

HONG KONG ADVANCED LEVEL EXAMINATION
AL PHYSICS
1984 Essay Type Question

1. (a) (i) Using a practical example, demonstrate what is meant by ‘the conservation of mechanical energy’.
- (ii) By means of a further practical example, show that in ‘real-life’ situations mechanical energy is often not conserved.

(b) Derive Bernoulli’s equation for fluid flow:

$$P + h\rho g + \frac{1}{2}\rho v^2 = \text{a constant.}$$

(c) Explain why Bernoulli’s equation is not strictly applicable to

- (i) a gas, and
- (ii) a viscous liquid flowing through a narrow tube.

(d) With the aid of diagrams and Bernoulli’s equation, explain the observed effects of

- (i) the motion of a spinning ball, and
- (ii) the mixing of coal gas and air in a bunsen burner.

2. (a) Explain what is meant by a scale of temperature for a thermometer.

(b) Considering the scales of two thermometers based on two different physical properties, explain why the observed temperatures might be found to differ.

(c) Give brief descriptions (not including theory or calibrations) of two different types of thermometer which could be used to measure accurately, in the range 200 °C - 300 °C,

- (i) a steady temperature, and
- (ii) a rapidly changing temperature.

3. (a) Compare the main physical characteristics of the light emitted by
- a gas discharge tube, and
 - a gas laser.
- (b) Explain in detail the light production mechanisms of these two sources.
- (c) Describe TWO different applications of lasers outside their use in physics laboratories, explaining why they are employed.
4. The concept of waves can be applied to (1) a musical sound, and (2) a V.H.F. radio transmission. For these two types of waves describe
- their main propagation characteristics,
 - their normal frequency ranges, and
 - methods for measuring the intensity of the waves (one method for each type of wave). Simple block diagrams and only brief explanations of the methods are required.
5. (a) Explain why it should be possible to generate electrical power using either of the two nuclear reactions
- ${}^2_1\text{H} + {}^3_1\text{H} \longrightarrow {}^4_2\text{He} + {}^1_0\text{n}$, or
 - ${}^{235}_{92}\text{U} + {}^1_0\text{n} \longrightarrow {}^{144}_{56}\text{Ba} + {}^{90}_{36}\text{Kr} + 2{}^1_0\text{n}$.
- (b) Which reaction process is currently being used in power-generating stations and why is the other, at present, not practical?
- (c) Sketch the basic structure of a nuclear power station, explaining the functions of
- the moderator,
 - the control rods, and
 - the coolant.
- (d) State any TWO precautions which need to be taken to reduce possible radiation hazards to the staff working in such stations.

6. (a)

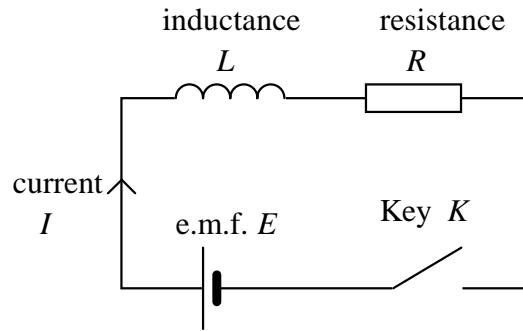


Figure 1

Write down a differential equation for the current I in the circuit in Figure 1 after the key K has been closed at a time $t = 0$, explaining clearly each term in the equation.

(b)

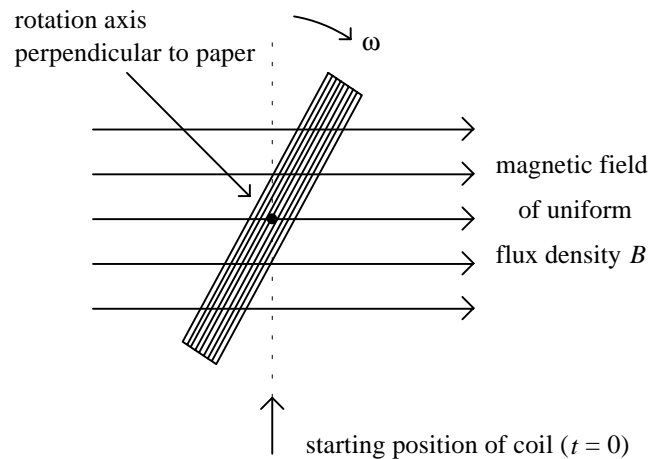


Figure 2

A coil of N turns, each of area A , is situated initially (at time $t = 0$) with the plane of the coil perpendicular to a magnetic field of uniform flux density B . The coil is then rotated at a uniform angular velocity ω about an axis perpendicular to the magnetic field and passing through the centre of the coil, as shown in Figure 2. Derive an expression for the e.m.f. induced in the coil at any subsequent time t .

- (c) If the coil has an inductance L and a resistance R and the ends are connected together, write down the corresponding differential equation for the current I in the coil. Assuming a solution of the form $I = P \cos \omega t + Q \sin \omega t$, where P and Q are constants, determine expressions for P and Q in terms of B , A , N , ω , L and R .
- (d) Obtain a further expression for the time-averaged power loss in the coil due to Joule heating, and show that if $\omega L \gg R$, the power loss is independent of ω .

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