招生學年度	九十七	招生類別	轉學招生考試
系所班別	物理學系二年級、電機工程學系二年級		
科　目	普通物理		
注意事項	【禁用計算機】		

- *You could define or introduce necessary symbols if not given. Symbols in your answer that are not given in a problem must be clearly explained or clearly defined.*
- *You could assume necessary parameter values if not given. Parameters assumed by the test taker should have reasonable values if numerical calculations are required.*
- *A numerical answers is considered correct if the order of magnitude is correct.*

1. (12%) Suppose a Geosynchronous satellite has mass 500 kg.

a) What is the height (order of magnitude) above the Earth surface that such a satellite has to be? (6 %)

b) How much energy does it take to launch this satellite from the ground to its orbit? (6 %)

Gravitational constant: $G = 6.673 \times 10^{-11}$ N·m²/kg².

Mass of the Earth: $M_E = 5.98 \times 10^{24}$ kg.

Mean radius of the Earth: $R_E = 6.37 \times 10^6$ m.

2. (10%) Let's try to design a speed detector using audible sound. Suppose a sound emitter/detector is stationary at the origin and an object can move either towards or away from the emitter/detector, as shown in the right figure. Assume that the sound detector has a working range just as the human ears do, roughly 20Hz ~ 20KHz, and that the sound emitter generates a 6 KHz sound wave. What is the maximum speed this device can detect when the object is moving a) towards (5%) or b) away from the detector (5%)?

Sound emitter/detector
(Stationary)

Moving object
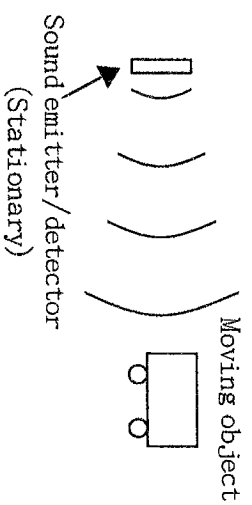
3. (10%) If the human body can be considered as a black body, what is the total radiation power per unit area of a normal person? (5 %) What is the peak value of the wavelength of the radiation distribution of such a person? (5 %)

Stefan-Boltzmann constant $\sigma = 5.670 \times 10^{-8}$ W/m².

The constant related to the peak wavelength : 2.898×10^{-3} m·K

4. (6%) How much energy is stored in a parallel-plate capacitor after fully charged by a voltage difference $\Delta V = 10V$? Assume the dimensions of each plate are (1cm × 1cm), and the separation of plates is 1mm.

Permittivity of free space $\varepsilon_0 = 8.854 \times 10^{-12}$ C²/N·m².

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5. (8%) Suppose we have built a Carnot engine that operates between a hot and a cold reservoir. Assuming the temperature difference between the two reservoirs is 150 K, and the efficiency of the Carnot engine is 30.0%. Find the temperatures of the two reservoirs.

6. (12%) Find the speed of propagation for the following waves, assuming SI units

   a. $F_1(x, t) = (0.50\,\text{m})\sin(1.50\,x + 0.30\,t)$ (3 %)

   b. $F_2(x, t) = (0.25\,\text{m})\cos[2.00(x - 0.45\,t)]$ (3 %)

   c. $F_3(x, t) = (0.3\,\text{m})\sin(1.50\,x - 0.45\,t + \pi)$ (3 %)

   d. $\dfrac{\partial^2 F_4(x, t)}{\partial x^2} = (7.30)\dfrac{\partial^2 F_4(x, t)}{\partial t^2}$ (3 %)

7. (6%) A small stone of mass m is thrown from a place of height h above the ground with an initial velocity v, as shown in the right figure. How