Homework 3: Refraction of light

1. For a ray of light travelling from air into glass, which of the following statements is/are correct?

   I The speed of light always changes.
   II The speed of light sometimes changes.
   III The direction of light always changes.
   IV The direction of light sometimes changes.

   A I only
   B III only
   C I and III only
   D I and IV only
   E II and IV.

2. A student carries out an experiment on the refraction of light. She observes a ray of red light passing from air to glass. The angle of incidence of the ray is 29 °.
   She makes the following statements about the light.

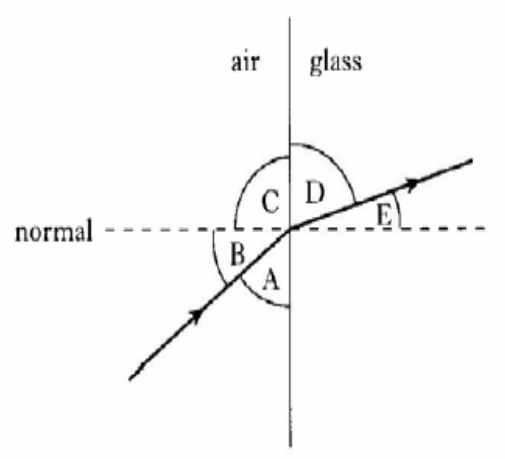
   I The refracted angle is less than 29 °.
   II The light is travelling at 3×10^8 ms^{-1} before refraction.
   III The speed of light in the glass is less than 3×10^8 ms^{-1}.

   Which of these statements is/are correct?

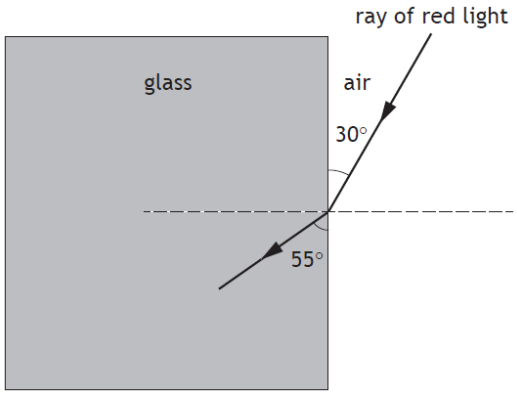
   A I only
   B II only
   C I and II only
   D II and III only
   E I, II and III.

3. A ray of light passes from air into glass as shown.

   Which letter marks the angle of refraction?



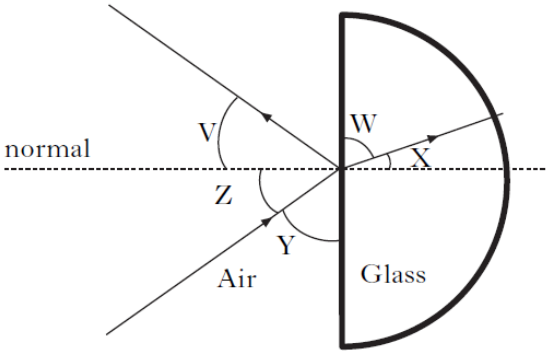
4. A ray of red light is incident on a glass block as shown.



Which row in the table shows the values of the angle of incidence and angle of refraction?

	Angle of incidence	*Angle of refraction*
A	35°	60°
B	30°	55°
C	30°	35°
D	60°	55°
E	60°	35°

5. The diagram shows what happens to a ray of light when it strikes a glass block.

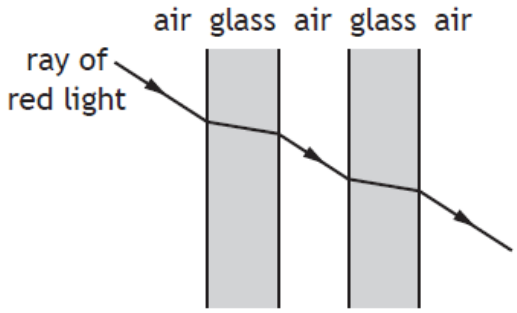


Which row in the table identifies the angle of incidence and the angle of refraction?

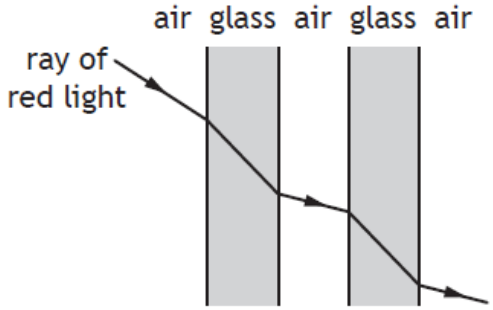
	Angle of incidence	Angle of refraction
A	V	W
B	Y	W
C	Y	X
D	Z	W
E	Z	X

6. A ray of red light passes through a double glazed window.
Which diagram shows the path of the ray as it passes through the window?

A



B



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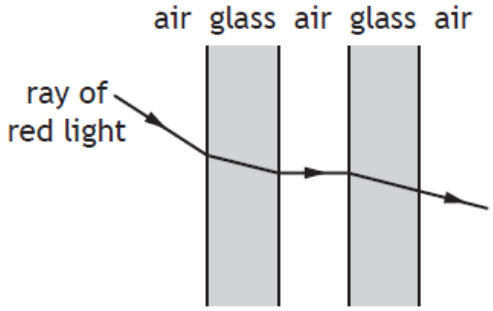
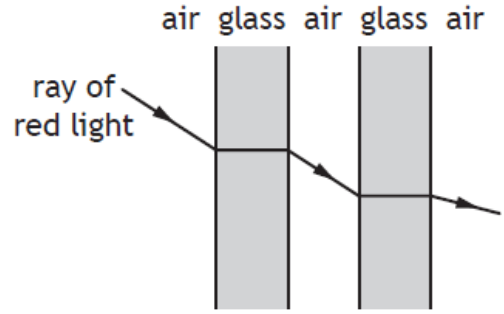
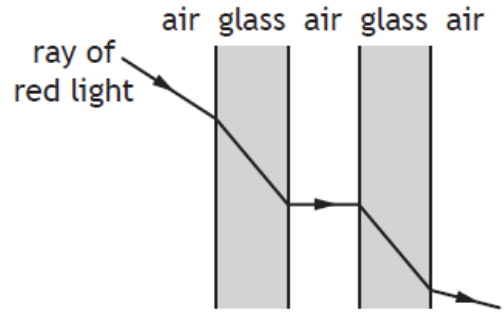


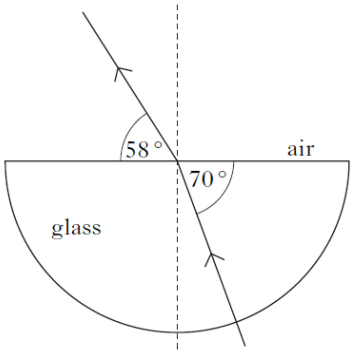
D



E



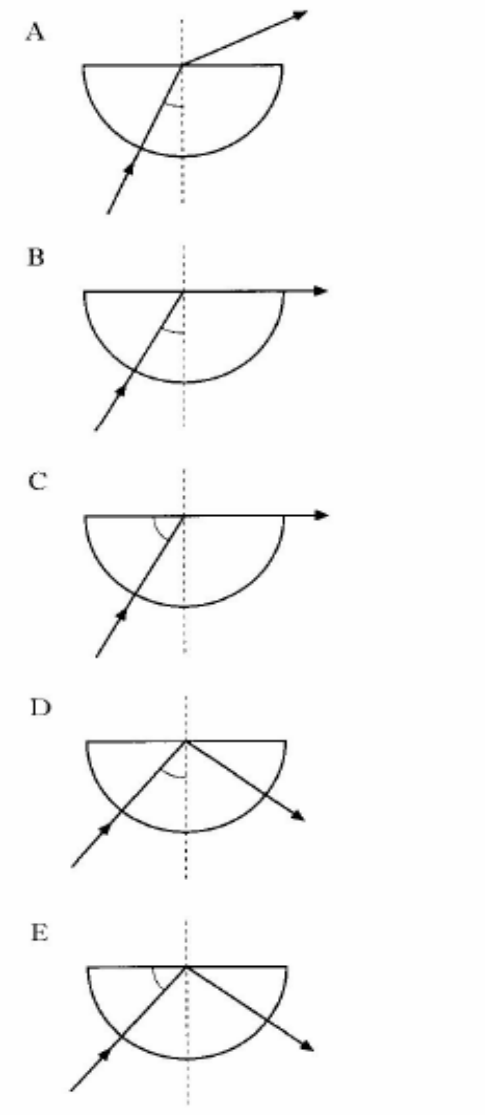
7. A ray of light passes through a glass block as shown.



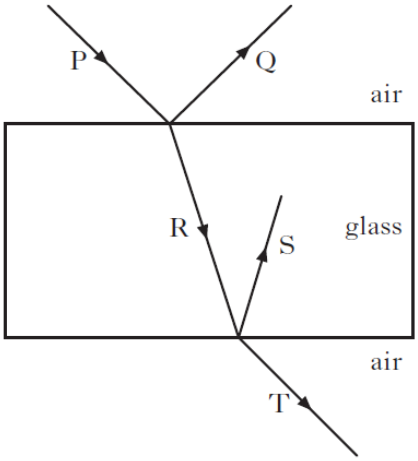
Which line correctly shows the angle of incidence and the angle of refraction?

	Angle of incidence	Angle of refraction
A	20 °	32 °
B	32 °	20 °
C	58 °	70 °
D	70 °	32 °
E	70 °	58 °

8. The diagrams show a light ray passing through a semi-circular glass block. In each case one angle has been marked.
In which diagram is this angle the critical angle?



9. The diagram shows a ray of light P incident on a rectangular glass block.



Which of the rays are refracted rays?

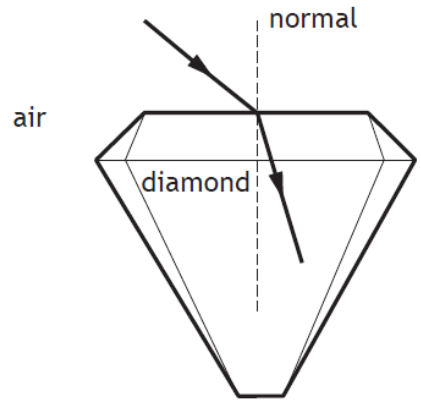
A Q and R
B R and S
C S and T
D Q and S
E R and T

10. Which of the following quantities change during the refraction of a ray of light?

I speed
II wavelength
III frequency

A I only
B II only
C III only
D I and II only
E I and III only.

11. Diamonds are popular and sought after gemstones.
Light is refracted as it enters and leaves a diamond.
The diagram shows a ray of light entering a diamond.



(a) Copy and complete the diagram and label the angle of incidence *i* and the angle of refraction *r*.

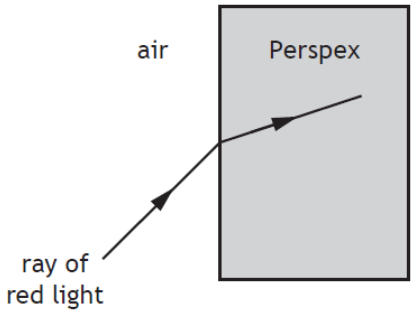
(b) State what happens to the speed of the light as it enters the diamond.

(c)The optical density of a gemstone is a measure of its ability to refract light.
Gemstones of higher optical density cause more refraction.
A ray of light is directed into a gemstone at an angle of incidence of 45°.
The angle of refraction is then measured. This is repeated for different gemstones.

Gemstone	Angle of refraction
A	24·3 °
B	17·0 °
C	27·3 °
D	19·0 °
E	25·5 °

Diamond is known to have the highest optical density.
Identify which gemstone is most likely to be diamond.

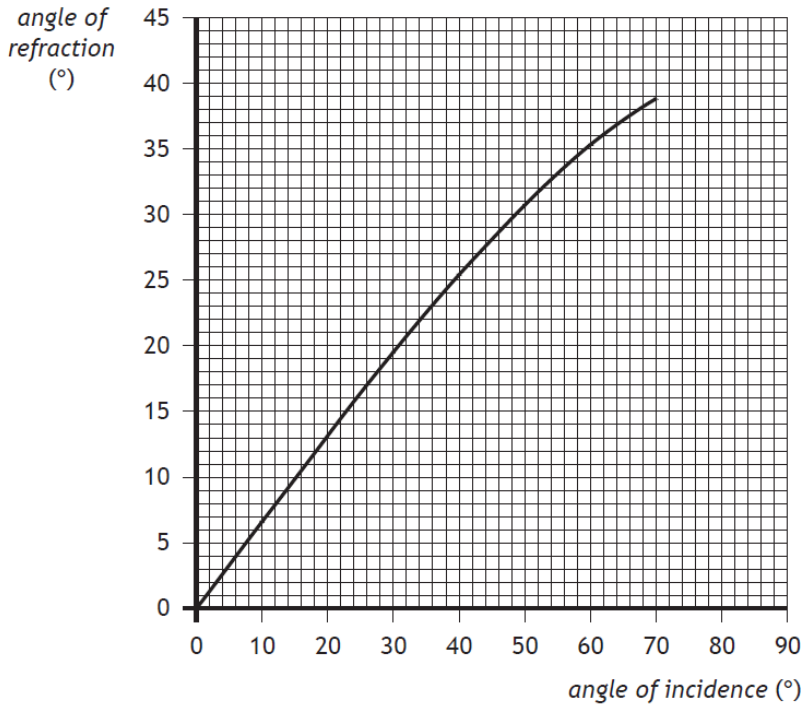
12. A student directs a ray of red light into a Perspex block to investigate refraction.



(a) Copy and complete the diagram.

(i) draw the normal;
(ii) label the angle of incidence *i* and the angle of refraction *r*.

(b) The student varies the angle of incidence and measures the corresponding angles of refraction. The results are plotted on a graph.



(b) (i) Determine the angle of refraction when the angle of incidence is 12°.
(ii) Use the graph to predict the angle of refraction the student would obtain for an angle of incidence of 80°.

(c) Suggest why it would be good practice for the student to repeat the investigation a further three or four times.