Q1. It is night-time and the desk lamp is on. Light shines onto the key.

(a) (i) Draw **one** ray of light on the diagram to show the light shining from the lamp onto the key. Use a ruler.
Put an arrow on the ray to show the direction of the light.  

(ii) There is a patch of light on the wall. This light has been reflected from the key. 
Draw a reflected ray of light on the diagram. 
Use a ruler.  

(b) There is a dark shadow on the table beside the mug. 
Explain how this shadow is formed.  

Q10. Light shines onto a ball. Naomi is looking at the ball.

(a) Describe how light from the lamp lights up the ball and makes it visible to Naomi.  

(b) (i) Naomi uses different colours of light and different coloured balls. 
Complete the table to show the colours that the balls appear to Naomi.
(i) Why does a black object appear black in any light?

(c) Choose from the following terms to complete the sentences below.

less than equal to greater than

At a plane mirror, the angle of incidence is the angle of reflection. The distance from the object to the mirror is the apparent distance from the mirror to the image.

(d) A beam of white light shines onto a sheet of white paper. An identical beam of light shines onto a mirror. The light is scattered from the paper and reflected from the mirror. Describe how scattering by paper and reflection by a mirror are different from each other.

Q11. The diagram shows a lighthouse on a rock.

It is night-time and there are boats at A, B, C, D and E.

(a) On which boat, A, B, C, D or E, would the light from the lighthouse be brightest?

(b) Each boat makes a shadow on the water.

(i) Draw a cross (X) on the diagram to show where the shadow of boat A will be.

(ii) Explain why the shadow forms there.

(c) The weather changes and the fog horn on the lighthouse makes a loud sound. On which boat, A, B, C, D or E, would the sound of the fog horn be quietest?

(d) Inside the lighthouse there is a powerful lamp and some mirrors. The diagram shows the lamp and a mirror. A ray of light from the lamp is shown. Carefully draw the ray which is reflected from the mirror. Use a ruler.
Q12.

The diagram shows rays of light coming from a point source, reflecting in a plane mirror, and entering a person's eye. The person sees an image of the light source at a point behind the mirror.

(a) On the diagram, draw construction lines to find the position where the image appears. Label the image I.

(b) (i) The person moves further away from the mirror. How does this affect the position of the image relative to the mirror?

(ii) The point source of light is moved closer to the mirror. How does this affect the position of the image?

The diagram shows two rays of light coming from a small fish in some water. The rays enter a person's eye.
(c) The person sees an image of the fish under the water. On the diagram, draw construction lines to find the position of the image. Label the image I.

(d) In some parts of the world, people catch fish using spears. When they see the image of a fish in the water, where should they aim?

Q13. (a) The diagram below shows a ray of red light entering a glass block.

![Diagram of light entering a glass block]

(i) Most of the light goes into the glass block, but some does not. What happens to the light which does not go into the glass block?

(ii) As the light goes into the glass block, it changes direction. What is the name of this effect?

(b) The diagram below shows white light passing through a prism and forming a spectrum on a white screen.

![Diagram of light passing through a prism]

The spectrum contains light of all colours. Red is at one end of the spectrum. Write blue, green and violet below in the order of the spectrum.
Q14  (a) The diagram shows a ray of light reflecting several times between two parallel mirrors.

\[ \text{incident ray} \]

\[ \text{emergent ray} \]

(i) What relationship is there between the angle of incidence for the first reflection and the angle of reflection for the last reflection?

(ii) At each reflection there is a small loss in the intensity of the light. Suggest one reason why there is a small loss in the intensity of light when it is reflected.

(b) In the diagram below, the angle of incidence has changed, but the mirrors are in the same positions.

\[ \text{incident ray} \]

State how this change in the angle of incidence would affect the intensity of the emergent ray. Explain your answer.

(c) The two mirrors are now moved so that they are at exactly 30° to each other. The incident ray is parallel to one of the mirrors.
Q15 On 11th August 1999 there will be an eclipse. The shadow of the Moon will pass over part of the Earth.
(a) The diagram below shows the Moon, the Moon’s shadow and the Earth.

On the diagram, draw an arrow pointing towards where the Sun must be.
1 mark

(b) At about midday the Moon’s shadow will pass over Cornwall in England. Where, in the sky, is the Sun at midday?
Tick the correct box.

towards the North  
towards the West  
towards the East  
towards the South

(c) The map shows the shape of the Moon’s shadow and the path it will take across Cornwall.
The Moon’s shadow will take about 2 minutes to move across a house in Falmouth. It will take less than 2 minutes to move across a house in Padstow. Explain why it will take less time for the Moon’s shadow to move across a house in Padstow than to move across one in Falmouth.

(d) Why does the Moon’s shadow move over the surface of the Earth?

Q16 James’s coin has rolled under a cupboard. It is dark under the cupboard, and he cannot see the coin even though the light is on. The diagram shows his problem.

(a) Explain why a shadow forms under the cupboard.

(b) James uses a mirror to shine light from the light bulb onto the coin. He holds the mirror so that it touches the floor at point X.

(i) The symbol for a mirror is

Copy the symbol onto the diagram at point X to show the correct angle for the mirror.

(ii) On the diagram, draw the ray of light from the bulb to the coin. Draw an arrow on the ray to show which way the light is travelling. Use a ruler.
(iii) Use the correct word to complete the sentence.
At the mirror, the light is

Q17 The human eye detects red light, blue light and green light. A combination of red, green and blue light is seen as white. We ‘see’ other colours when different combinations of red, blue and green enter the eye. This is shown in the table.

<table>
<thead>
<tr>
<th>light entering the eye</th>
<th>colour ‘seen’ by the eye</th>
</tr>
</thead>
<tbody>
<tr>
<td>no light</td>
<td>black</td>
</tr>
<tr>
<td>red</td>
<td>red</td>
</tr>
<tr>
<td>blue</td>
<td>blue</td>
</tr>
<tr>
<td>green</td>
<td>green</td>
</tr>
<tr>
<td>red + blue</td>
<td>magenta</td>
</tr>
<tr>
<td>blue + green</td>
<td>cyan</td>
</tr>
<tr>
<td>red + green</td>
<td>yellow</td>
</tr>
<tr>
<td>red + blue + green</td>
<td>white</td>
</tr>
</tbody>
</table>

(a) Some magenta paint is illuminated by a combination of red, green and blue light. Explain why the paint appears magenta.

(b) A mixture of cyan paint and yellow paint appears green in a combination of red + blue + green light. Explain what happens to:

(i) the red light?

(ii) the blue light?

(iii) the green light?

(c) Most colours of paint can be obtained by mixing different combinations of cyan, magenta and yellow paints.

What combination of these paints makes:

(i) blue paint?

(ii) red paint?

Q18 The diagram shows a lamp and a piece of cardboard. The piece of cardboard has a hole in it. Light from the lamp passes through the hole and forms a bright spot on a wall.
(a) (i) Which point on the wall, A, B, C, D or E, is lit up by the lamp?

(ii) Explain why the other points on the wall are not lit up by the lamp.

(b) A piece of clear green plastic is placed over the hole. What is the colour of the light which shines on the wall?

(c) The diagram shows a ray of light from a lamp hitting a mirror.

Which arrow, P, Q, R or S, shows the reflected ray?

Q19. Sophie places a coin at the bottom of an empty mug. She cannot see the coin with her eye in the position shown.
(a) Sophie fills the mug with water. Her head is in the same position as before, but now she can see part of the coin.

Draw a ray of light on the diagram to show how Sophie can see part of the coin.
Use a ruler.
Draw an arrow on the ray to show its direction.

(b) Sophie pours some concentrated blackcurrant juice into the water. The blackcurrant drink acts like a red filter and makes the coin look red.
Explain how a red filter works.

A car is driving behind the two cyclists. Light from the car headlamp shines on the cyclists.

(a) What happens to the light when it reaches the light-coloured clothes?

(b) On the drawing above, draw a ray of light to show how light from the headlamp reaches the driver so that he can see the cyclist in the light-coloured clothes.
Draw arrows to show the direction of the light.
Q21. The diagram below shows the shapes and positions of five glass objects.

Harriet put a square of black card on top of each glass object. She shone a ray of red light onto each object.

The diagrams below show the rays of light going under the cards and coming out again. Which object is under each card? Write the correct letter below each diagram. One has been done for you.

Q22. Two identical triangular glass prisms were placed together. A narrow beam of white light was shone into them as shown below.
(a) Draw the ray of light through the two prisms and on to the screen.

(b) The prisms were then separated and set up as shown in the diagram, with rays of white light shining through them. The prisms split the white light into colours as shown.

(i) A white screen was placed in position A as shown below. The rays of red, green and blue light are shown. Describe the appearance of the light on the screen.

(ii) The white screen was moved away from the prisms to position B as shown below.
The rays of red, green and blue light are shown.
Describe the appearance of the light on the screen.

Q23. In 1610, the Italian scientist, Galileo, observed four bright moons near Jupiter. Each night the moons moved.
(a) (i) The Sun and stars are light sources, and the planets are seen by reflected light. Explain how we can see the moons of Jupiter.

(ii) The four moons are approximately the same distance from the Earth. However, they do not have the same brightness. Suggest one reason for this.

(b) The table shows the distances of the four moons from the centre of Jupiter, and the times of their orbits. Europa's distance has been left out.

<table>
<thead>
<tr>
<th>name of moon</th>
<th>distance from Jupiter, in millions of km</th>
<th>time for one orbit, in Earth days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Io</td>
<td>0.42</td>
<td>1.8</td>
</tr>
<tr>
<td>Europa</td>
<td></td>
<td>3.6</td>
</tr>
<tr>
<td>Ganymede</td>
<td>1.07</td>
<td>7.2</td>
</tr>
<tr>
<td>Callisto</td>
<td>1.88</td>
<td>16.7</td>
</tr>
</tbody>
</table>

The graph was plotted using the information in the table.
Use the graph to estimate Europa’s distance from Jupiter.

............................................................................................................................ millions of km

(c) Galileo realised that Jupiter and its moons formed a model of our Solar System. In this model:

what did Jupiter represent? .............................................................................
what did the moons represent? .................................................................

1 mark

Q24. A teacher has a small torch. He switches it on and points it towards a mirror.

(a) A ray of light from the torch reflects off the mirror. Use a ruler to draw the ray of light:

(i) from the torch to the mirror;

(ii) reflecting off the mirror.

Add arrows to the rays to show the direction of the light.

Maximum 5 marks
(b) A laser beam is a very bright and powerful beam of light. It is very dangerous to point a laser beam towards people or animals.
Which part of the body can be most easily damaged by a laser beam?

KS3 Phx 8K EQ 4 Teachers 183 marks Mark Scheme

M1. (a) (i) the first mark is for a continuous straight line from the rim of the lamp to the key the line must reach the key
the second mark is for the arrow on the line
the arrow must point away from the lamp
(ii) the mark is for a straight line from the key to the patch of light
the line must both touch the key and reach the patch of light

(b) any one from
- light cannot bend around the mug
- light cannot go through the mug
- light travels in straight lines
- the mug absorbs or scatters the light
- the mug is opaque or the mug is in the way of the light
- the reflected ray drawn from any part of the key irrespective of the first ray
- the reflected ray need not have an arrow
- do not accept broken lines
- do not accept ‘light reflects off the mug’

M10. (a) the light is scattered by the ball
- it is scattered or reflected
- or bounces off the ball
- some of the light from the ball enters Naomi’s eye
- it goes into or gets to her eye

(b) any one from
- light cannot go through the boat
- light cannot bend round the boat
- the boat is opaque
- the boat absorbs or reflects the light
- light travels in straight lines
- the reflected ray touches the incident ray at the surface of the mirror

M11. (a) A

(b) (i) the centre of a cross (X) drawn in the shaded area between boats A and B
- the centre of the cross below the water line
- do not accept the centre of the cross below the water line
- above the shaded area

(ii) any one from
- light cannot go through the boat
- the boat is opaque or the boat absorbs or blocks or stops or reflects the light
- light travels in straight lines
- do not accept ‘pink’ or ‘light red’
- do not accept ‘light green’
- do not accept ‘light green’
- equal to
- equal to
- accept ‘equals’ or ‘the same as’
- one mark is for describing scattering and one mark is for describing reflection
- scattering sends or reflects light in all directions
- accept ‘scattered light goes all over the place’ or ‘the light from the paper goes off in lots of rays’ or ‘no image can be seen in the paper’
- reflection sends light in one direction or to one point
- accept ‘the light from the mirror is all in one ray or beam’
- or ‘reflected light goes at one exact angle’
- or ‘an image can be seen in the mirror’

(c) E

(d) the reflected ray touches the incident ray at the surface of the mirror
a horizontal line as the reflected ray

if the reflected ray has been drawn without using a ruler, do not award this mark accept responses in which a normal has been drawn and the angles of incidence and reflection are approximately equal, even if the reflected ray is not horizontal.

M12. (a)

either the dashed construction lines - - - - or the dotted lines ...... must be drawn accept a combination of construction lines and arcs of circles, drawn with a compass, which enable the image to be located correctly construction lines may be dotted, dashed or continuous accept a dot instead of the letter I to indicate the position of the image award no mark if construction lines are not drawn or if the position of the image is not very close to the correct position above the fish

(b) (i) it is in the same place accept 'it does not'

(ii) it is closer to the mirror accept 'closer to the eye' or 'it is closer'

(c)

construction lines may be dotted, dashed or continuous accept a dot instead of the letter I to indicate the position of the image award no mark if construction lines are not drawn or if the position of the image is not very close to the correct position above the fish

d below the apparent position of the fish accept 'below the image' or 'lower in the water' or 'below where they see the fish' accept 'in front of the image' do not accept 'below the fish'

M13. (a) (i) any one from

• it is reflected accept 'bounces off'

• it is scattered accept 'it is absorbed by the air'

• it is absorbed by the glass' or 'it goes into the air

(ii) refraction

(b) green blue violet all three colours in the correct order are required for the mark accept 'orange, yellow, green, blue, indigo, violet' in the correct order

(c) The green part of the spectrum stays the same, but the other colours disappear. i.e. a tick in the third box if more than one box is ticked, award no mark

M14. (a) (i) they are the same or equal

(ii) any one from

• some light is scattered by unevenness of the surface accept 'scattering'

• some light is absorbed in the mirror
accept ‘absorption by the mirror’
do not accept ‘absorption in the air’ or ‘absorption’
accept ‘some is internally reflected between the two surfaces of the glass or mirror’
do not accept ‘not all of the light is reflected’

(b) the intensity would be greater because there are fewer reflections
both the effect and the reason are required for the mark

(c)

the first mark is for drawing the path of the ray
both parts of the path are required for this mark
the rays must touch the mirrors within the tolerances shown
the second mark is for indicating that the ray emerges along
the same line as the incident ray but in the opposite direction
either the label or the arrow is sufficient

M15. (a) horizontal arrow pointing to the left
the arrow may be drawn anywhere on the diagram

(b) towards the South ✓
if more than one box is ticked, award no mark

(c) any one from
• the part of the shadow which passes over Padstow is narrower
• the part of the shadow which passes over Falmouth is wider or bigger

(d) any one from
• the Moon moves around the Earth
• the Earth spins on its axis
accept ‘the Earth turns or rotates or goes round’
do not accept ‘the Earth moves around the Sun’ or ‘the Earth moves’ or ‘the Sun moves’

M16. (a) any one from
• light cannot go through the cupboard
• light cannot bend round the cupboard
accept ‘the cupboard stops or blocks or absorbs the light’
do not accept ‘the cupboard reflects the light’
accept ‘light travels in straight lines’

(b) (i) mirror symbol is at approximately 45° to the floor
the mirror must slope downwards to the right
the hatching marks must be on the underside of the mirror
do not accept rectangular drawings of a mirror

(ii) at least one arrow showing the direction of the ray is required
to award both marks
ray from bulb to any part of mirror
ray from mirror to coin

(iii) reflected
the ray must be straight and must touch both the bulb and the mirror the ray need not be vertical
consequential marking applies
accept a ray drawn to the mirror regardless of where the mirror has been drawn
the ray must be straight and must touch both the mirror and the coin
the ray must touch the mirror at the same point as the ray from the bulb
consequential marking applies
accept a ray drawn from the mirror regardless of where the mirror has been drawn
accept ‘reflecting’
do not accept ‘scattered’ or ‘absorbed’ or ‘refracted’ or ‘bounced off’

M17. Answers may be in either order
(a) it absorbs the green light
accept ‘the green light is not reflected’

it scatters the red and the blue light
both colours are required for the mark
accept ‘it reflects the red and the blue light’
accept ‘the eye receives only red and blue light’
accept ‘it reflects only the red and the blue light’
or ‘it absorbs only the green light’ for both marks

(b) (i) it is absorbed by the cyan paint
do not accept ‘it is absorbed’

(ii) it is absorbed by the yellow paint
do not accept 'it is absorbed'

(iii) it is scattered or reflected by both paints
accept 'it is scattered or reflected'

(c) (i) cyan and magenta
colours may be in either order

(ii) magenta and yellow
colours may be in either order

M18. (a) (i) B

(ii) any one from
• light travels in straight lines
• light will not pass through the cardboard
accept 'the cardboard blocks the light'
or 'the cardboard is opaque'
• they are in the shadow of the cardboard
do not accept 'they are in the shadow'

(b) green

(c) Q

M19. (a) one mark for a ray from coin to eye, bending at the surface of the water, and not passing through the mug
both parts of the ray must slope upwards to the left
accept small discontinuities in the ray accept rays which are almost straight but which may have not been drawn with a ruler

one mark for accurately drawing the correct ray
do not award this mark unless the first mark was also awarded the ray must touch the coin, touch the pupil of the eye, and must be continuous
both parts of the ray must be drawn with a ruler

one mark for an arrow showing that the light enters the eye

(b) red light passes through
answers may be in either order accept 'the filter or drink does not affect the red light'
do not accept 'it reflects red light'

the other colours are absorbed
accept 'only the red light passes through the filter'
or 'every colour except red is absorbed' for both marks
do not accept 'the light turns red'

M20. (a) it is reflected
accept 'it is scattered'
accept 'it reflects or bounces off'

(b) one mark is for a ray from the headlamp to the light-coloured clothes and from them to the driver’s eye
both parts of the ray are required
accept small discontinuities in the ray
accept rays which are almost straight but which have not been drawn with a ruler
do not accept dotted lines

• one mark is for accurately drawing the correct ray
this is a dependent mark do not award this mark unless
the first mark was also awarded the ray must touch the headlamp, touch the cyclist’s clothes, and touch the driver’s eye the ray must be continuous
both parts of the ray must be drawn with a ruler

• an arrow showing that the light enters the eye or leaves the headlamp
accept a correct arrow on an incomplete line

(c) it is absorbed
accept 'it absorbs'
accept 'most is absorbed'
accept 'it is not reflected'
accept 'only some is reflected'

M21. (a) Q
accept a drawing of the correct object

(b) P
accept 'R'
accept a drawing of the correct object

(c) S
accept a drawing of the correct object

(d) R
accept a drawing of the correct object

M22. (a) one mark for the ray bending the correct way at the first surface and passing through the prisms in a straight line
one mark for the ray emerging parallel to incoming ray

[Diagram of ray emerging parallel to incoming ray and ray emerging from lower edge]
M23. (a) (i) any two from
• light from the Sun
  do not accept ‘light from the Sun and stars’
• reflected from the moons’ surfaces
  do not accept ‘the Sun reflects off the surface’
• travels from the moons to the eyes
  accept ‘they reflect sunlight’ for both marks
  
(ii) any one from
• they reflect different amounts of light
  accept ‘they have different albedos’
  accept ‘some are dark’ or ‘they are different colours’
• they are not the same size
  accept ‘one could be partly in the shadow of Jupiter’

M24. (a) (i) a straight line from the
torch to the mirror
(b) 0.68
  the unit is not required for the mark
  accept answers from 0.65 to 0.70
(c) the Sun
  planets
  both answers are required for the mark

[5]