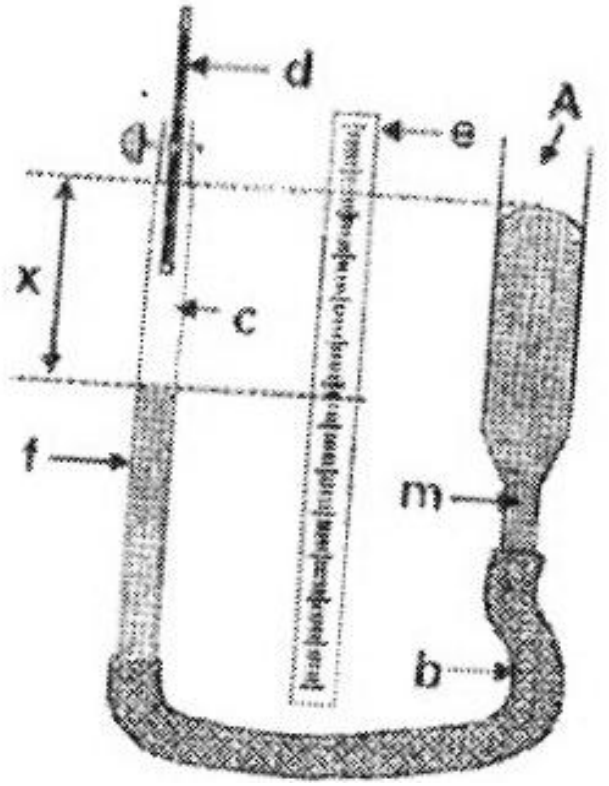

FIGURE 1

3.2.1 Label the parts marked A, b, c, d, e, m and x in FIGURE 1 above. Write only the name of the part next to the letter (A, b, c, d, e, m, x) in the ANSWER BOOK. (6)

3.2.2 What is the function of the part labelled 'd'? (1)

3.3 Determine the force with which two masses of 20 kg and 300 g respectively attract one another when they are a distance of 180 mm apart. (2)

3.4 Determine the surface tension of a liquid that requires a force of 0.0095 N to hold a wire frame 180 mm wide in equilibrium. (2)

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3.5 A bullet with a mass of 70 g is travelling at 420 m/s when it hits the target. If all the available energy is changed into heat energy:

Calculate the change in temperature of the bullet if the specific heat capacity of the bullet is 136,2 J/kg K. (4)

3.6 State FOUR factors that will make a galvanometer to be more sensitive. (4)
[25]

QUESTION 4

4.1 A cylinder contains 200 g of gas at a pressure of 3 bars and a temperature of 50 °C. The gas is compressed adiabatically to one-third of the original volume.

If the gas has a C_p = 360 J/kg.K and C_v = 220 J/kg.K, calculate the following:

4.1.1 The gas constant for this gas (2)

4.1.2 The original volume of the gas (3)

4.1.3 The value of the compression coefficient (γ) (2)

4.1.4 The final pressure (4)

4.1.5 The final temperature (3)

4.2 Calculate the volume of gas having a temperature of 350 K and a pressure of 2 bars, if the gas weighs 60 g and has a molecular mass of 42 kg/mol.

The gas constant R = 8314 J/mol K. (4)

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4.3 Study FIGURE 2 below and answer the questions.

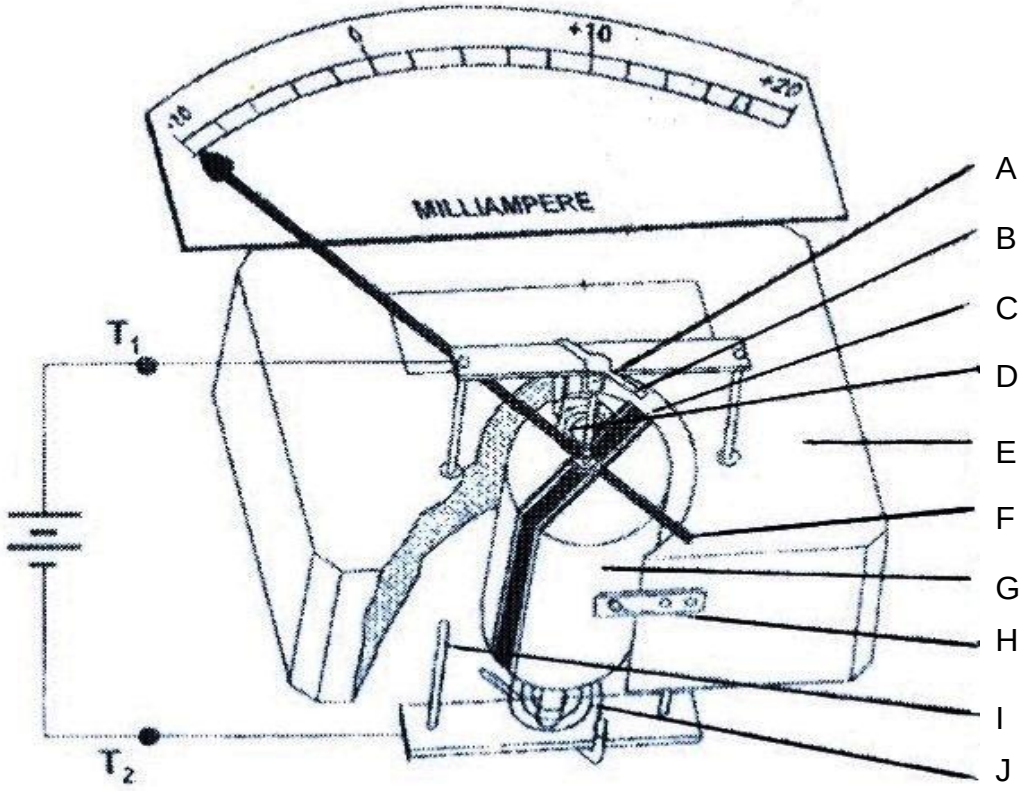

FIGURE 2

4.3.1 What is the name of the instrument in FIGURE 2 above? (1)

4.3.2 Label the parts marked A-J in FIGURE 2 above. Write only the name of the part next to the letter (A-J) in the ANSWER BOOK. (10)
[29]

TOTAL: 100

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ENGINEERING PHYSICS N5

FORMULA SHEET

Any applicable formula may be used.

$$B = \frac{\mu_0 I}{2r}$$

$$B = \frac{\mu_0 NI}{L}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \frac{\mu_0 NI}{2r}$$

$$B = \frac{\phi}{A}$$

$$\phi = B\,A\sin\theta$$

$$E = \frac{I\cos\theta}{r^2}$$

$$E = \frac{\sigma}{\varepsilon} = \frac{F/A}{\Delta L/L}$$

$$E = e\sigma T^4 At$$

$$\text{emf} = \frac{N\Delta\phi}{\Delta t}$$

$$\text{emf} = BLv$$

$$F = \frac{Gm_1m_2}{r^2}$$

$$F = BIL\sin\theta$$

$$f = nz$$

$$f = f_1 - f_2$$

$$\frac{1}{f} = \frac{1}{a} + \frac{1}{b}$$

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

$$h = \frac{2\,T\cos\alpha}{r\rho g}$$

$$n = \frac{\sin i}{\sin r}$$

$$n = \frac{\sin(A + Dm)/2}{\sin A/2}$$

$$\sin\theta_c = \frac{1}{n}$$

$$\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{I_s}{I_p}$$

$$p = \rho gh$$

$$\rho = \frac{m}{V}$$

$$pV = mRT\ (m = nM)$$

$$pV = nR_0T$$

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

$$p_1V_1^{\gamma} = p_2V_2^{\gamma}$$

$$Q = u + w$$

$$Q = mc\Delta t$$

$$Q = \frac{ka\Delta T\Delta t}{L}$$

$$R_s = \frac{V_0}{I_g} - R_g$$

$$R_s = \frac{R_gI_g}{I_t - I_g}$$

$$R = c_p - c_v$$

$$\gamma = \frac{c_p}{c_v}$$

$$\frac{r_1}{r_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{M_2}{M_1}} = \frac{t_2}{t_1}$$

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$$T = \frac{F}{2\ell} = \frac{F}{4\pi r}$$

$$V = \frac{b}{a}$$

$$V = \frac{0{,}25 \times d}{f_1 \times f_2}$$

$$V = 4/3\,\pi\, r^3$$

$$v = \sqrt{\frac{3p}{\rho}} = \sqrt{\frac{3R_0T}{M}} \quad \left(n = \frac{m}{M}\right)$$

$$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{E}{\rho}} = \sqrt{\frac{\gamma P}{\rho_0}}$$

$$\mu = \frac{m}{L}$$

$$v = f8$$

$$8 = d \sin 2$$

$$\frac{v}{v_0} = \sqrt{\frac{T}{T_0}}$$

$$W = VI$$

$$W = pV$$

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CONSTANT VALUES

Speed of light	$c = 2, 99 \times 10^{8}$ m/s
Speed of sound at 0 °C	$v = 330$ m/s
Gravitational constant	$G = 6{,}673 \times 10^{-11}$ N.m^2/kg^2
Stefan-Boltzmann's constant	$\Phi = 5, 67 \times 10^{-8}$ W/m^2.K.^{4}
Universal gas constant	$R_0 = 8{,}314$ J/mol. K
Permeability in a vacuum	$\mu_0 = 4\,\pi \times 10^{-7}$ Wb/A. m
Specific heat capacity of water	$c = 4\,187$ J/kg.K
Standard atmospheric pressure	$p = 1{,}013 \times 10^{5}$ Pa
Gravitational acceleration	$g = 9, 8$ m/s^2
Refractive index	
Water	$n = 1, 33$
Glycerine	$n = 1, 47$
Glass	$n = 1, 5$
Surface tension water	$T = 0, 0756$ N/m (0 °C) $T = 0, 0728$ N/m (20 °C)
Mass:	
Sun	$m = 1, 99 \times 10^{30}$ kg
Earth	$m = 5, 98 \times 10^{24}$ kg
Moon	$m = 7, 36 \times 10^{22}$ kg
Radius:	
Sun	$r = 6, 95 \times 10^{8}$ m
Earth	$r = 6, 38 \times 10^{6}$ m
Moon	$r = 1, 74 \times 10^{6}$ m

Other :

1 bar = 10^5 Pa

1 ton = 10^3 kg

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