Admissions Testing Service

NAZARBAYEV UNIVERSITY

Foundation Year Programme

Entrance Tests

PHYSICS SPECIFICATION

NUFYP SET 2017

V1.0 October 2016

Physics

1. Electricity

1.1 Electrostatics:

a. charging of insulators by friction
b. object gaining electrons becomes negatively charged
c. object losing electrons becomes positively charged
d. forces between charged objects (attraction, repulsion).

1.2 Electric current:

a. conductors and insulators
b. current = charge / time
c. use of voltmeter and ammeter
d. resistance = voltage / current
e. *V-I* graphs for a fixed resistor and a filament lamp
f. series and parallel circuits – current and voltage rules
g. resistor combinations in series (but not parallel)
h. voltage = energy / charge
i. knowledge of basic circuit symbols and diagrams.

1.3 Power and energy:

a. power = current × voltage
b. energy transfer = power × time = VIt.

2. Motion and energy

2.1 Kinematics:

a. speed = distance / time
b. acceleration = change in speed / time
c. distance-time and speed-time graphs
d. calculations using gradients and areas under graphs
e. average speed.

2.2 Forces and motion:

a. inertia and Newton's first law
b. momentum = mass × velocity
c. conservation of momentum
d. Newton's second law: force = mass × acceleration
e. resultant force
f. difference between mass and weight, and the relationship between them ($W = mg$)
g. gravitational field strength (approximated as 10 N / kg on Earth)
h. free-fall acceleration
i. Newton's third law.

2.3 Energy:

a. work = force × distance moved in direction of force
b. appreciation of work done as a transfer of energy
c. potential energy = mgh
d. kinetic energy = $\frac{1}{2}mv^2$
e. power = energy transfer / time.

2.4 Energy conversion:

a. law of conservation of energy
b. forms of energy
c. ideas of useful energy and wasted energy
d. percentage efficiency = (useful output / total input) × 100.

3. Thermal Physics

3.1 Conduction:

a. thermal conductors and insulators
b. factors affecting rate of conduction.

3.2 Convection:

a. effect of temperature on density of fluid
b. fluid flow caused by differences in density
c. factors affecting rate of convection.

3.3 Radiation:

a. infrared radiation (see 4. Waves).

3.4 Matter:

a. particle models of solids, liquids and gases
b. state changes
c. evaporation
d. diffusion
e. density = mass / volume
f. experimental determination of densities
g. comparison of densities of the three states.

4. Waves

4.1 Wave nature:

a. transfer of energy without net movement of matter
b. transverse and longitudinal waves
c. examples (including electromagnetic waves, sound, seismic)
d. amplitude, wavelength, frequency and period
e. frequency $= 1 /$ period, and the SI unit of frequency is hertz (Hz), 1 Hz means 1 wave per second
f. speed $=$ distance / time
g. wave speed $=$ frequency $\times$ wavelength.

4.2 Wave behaviour:

a. reflection at a surface
b. refraction at a boundary
c. effect of reflection and refraction on speed, frequency and wavelength
d. analogy of reflection and refraction of light with that of water waves.

4.3 Optics:

a. ray diagrams for refraction at a planar boundary (qualitative only), and reflection (angle of incidence is equal to angle of reflection).

4.4 Sound waves:

a. longitudinal waves
b. reflection causes echoes.

5. Electromagnetic spectrum

5.1 EM waves:

a. nature and properties of electromagnetic waves (transverse, travel at speed of light in vacuum).

5.2 The spectrum:

a. parts of the spectrum (radio waves, microwaves, IR, visible light, UV, X-rays, gamma)
b. distinction by different wavelengths, frequencies
c. order of component parts by wavelength, frequency
d. applications
e. dangers.

6. Radioactivity

6.1 Atomic structure:

a. protons, neutrons and electrons
b. popular models of atomic structure
c. relative charges and masses of sub-atomic particles
d. atomic number, atomic mass
e. isotopes.

6.2 Radioactive decay:

a. emissions from the nucleus
b. random and spontaneous nature
c. alpha, beta and gamma emission
d. nature of alpha and beta particles, gamma radiation
e. radioactive decay equations
f. effect of decay on atomic number and mass.

6.3 Ionising radiation:

a. penetrating abilities of alpha, beta and gamma
b. ionising abilities of alpha, beta and gamma
c. applications, dangers and hazards of ionising radiation.

6.4 Half-life:

a. decrease in activity over time
b. graphical representation of decay (including of decay products)
c. meaning of half-life.

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Admissions Testing Service
Cambridge English
Language Assessment
1 Hills Road
Cambridge
CB1 2EU
United Kingdom

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