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Faculty of Medicine, Masaryk University, Brno
PHYSICS Admission Exam

Note: We do not consider any relativistic effects in the test questions unless otherwise stated. The frame of reference (co-ordinate system), in case one is needed, is inertial and connected with the observer. In the questions oriented on mechanics we consider incompressible solids and liquids unless otherwise stated. The gravitational field is homogeneous. In optics-oriented questions all lenses are considered thin and the light rays are paraxial.

1. Which of the following quantities has a dimensionless unit (i.e. only number)?

a) index of refraction b) luminous flux c) power d) frequency e) No answer is correct.

2. Which of the following units can be expressed as a product of second and ampere?

a) volt b) watt c) joule d) coulomb e) No answer is correct.

3. Find the quantity whose unit can be expressed as [kg·m·s-1].

a) torque b) acceleration c) momentum d) force e) No answer is correct.

4. Which of the sets includes only vector quantities?

a) amount of substance, force, pressure

b) distance, acceleration, pressure

c) impulse of force, instantaneous velocity, momentum

d) power, capacitance, voltage

e) No answer is correct.

5. A race car slows down after finishing the race (uniformly decelerated rectilinear motion) with deceleration (negative acceleration) of –2.0 m·s-2. How long will take this deceleration from the full speed of 80 m·s-1 to zero speed?

a) 10 s b) 40 s c) 100 s d) 200 s e) No answer is correct.

6. A particle moves uniformly in circles with a radius of 20 cm and at a constant speed of 200 m·s-1. What is the frequency of its circling?

a) 15.92 Hz b) 100 Hz c) 159.2 Hz d) 10 Hz e) No answer is correct.

7. A body moving at a velocity of 100 m·s-1 was stopped by a constant force of 100 N in 10 s. What is the mass of the body?

a) Data are insufficient for the calculation. b) 0.1 kg c) 1 kg d) 10 kg e) No answer is correct.

8. A toy with a 100%-efficiency 2W-drive moves on a horizontal flat surface at a constant velocity. The force exerted by the drive to overcome friction is 4 N (assume a force parallel to the toy's direction of movement). What is the velocity of the toy?

a) 0.5 m·s-1 b) 2 m·s-1 c) 8 m·s-1 d) Impossible to calculate without knowing the friction coefficient. e) No answer is correct.

9. Peter (40 kg) and Paul (50 kg) play on a massless seesaw which can rotate about its pivot point. Peter sits 2 m away from the pivot. Calculate how far from the pivot is Paul's position to balance Peter on the opposite arm of the seesaw?

a) more than 200 cm

b) a little more than 100 cm is enough

c) 160 cm is just correct

d) less than 100 cm

e) No answer is correct.

10. A paint sprayer (spray gun) can be based on lowering pressure in the narrowed part of a tube with streaming air. It produces underpressure that draws paint from an attached vessel through another thin tube into the narrow part of the tube with air stream. What claim or statement is right?

a) It is a nonsense. The air streaming has nothing to do with the tube profile.

b) It is correct. The basic explanation we can find in Bernoulli´s principle.

c) It is not correct. The air stream must be faster which increases air pressure in the narrower part of the tube.

d) The described device cannot work because the air is of very low density compared with the paint and hence described exhausting is not possible.

e) No claim is correct.

11. If a particle is in a free fall in vacuum (e.g. in an evacuated tube in the lab),

a) its kinetic energy increases and its gravitational potential energy decreases.

b) its kinetic energy does not change and its gravitational potential energy decreases.

c) its kinetic energy increases and its gravitational potential energy does not change.

d) the sum of its potential and kinetic energy increases.

e) No answer is correct.

12. Which could be the common air pressure on top of Mt. Everest?

a) less than 50 kPa b) about 10 kPa c) about 100 kPa d) less than 100 mmHg e) No answer is correct.

13. Which of the following sentences expresses correctly the Pascal's Law?

a) The total pressure in a liquid is uniform in all directions inside the liquid body.

b) The pressure is transmitted in a liquid evenly downwards and upwards.

c) Hydrostatic pressure is constant in any point of the liquid.

d) Hydrostatic pressure in a water tank is directly proportional to the bottom depth.

e) No sentence is correctly fitting.

14. The hydrostatic pressure exerted on a submarine does not depend on

a) the surface area of the submarine.

b) density of the sea water.

c) submerged depth of the submarine.

d) gravitational acceleration.

e) No answer is correct.

15. The flow rate of an ideal liquid gushing out of an outlet at the bottom of a vessel depends on

a) gravitational acceleration

b) liquid density.

c) size of the opening.

d) air pressure.

e) No answer is correct.

16. The diameters of different parts of a pipe are in a 3:4 ratio. Thus, the ratio of the liquid flow rates in the respective parts of the pipe is:

a) 9:16 b) 16:9 c) 4:9 d) 9:4 e) No answer is correct.

17. What amount of a substance is represented by 1.00 kg of water vapour?

a) 1 mole b) 1000 moles c) less than 1 mole d) about 55.6 moles e) No answer is correct.

18. At the normal atmospheric pressure, the minimum density of liquid water is measured at a temperature of: a) 0 °C b) 300 K c) 3.98 °C d) about 100 °C e) No answer is correct.

19. In frosty winter, it can happen that the wires of power lines can snap (not only because of heavy frost or ice on wires). I can be caused by

a) heating of wires due to increased transmission of electricity

b) thermal dilatation of wires at low temperatures

c) thermal contraction of wires at low temperatures

d) weakening the metal at low temperatures

e) No answer is correct

20. If we decrease the pressure of a perfect gas to one third in a reversible isothermal process, we obtain

a) double temperature.

b) triple volume.

c) a temperature decrease to one half.

d) a volume decrease to one third.

e) No answer is correct.

21. To describe a reversible isothermal compression of a perfect gas we can write: 3

a) $p1.V1 = p2.V2$

b) $V1/T1 = V2/T2$

c) $p1.V1.T1 = p2.V2/T2$

d) $V1.T1 = V2.T2$

e) No answer is correct.

22. The pressure inside a soap bubble produced at the end of a capillary is

a) directly proportional to the bubble volume.

b) does not depend on the bubble radius.

c) inversely proportional to the bubble radius.

d) proportional to the square root of its radius.

e) No answer is correct.

23. The frequency f of harmonic oscillation (T - period, ω - angular frequency) can be written:
a) $f = 2\pi/T$ b) $f = 2\pi/\omega$ c) $f = 1/T$ d) $f = \omega T$ e) No answer is correct.

24. If we increase the sound level by 40 dB, the sound intensity increases:

a) 4 times b) 40 times c) 10 000 times d) by 40 $W \cdot m^{-2}$ e) No answer is correct.

25. Find the true sentence about sound and ultrasound?

a) Sound waves are always longitudinal in water.

b) Sound waves are always transverse in water.

c) When transverse sound waves travel from air into the water they become longitudinal.

d) When transverse sound waves travel from the water into air they become longitudinal.

e) No answer is correct.

26. A particle having a small negative charge - a test particle - was moved away from particle at rest which had a great positive charge. Thus:

a) the electric potential decreased along its path.

b) the intensity of the electric field did not change along the path of the test particle.

c) no voltage across the two particles could be measured.

d) the electric potential increased along the path of the test particle.

e) No answer is correct. 27. In a direct current circuit, we reduce the voltage across the plates of a capacitor. It causes that

a) the amount of the net electric charge induced on each of the capacitor plates increases.

b) the capacitance of the capacitor decreases.

c) the capacitance of the capacitor increases.

d) the amount of the net electric charge induced on each of the capacitor plates decreases..

e) No answer is correct.

28. What is the current through the filament of a light bulb with a power of 24 W wired to a DC (direct current) 120 V source?

a) 2.0 A b) 5.0 A c) 0.2 A d) 2880 mA e) No answer is correct.

29. What can happen to the electron beam in an X-ray tube when it will be placed in an magnetic field (magnetic field lines are perpendicular to the electron beam)?

a) nothing, there is no effect in vacuum.

b) the electrons will be directed to the magnet´s north pole.

c) the electrons will be directed to the magnet´s south pole.

d) the electron beam becomes curved in the plane perpendicular to field lines. e) No answer is correct.

30. If a proton moves in a homogeneous magnetic field from its north pole to its south pole (in the direction of B vector),

a) it is decelerated uniformly.

b) it is accelerated towards the south pole.

c) it turns in the direction of the thumb of the right hand whose fingers are oriented like B.

d) the magnetic field does not influence its motion

e) No answer is correct.

31. The impedance of an AC circuit involving only one coil increases when

a) the self-inductance of the coil is reduced.

b) the self-inductance of the coil increases.

c) a resistor is connected in parallel

d) the frequency of AC is lowered.

e) No answer is correct.

32. The Faraday constant is the same as a) the electric voltage necessary to deposit 1 kg of

a) substance to the cathode or anode.

b) the energy necessary to transfer one electron from the electrode to infinity.

c) the energy necessary to transfer 1 mole of a substance to the cathode or anode.

d) the electric charge of one kilogram of hydrogen ions.

e) No answer is correct.

33. The total internal reflection of light rays cannot occur

a) when a light travels from diamond into vacuum.

b) on the interface between polished glass and vacuum.

c) when the angle of reflection is smaller than the angle of refraction.

d) when a light travels from the air into water.

e) No answer is correct.

34. What is the physical principle of the optical fibre?

a) light diffusion inside the fibre.

b) interference of white light.

c) accommodation of the light rays to the narrow space available.

d) total light reflection at the interface between the fibre core and cladding.

e) No answer is correct.

35. A converging lens has a dioptric power (strength) of 5 dioptres. Assume light rays approaching the lens parallel to the principal axis. How far from the centre of the lens will the rays intersect after their passage through the lens?

a) 1/20 cm b) 0.20 cm c) 5 cm d) 20 cm e) No answer is correct.

36. In the formula 1 2 f f d · Δ· γ = for the angular magnification of a microscope the symbol d can be

a) the diameter of the objective.

b) the thickness of the objective lens.

c) the diameter of the eyepiece.

d) the distance of the most distinct vision (25 cm).

e) No answer is correct.

37. The properties of X-rays are very similar to the properties of

a) gamma rays. b) cathode rays. c) accelerated electrons. d) infrared radiation. e) No answer is correct.

38. A phenomenon can be called “photoelectric effect” if

a) light is transformed into useful electric work.

b) the energy of incident photons is transformed into the energy of emitted electrons and scattered photons.

c) the photon energy is transformed into the energy of an electron ejected from a metallic surface.

d) a body emits light when it is carrying electric current.

e) No answer is correct.

39. The particles have the same velocity at the moment they enter at right angles a homogeneous electric field. Which of these particles has the least curved trajectory?

a) proton

b) β-particle

c) α-particle

d) Cu2+ ion

e) No answer is correct.

40. What is the half-life of a radionuclide if the activity in its sample decreased to one sixteenth after 12 years? (Help: Consider the definition of the half-life!)

a) 12/16 years b) 2 years c) 3 years d) 6 years e) No answer is correct.