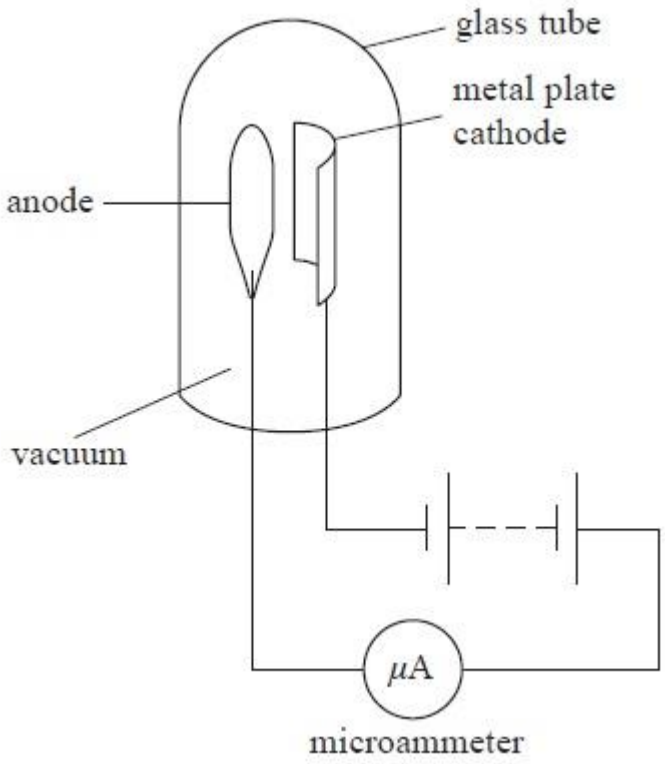
Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Q1.
Phototubes are devices which make use of the photoelectric effect to detect light above a specific frequency.



(a) Explain why

- no current flows when the phototube is in darkness
- current flows in the circuit when the phototube is illuminated by light above a specific frequency.

(5)

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(b) Make an appropriate calculation to explain why caesium is used as the cathode for visible light but zinc is not.

work function of zinc = 3.63 eV

work function of caesium = 2.14 eV

(4)

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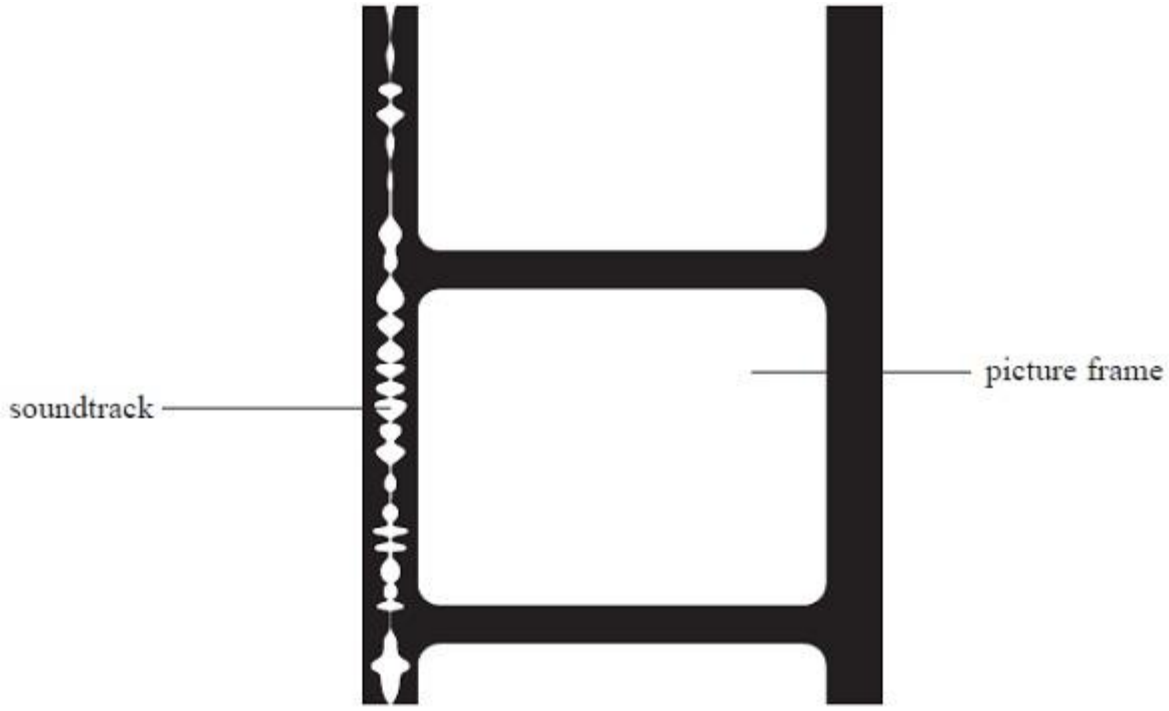
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(c) Before digital technology was used, the films used at the cinema had an optical soundtrack next to the picture frames.



The film, including the soundtrack as shown, moves through a projector past a source of light. Light is detected by a phototube on the other side of the soundtrack. The changing current produced by the phototube circuit is converted to a sound signal with the same variation in amplitude and frequency as the original sound.

(i) State what is meant by amplitude.

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(1)

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(ii) Explain how the changing pattern of the soundtrack produces a changing current in the phototube circuit.

(3)

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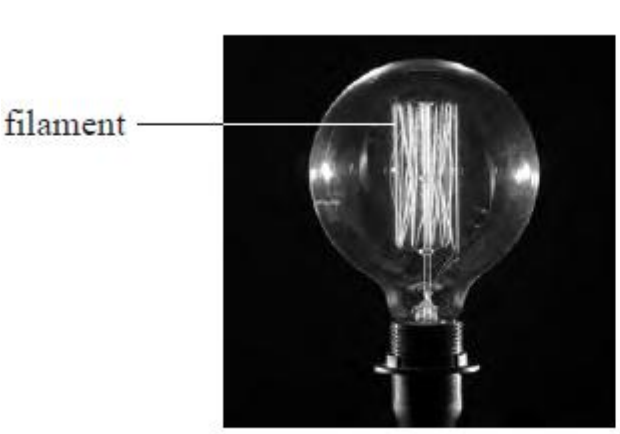
(Total for Question = 13 marks)

Q2.

Filament and fluorescent are two types of light bulb.

Filament light bulbs contain a tightly coiled wire filament, surrounded by an inert gas and encased in a thin glass bulb. When the potential difference (p.d.) across the bulb is sufficient, the filament heats up, emitting visible light.

Fluorescent light bulbs use a long tube of glass containing a small amount of mercury. When a sufficient p.d. is applied across the ends of the tube, electrons moving through the tube cause the mercury to become a vapour and emit photons in the ultraviolet part of the electromagnetic spectrum. The collisions of these photons with the phosphor coating of the tube result in the emission of photons of visible light.



Filament bulb



Fluorescent bulb

A filament bulb contains a tungsten filament of diameter 3.8×10^{-5} m and uncoiled length 1.6 m. As the temperature of the filament increases, the resistance of the filament increases to a maximum which is 14 times greater than the initial resistance at room temperature.

(i) Determine the power of the filament at maximum brightness.

p.d. across filament = 240 V
resistivity of tungsten at room temperature = 5.6×10^{-8} Ω m

(5)

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Power = ...

(ii) Filament bulbs are designed to last for thousands of hours of use. Over time the filament may wear away, becoming thinner at one point. This can cause the filament to melt and break at that point.

Assess whether the filament is more likely to break as the bulb is switched on or when it is in use.

(4)

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(Total for question = 9 marks)

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