higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

ENGINEERING PHYSICS N5

8 April 2020

This marking guideline consists of 8 pages.

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QUESTION 1

1.1 1.1.1 False
1.1.2 False
1.1.3 False
1.1.4 True
1.1.5 True

(5 × 1) (5)

1.2 1.2.1 The total radiation energy emitted per unit area✓ per unit time by a body is proportional✓ to the fourth power of the absolute temperature. (3)

1.2.2 Distant objects can be seen clearly,✓ but images of nearby objects✓ are blurry.✓ (3)

1.2.3 Deformation✓ of a solid due to stress✓ (2)

1.2.4 Point in space where magnetic field✓ exerts magnitude✓ and direction✓ (3)

1.2.5 Wave oscillates at right angles✓ to direction of travel✓ (2)

1.3 1.3.1 To test absorptive capacity of various colours and surfaces

1.3.2 To determine the pole strength of a magnet

(2 × 2) (4)

1.4 1.4.1
- Mandolin
- Guitar
- Violin (Any ONE)

1.4.2
- Cellophane
- Pig's bladder
- Skin of dried fruit
- Parchment (Any ONE)

1.4.3 Binoculars

(3 × 1) (3)
[25]

QUESTION 2

2.1 Cohesive force is the force of attraction between the molecules of a liquid.

Adhesive force is the force of attraction between the molecules of different substances. (2 + 2) (4)

2.2 2.2.1 Warm objects radiate more heat than cooler objects

2.2.2 Black (dark) objects radiate more heat than white objects

2.2.3 Duller objects radiate more heat than shiny objects

2.2.4 Objects with greater surface area radiate more heat than smaller objects

(4 × 1) (4)

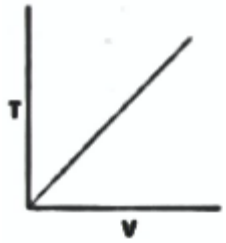
2.3
- Image at 2F
- Image real
- Image inverted
- Image actual size (4)

2.4 2.4.1 $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

A = 600 K ✓
B = 2.4 m^3 ✓ (2)

2.4.2 The volume of a given mass of a gas kept at constant pressure✓ is directly proportional✓ to the absolute temperature.✓ (3)

2.4.3



1 mark for labelled axes
2 marks for correct shape (3)

2.5 2.5.1 $T = mg$

$= 18 \times 9.8$
$= 176.4\ N$ (1)

2.5.2 $\mu = \frac{m}{l}$

$= \frac{9.5 \times 10^{-3}}{6}$

$\mu = 1{,}583 \times 10^{-3}$kg/m✓

$v = \sqrt{\frac{T}{\mu}}$

$= \sqrt{\frac{176.4}{1.533 \times 10^{-3}}}$

v = 338,817 m/s✓ (2)

2.5.3 $\lambda = \frac{v}{f}$

= (338,817/200)✓

= 1,694 m✓ (2)
[25]

QUESTION 3

3.1 3.1.1 $\frac{1}{F} = \frac{1}{a} + \frac{1}{b}$

$\frac{1}{150} = \frac{1}{400} + \frac{1}{b}$✓

$\frac{1}{b} = \frac{1}{150} - \frac{1}{400}$

$b = 240$ mm✓ (2)

3.1.2
- Real
- Inverted (2)

3.1.3 $V = \frac{b}{a}$

$= \frac{240}{400}$

$V = 0.6$✓

$V = \frac{\text{size of image}}{\text{size of object}}$

$V \times \text{size of object} = \text{size of image}$

$\text{size of image} = 0.6 \times 50$

$\text{size of image} = 30 \text{ mm}$✓

Image is smaller than object✓ (3)

3.2 3.2.1 $P = 4.5 \times 10^5 \text{ Pa}$
$T = 114 + 273 = 387\text{K}$
$m = \frac{24}{1000} = 0.024 \text{ Kg}$

$V = 0.0065 \text{ m}^3$
$R = \frac{PV}{mT}$

$= \frac{4.5 \times 10^5 \times 0.0065}{0.024 \times 387}$ ✓✓

$= 314.922$ J/Kg.K✓ (3)

3.2.2 $P_2 = 0.25 \times 10^5 \text{ Pa}$
$R = 314.922$ J/Kg.K
$m = \frac{24}{1000} = 0.024 \text{ Kg}$

$V_2 = 0.028 \text{ m}^3$
$T_2 = \frac{P_2 V_2}{mR}$

$= \frac{0.25 \times 10^5 \times 0.028}{0.024 \times 314.922}$ ✓

$= 88.911$ K✓

$U = mc_v\Delta t$

$= 0.024 \times 1470 \times (387 - 88.911)$ ✓✓

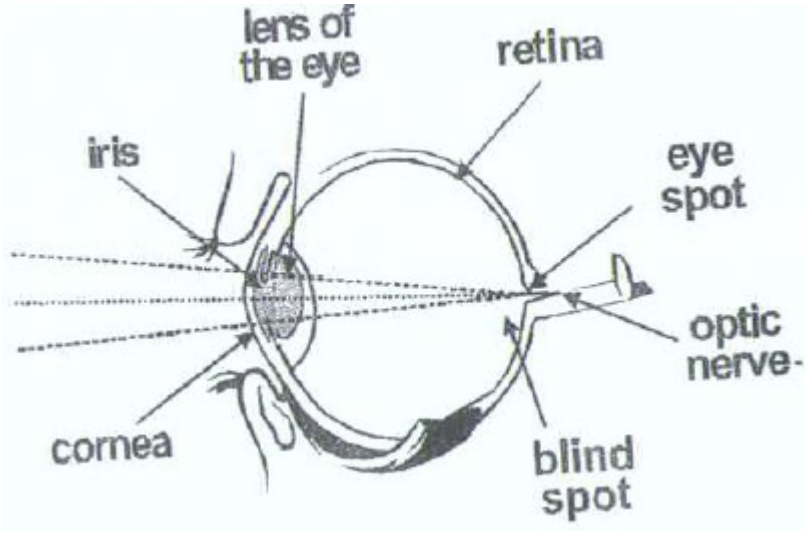
$= 10516.580$ J✓ (5)

3.2.3 $U = mR\Delta t$

$= 0.024 \times 314.922 \times (387 - 88.911)$ ✓✓

$= 2252.995$ J✓ (3)

3.3



1 mark for each correct label (7) (7)

[25]

QUESTION 4

4.1 $L = \frac{200}{1000} = 0.2\ m$

v = 345 m/s

$\lambda = 4L$

$= 4 \times 0.2$

$= 0.8$ m✓

$v = f \times \lambda$

$345 = f \times 0.8$

$f = 431.25\ Hz$✓

$f = nz$

$431.25 = n \times 30$✓

$n = 14.375\ rev/s$✓

$n = 14.375 \times 60$✓

$n = 862.5\ rpm$✓ (6)

OR

$$f = \frac{v}{\lambda} = nz$$

$$n = \frac{v}{\mathrm{z} \times \lambda}$$

$$= \frac{345}{30 \times 4 \times 0.2} \checkmark\checkmark\checkmark$$

$$n = 14.375\ rev/s \checkmark$$

$$n = 14.375 \times 60 \checkmark$$

$$n = 862.5\ rpm \checkmark$$

4.2 $\mathrm{I_t} = 20\ \mathrm{A}$

$\mathrm{I_G} = 30\ \mathrm{mA} = 30 \times 10^{-3}\ A$

$R_G = 60\ \Omega$

$V = \mathrm{I_s} \times R_s = \mathrm{I_G} \times R_G$

$$R_s = \frac{\mathrm{I_G} \times R_G}{\mathrm{I_t} - R_G}$$

$$= \frac{30 \times 10^{-3} \times 60}{20 - 30 \times 10^{-3}} \checkmark\checkmark$$

$R_s = 0.0901\ \Omega \checkmark$ (3)

4.3 $$\mathrm{B} = \frac{\mu_0 \times \mathrm{I}}{2\pi \mathrm{r}}$$

$$= \frac{4\pi \times 10^{-7} \times 12}{2\pi \times 80 \times 10^{-3}} \checkmark\checkmark$$

$\mathrm{B} = 3 \times 10^{-5}\ Wb/m^2 \checkmark$ (3)

4.4
- H = magnetic strength
- T = time
- R = distance between magnet and magnetic field
- I = moment of inertia
- μ_0 = magnetic permeablility
- θ = angle of deflection (6)

4.5 $$E = \frac{I}{r^2} \times Cos\ \theta$$

$$= \frac{80}{(\frac{500}{1000})^2} \times Cos\ 40 ✓$$

$$E = 245.134\ Lux ✓$$ (2)

4.6 $$T = \frac{F}{2L}$$

$$= \frac{0.025}{2 \times \frac{230}{1000}} ✓$$

$$T = 0.054\ N/m ✓$$ (2)

4.7 $$PV = m\ RT$$

$$R = \frac{PV}{mT}$$

$$= \frac{0.025 \times 4 \times 10^5}{0.018 \times 368} ✓✓$$

$$R = 1509.662\ J/Kg.K ✓$$ (3)

[25]

TOTAL: 100

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