

國立中正大學100學年度學士班二年級轉學生招生考試試題

學系別： 數學系、地球與環境科學系
物理學系、機械工程學系

科目：普通物理

第 2 節

第 1 頁，共 4 頁

(一) 選擇題 (50%)

- 1) If you were to move into outer space far from any stars or planets,
 - A) your mass would change, but your weight would not change.
 - B) your weight would change, but your mass would not change.
 - C) both your weight and mass would change.
 - D) neither your weight nor your mass would change.

- 2) Find the wavelength (in nm) of a 7.75 eV photon.
 - A) 136 nm
 - B) 160 nm
 - C) 176 nm
 - D) 191 nm

- 3) Why do heavy nuclei contain more neutrons than protons?
 - A) Neutrons are radioactive, and so are heavy nuclei.
 - B) Neutrons are lighter than protons.
 - C) Neutrons are heavier than protons.
 - D) Neutrons dilute the electric repulsion of the protons.

- 4) The reactance of a capacitor is $7.0 \text{ k } \Omega$ at a frequency of 0.20 kHz . What is the capacitance?
 - A) $0.114 \text{ } \mu\text{F}$
 - B) $0.71 \text{ } \mu\text{F}$
 - C) $4.5 \text{ } \mu\text{F}$
 - D) $0.161 \text{ } \mu\text{F}$

- 5) A circular coil of 60 turns and radius 2 cms is placed with its plane oriented at 90° to a magnetic field of 0.1 T. The field is now increased at a steady rate, reaching a value of 0.8 T after 7 seconds. What EMF is induced in the coil?
 - A) 0.0099 V
 - B) 0.012 V
 - C) 0.0075 V
 - D) 0.015 V

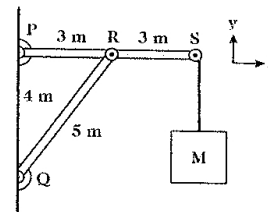
- 6) Which of the following is an accurate statement?
- A) Magnetic field lines have as their sources north and south poles.
 - B) A magnetic field line is, by definition, tangent to the direction of the magnetic force on a moving charge at a given point in space.
 - C) The magnetic force on a moving charge does not change its energy.
 - D) The magnetic force on a current carrying wire is greatest when the wire is parallel to the magnetic field.

- 7) A Carnot engine is operated as an air conditioner to cool a house in the summer. The air conditioner removes 14kJ of heat per second from the house, and maintains the inside temperature at 293 K, while the outside temperature is 375 K. The power required for the air conditioner under these operating conditions, in SI units, is closest to:

- A) 6300
- B) 4700
- C) 5500
- D) 3900

- 8) A uniform 700 kg beam, 6 m long, is freely pivoted at P. The beam is supported in a horizontal position by a light strut, 5 m long, which is freely pivoted at Q and is loosely pinned to the beam at R. A load of mass is suspended from the end of the beam at S. A maximum compression of 19,000N in the strut is permitted, due to safety. In Figure below, the maximum mass M of the load is closest to:

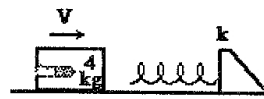
- A) 231 kg



- B) 425 kg
- C) 619 kg
- D) 1125 kg

- 9) An 8 g bullet is shot into a 4.0 kg block, at rest on a frictionless horizontal surface. The bullet remains lodged in the block. The block moves into a spring and compresses it by 9.4 cm. The force constant of the spring is 1000 N/m. In Figure below, the initial velocity of the bullet is closest to:

A) 800 m/s



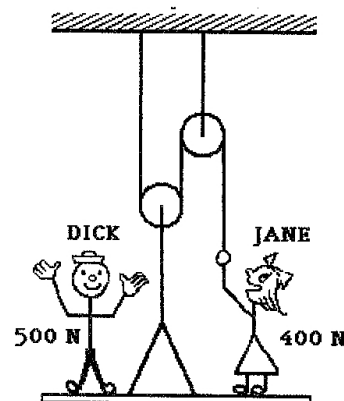
B) 710 m/s

C) 770 m/s

D) 740 m/s

- 10) Dick and Jane stand on a platform of negligible weight, as shown in Figure below. Dick weighs 500 N and Jane weighs 400 N. Jane is supporting some of her weight on the end of the rope she is holding. What is the downward force she is exerting on the platform?

A) 0



B) 50 N

C) 100 N

D) 300 N

國立中正大學100學年度學士班二年級轉學生招生考試試題

學系別： 數學系、地球與環境科學系
物理學系、機械工程學系

科目：普通物理

第 2 節

第 4 頁，共 4 頁

(二) 問答題 (30%)

- 1) Define the following physics quantities:
 - a) torque, b) angular momentum, c) moment of inertia, d) specific heat,
 - e) capacitance, f) current, g) inductance, h) magnetic dipole moment,
 - i) angular wave number, and j) Poynting vector. (10 %)
- 2) Describe Faraday's law of induction and name some real life applications in today's world. (5%)
- 3) Describe the three heat transfer mechanisms between a system and its environment: conduction, convection, and radiation. (5%)
- 4) Discuss the Doppler's effect and its real life applications. (5%)
- 5) Write down and describe the four Maxwell's equations in free space. (5%)

(三) 計算題 (20%)

- 1) (a) Show that the condition for destructive interference in a thin film of thickness d and index of refraction n surrounded by air is given by $2nd = m\lambda$ ($m = 0, 1, 2, \dots$), where λ is the wavelength of the light in free space. (5%)
(b) A silicon solar cell ($n = 3.5$) is coated with a thin film of silicon monoxide (SiO_2 , $n = 1.45$) to minimize reflective losses from the surface. Calculate the minimum film thickness that produces the least reflection by an incident light at a wavelength of 600 nm. (5%)
- 2) The radiation dose equivalent H (unit: $\text{Sv} = \text{J/kg}$) is a measure of the risk or biological effect associated with an exposure to ionizing radiation. It is obtained by $H = D \times \text{RBE}$, where D is absorbed dose (unit: $\text{Gy} = \text{J/kg}$) and RBE (relative biological effectiveness) is a dimensionless quality factor of radiation. The SI unit of H is sievert (西弗) or rem, $1\text{Sv} = 1\text{J/kg}$. A 75 kg worker at a breeder reactor plant accidentally ingests 5.0 mg of ^{239}Pu dust for one hour and receives a whole body radiation dose D of 0.04 Gy by alpha particles for which the RBE factor is 20. Calculate (a) the absorbed energy in joules and (b) the dose equivalent H in sieverts. (10%) (Note that the amount of radiation exposure expected to cause significant harm to humans is 3 Sv and highest reported level during Fukushima (福島) accident: 204 Sv/h.)