Exercise 5 Irradiance

Past Paper Homework Questions

1. The irradiance of light from a point source is 20 W m^{-2} at a distance of 5.0 m from the source.

What is the irradiance of the light at a distance of 25 m from the source?

A $0{\cdot}032\,W\,m^{-2}$

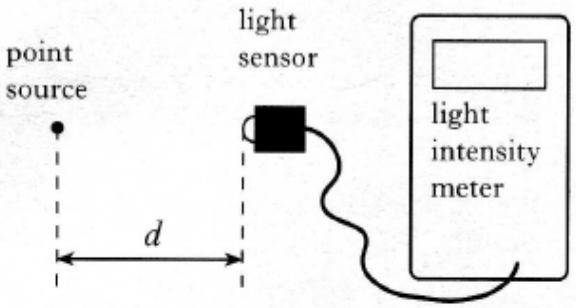
B $0{\cdot}80\,W\,m^{-2}$

C $1{\cdot}2\,W\,m^{-2}$

D $4{\cdot}0\,W\,m^{-2}$

E $100\,W\,m^{-2}$

2. The apparatus used to investigate the relationship between light irradiance I and distance d from a point source is shown.



The experiment is carried out in a darkened room.

Which of the following expressions gives a constant value?

A $I \times d$

B $I \times d^2$

C $\frac{I}{d}$

D $\frac{I}{d^2}$

E $I \times \sqrt{d}$

3. The irradiance of light from a point source is $32\,W\,m^{-2}$ at a distance of 4·0 m from the source.

The irradiance of the light at a distance of 16 m from the source is

A $0{\cdot}125\,W\,m^{-2}$

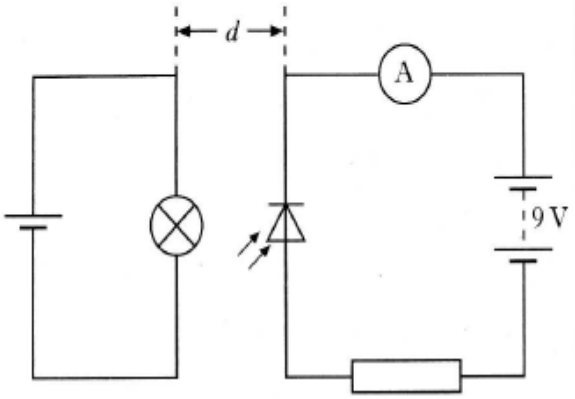
B $0{\cdot}50\,W\,m^{-2}$

C $2{\cdot}0\,W\,m^{-2}$

D $8{\cdot}0\,W\,m^{-2}$

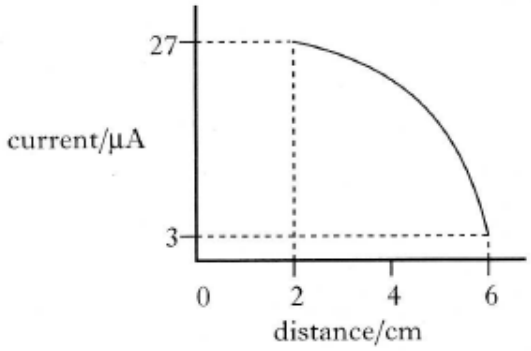
E $128\,W\,m^{-2}$.

4. In a darkened room, a small lamp is placed 2 cm from a photodiode which is connected in the circuit as shown. The lamp may be regarded as a point source. The reading on the ammeter is 27 μA.

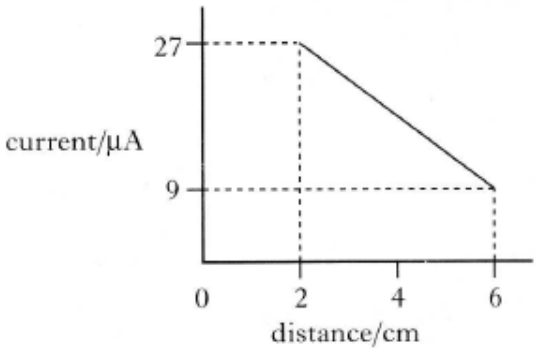


Which graph shows correctly how the ammeter reading changes as the distance d between the lamp and the photodiode is increased to 6 cm?

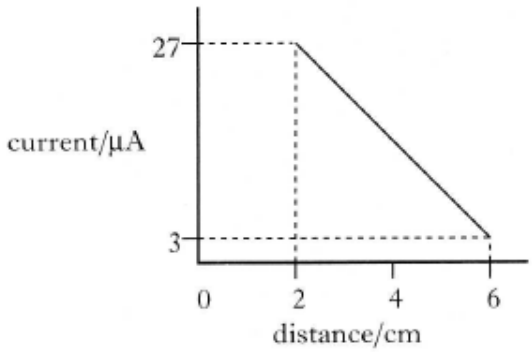
A



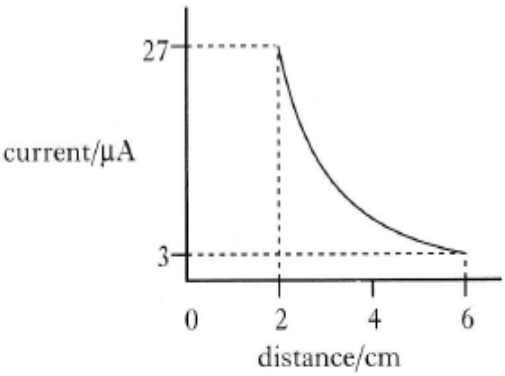
B



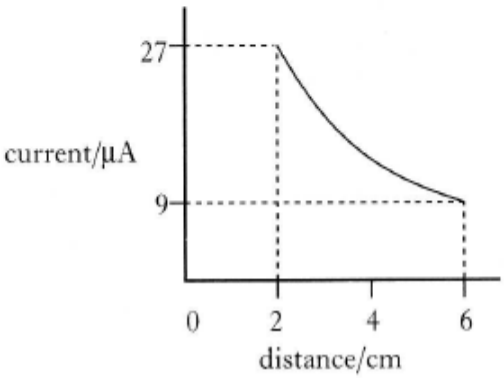
C



D



E

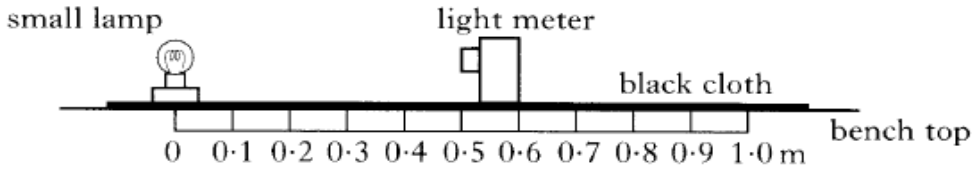


5. A student carries out an experiment to investigate how irradiance on a surface varies with distance from a small lamp.

Irradiance is measured with a light meter.

The distance between the small lamp and the light meter is measured with a metre stick.

The apparatus is set up as shown in a darkened laboratory.



The following results are obtained.

Distance from source/ m	0·20	0·30	0·40	0·50
Irradiance/ units	675	302	170	108

(*a*) What is meant by the term *irradiance*? **1**

(*b*) Use **all** the data to find the relationship between irradiance I and distance d from the source. 3

(*c*) What is the purpose of the black cloth on top of the bench? **1**

(*d*) The small lamp is replaced by a laser.

Light from the laser is shone on to the light meter.

A reading is taken from the light meter when the distance between it and the laser is 0·50 m.

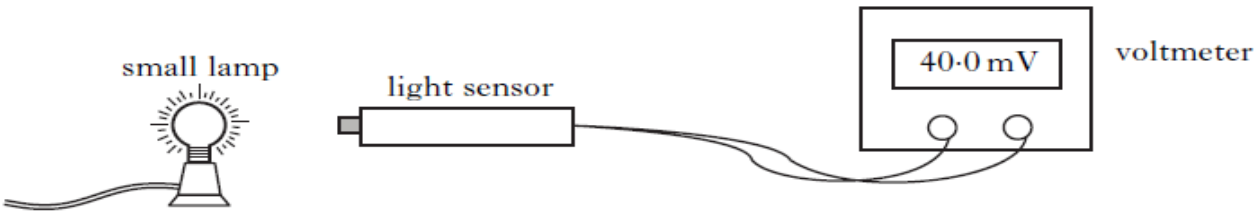
The distance is now increased to 1·00 m.

State how the new reading on the light meter compares with the one taken at 0·50 m.

Justify your answer. **2**

6. The diagram shows a light sensor connected to a voltmeter.

A small lamp is placed in front of the sensor.



The reading on the voltmeter is 20 mV for each 1·0 mW of power incident on the sensor.

(*a*) The reading on the voltmeter is 40·0 mV.

The area of the light sensor is $8{\cdot}0 \times 10^{-5}\,m^2$.

Calculate the irradiance of light on the sensor. 4

(*b*) The small lamp is replaced by a different source of light.

Using this new source, a student investigates how irradiance varies with distance.

The results are shown.

Distance/m	0·5	0·7	0·9
Irradiance/W m^{-2}	1·1	0·8	0·6

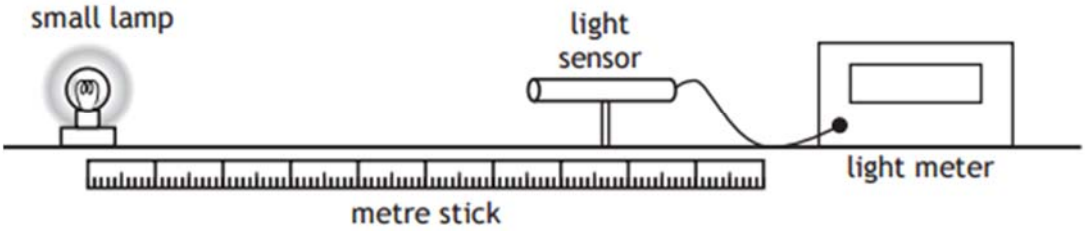
Can this new source be considered to be a point source of light?

Use **all** the data to justify your answer. 3

(7)

7. MARK

A student investigates how irradiance I varies with distance d from a point source of light.



The distance between a small lamp and a light sensor is measured with a metre stick. The irradiance is measured with a light meter.

The apparatus is set up as shown in a darkened laboratory.

The following results are obtained.

d (m)	0·20	0·30	0·40	0·50
I (W m^{-2})	134·0	60·5	33·6	21·8

(a) Use all the data to establish the relationship between irradiance I and distance d. 3

(b) The lamp is now moved to a distance of 0·60 m from the light sensor.
Calculate the irradiance of light from the lamp at this distance. 3

(c) Suggest one way in which the experiment could be improved.
You must justify your answer. 2

(d) The student now replaces the lamp with a different small lamp.
The power output of this lamp is 24 W.
Calculate the irradiance of light from this lamp at a distance of 2·0 m. 4

Total 30