FACULTY OF SCIENCE

PHYSICS	**AUCKLAND PARK KINGSWAY CAMPUS**

PHYG01B

SPECIAL SUPPLEMENTARY EXAMINATION
2021

PHYG01B

EXAMINER: **Miss CS van Niekerk**

INTERNAL MODERATOR: Prof. E Carleschi

TIME: 2½ HOURS **MARKS: 100**

Please read the following instructions carefully:

ANSWER ALL QUESTIONS: 1-6

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/Question 1

Given equations:

$\lambda_{max} = (2.898\times10^{-3}\ \text{m.K})/T$ $\Delta E(2H + 2n \rightarrow 1He) = 4.272\times10^{-12}$ J

$E_n = -(2.177\times10^{-18}\ \text{J})/n^2$ $N = N_0 \times \exp(-0.693 \times t/T_{1/2})$

$F_{\text{shear force}} = \eta A\Delta v/\Delta y$ $F_{\text{drag/sphere}} = 6\pi R v \eta$

Constants:

$c = 3\times10^8$ m/s $g = 9.8$ m/s^2 $G = 6.67\times10^{-11}$ N.m^2/kg^2 $h = 6.626\times10^{-34}$ J.s
$k = 9\times10^9$ N.m^2/C^2 $q_e = -1.6\times10^{-19}$ C $\sigma = 5.67\times10^{-8}$ W.m^{-2}.K^{-4}

QUESTION 1 **[18]**

a) Define the thermal expansion coefficient α. If you use a formula, define all terms in this expression. (3)

b) A 50 g cube of ice with an initial temperature of –10°C is dropped into thermally insulated water with an initial temperature of 25°C. The final temperature of the mixture is 24°C. Determine the initial mass of the water.
(c_{water} = 4186 J.kg^{-1}.K^{-1}, c_{ice} = 2100 J.kg^{-1}.K^{-1}, $L_{ice/water}$ = 333000 J.kg^{-1}) (5)

c) Describe how a cold front leads to rainfall. Particularly focus on the physics of the process. (5)

d) Does heat conduction depend on the dimensions of the material and how? (2)

e) Explain why glaciers move more quickly than expected. (3)

QUESTION 2 **[16]**

a) Using a diagram where necessary, define the amplitude, wavelength and period of a wave. (4)

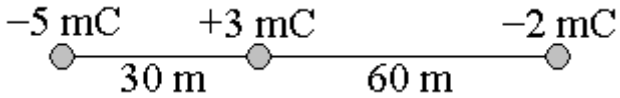
b) How is sound generated in thunder? (4)

c) A standing wave is generated through the interference of two waves moving parallel to the *x*-axis at 5.00 m/s in opposite directions, both with amplitude 1.20 cm and a wavelength of 1.80 m. Determine the equation describing the *y*-displacement as a function of *x* and *t*. (5)

d) Briefly discuss the driving mechanisms for continental drift. (3)

QUESTION 3 **[21]**

a) Determine the resultant force on the –2.0 mC charge in the diagram below. (5)



b) What is a non-ohmic conductor? (2)

c) What process does the Curie point describe, and how can this process aid in the dating of geological formations? (6)

d) A beam of blue light initially moves with a wavelength of 400 nm in a vacuum. It then moves into a medium where it travels a distance of 18.0 cm in 1 ns. Calculate the wavelength of the light inside the medium. (5)

e) How does one determine the final image of an object when there are two lenses? (3)

QUESTION 4 **[18]**

a) A star with a surface temperature of 7500 K radiates with a power of 2.40×10^{17} W.
i) At what wavelength does most of the light radiate?
ii) If the temperature of the star dropped by 800°C, what would be the power radiated by the star? (5)

b) How can one determine the composition and nature of a substance using atomic spectra? (4)

c) Where do cosmic rays originate from? (2)

d) Define the half-life of a radioactive substance. (3)

e) Given that the mass of the Sun is 2.0×10^{30} kg, determine the average speed of Jupiter if Jupiter is 7.78×10^{8} km from the Sun. (4)

QUESTION 5 **[16]**

a) Explain why the temperature increases with height in the stratosphere. (3)

b) What effect do greenhouse gases have on the Earth's incoming and outgoing radiation? (4)

c) Describe the Coriolis Effect and explain how this determines air flow around a low pressure system. (6)

d) The viscosity of air is 2.0×10^{5} Pa.s. Determine the wind speed 20 cm above the ground if the air flow is caused by a shear force of 1.2×10^{-3} N per m^2 at a level of 1.0 m above the ground. (3)

QUESTION 6 **[11]**

a) A dam is completely filled with water. A valve of 0.05 m^2 in area is opened up high up on the dam, and a jet of water rushes out of there at a speed of 2.5 $m.s^{-1}$. If the speed of the water jet is 10 $m.s^{-1}$ at the bottom of the dam, calculate the cross-sectional area of the water jet at that point. (3)

b) What is diffusion? Also briefly explain what causes it. (3)

c) A stone of mass 2.8 g and volume 1.20 cm^3 is placed at the surface of a 2.0 m deep pool of water (ρ_{water} = 1000 $kg.m^{-3}$). How long does it take for the stone to reach the bottom of the pool? (5)