1 A circle is an ellipse in which half the major axis is equal to half the minor axis and the common quantity is called the radius. Suppose it is known that the surface area inside an ellipse is equal to $(\alpha\,a\,b)$, where α is a constant and a and b are half the major and minor axes, respectively. Knowing that the relation of the surface area inside a circle is $\pi\,r^2$, where r is the radius of the circle, what is the value of α?

a $(\pi/2)$ **b** π **c** $(2\,\pi)$ **d** π^2

---

2 The body mass index (BMI) of a person is defined as the ratio of his (her) mass in kg, divided by the square of his (her) height in m. For someone of the mass 45 kg and the height 170 cm, what is the value of BMI?

a 3.95   **b** 15.6   **c** 26.5   **d** 1190

---

3 The Schwarzschild radius corresponding to a mass m is defined as $(2\,G\,m\,c^{-2})$, where $G = 6.7\times10^{-11}\,\text{kg}^{-1}\,\text{m}^3\,\text{t}^{-2}$ is the universal constant of gravitation, and $c = 3\times10^8\,\text{m}\,\text{s}^{-1}$ is the speed of light in vacuum. The mass of the moon is $7\times10^{22}\,\text{kg}$. What is the value of the Schwarzschild radius of the moon?

a $10^{-6}\,\text{m}$ **b** $10^{-4}\,\text{m}$ **c** $10^{-2}\,\text{m}$ **d** $1\,\text{m}$

---

4 The magnitude of a star is defined as $2.5\,\log(I_0/I)$, where I is the intensity of the star, I_0 is some constant, and the logarithm is in base 10 *not the natural logarithm*. The magnitudes of two stars A and B are 1 and 11, respectively. What is the ratio of their intensities?

a 5   **b** 10   **c** 25   **d** 10^4

---

5 You have probably heard of the 80-g-paper. By this, it is meant that the mass of $1\,\text{m}^2$ of such a paper is 80 g. The surface area of an A0 sheet of paper is $1\,\text{m}^2$. The surface area of a sheet of An paper is $2^{-n}\,\text{m}^2$, where n is an integer. What is the mass of a single sheet of A4 paper of the type 80-g-paper?

a 80 g   **b** 20 g   **c** 5 g   **d** 1 g

---

6 A particles is at rest at $t = 0$. The acceleration of the particle is proportional to t, where t is the time. Suppose that at the time t, the speed of the particle is v. What is the speed of the particle at the time $(2\,t)$?

a v **b** $(2\,v)$ **c** $(4\,v)$ **d** $(8\,v)$

---

7 For the particle of the previous problem, suppose that the distance the particle has traveled between the time zero and t is x. What is the distance that the particle has traveled between the time zero and $(2\,t)$?

a x **b** $(2\,x)$ **c** $(4\,x)$ **d** $(8\,x)$

---

8 It takes one day for the earth to complete one rotation around its (polar) axis. The radius of the earth is 6400 km. What is the speed of a point on the earth's equator, due to the rotation of the earth around its axis? (The equator is the set of points on the earth, for which the distance from the north pole is equal to the distance from the south pole.)

a 0.5 km s^{-1} **b** 5 km s^{-1} **c** 30 km s^{-1} **d** 700 km s^{-1}

---

9 It takes one year for the earth to complete its orbit around the sun. The radius of the earth's orbit is 150×10^6 km. What is the speed of the earth, due to its orbital motion?

a 0.5 km s^{-1} **b** 5 km s^{-1} **c** 30 km s^{-1} **d** 700 km s^{-1}

---

10 Lake Baikal (in Siberia) is the largest fresh water lake on the earth. It contains some one fifth of the total fresh water of the earth. It is about 600 km long, 50 km wide, and 700 m deep (on the average). What is the total volume of the fresh water on the earth?

a 10 km^3 **b** 1000 km^3 **c** 10^5 km^3 **d** 10^7 km^3

---

11 When a body gets hotter, the electromagnetic radiation emitted from which moves towards shorter wave lengths. The wavelength corresponding to the colors blue, green, yellow, and red, is increasing from blue to red. Of these colors (blue, green, yellow, and red) which corresponds to a hotter body (compared to others)?

a blue **b** green **c** yellow **d** red

12 In the motion of a planet around the sun, the line connecting the sun to the planet scans equal areas in equal times. Two times the time derivative of this area is equal to the angular velocity of the planet multiplied by the square of the distance of the planet from the sun. The earth is farthest from the sun, almost around the begin of Summer (of the northern hemisphere). When is the angular velocity of the earth in its motion around the sun maximum? (All times are according to the northern hemisphere.)

a early spring   **b** early summer

c early fall   **d** early winter

---

13 Good luck!

d	c	b	a	
		■		**1**
		■		**2**
		■		**3**
■				**4**
	■			**5**
	■			**6**
■				**7**
			■	**8**
	■			**9**
	■			**10**
			■	**11**
■				**12**