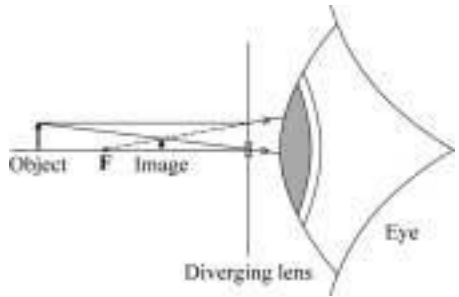


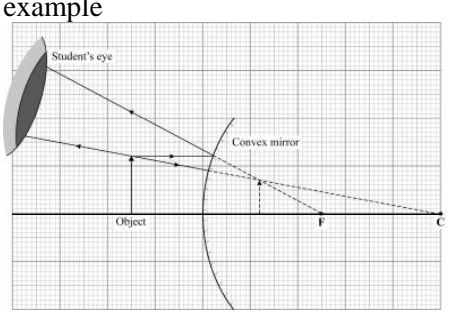
LENSES AND RAY DIAGRAM MARK SCHEMES

QUESTION 1

question	answers	extra information	mark
(a)	converging or convex		1
(b)	(principal) focus or focal point		1
(c)	either ()1.5 or ()1% or 150%	unambiguous evidence of appropriate measurements for 1 mark only eg 4 and 6 or 8 and 12 or 0.8 and 1.2	2
(d)	real rays cross to form it / formed at the intersection of real rays	accept image on the opposite side of the lens to the object accept can be put onto a screen	1
total			5

Question 2

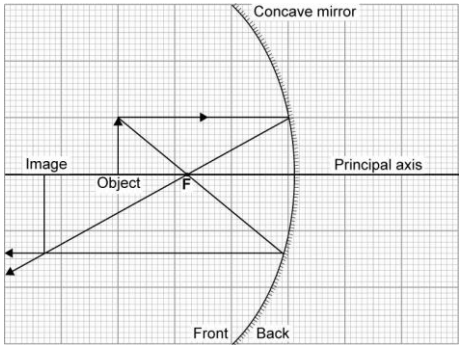
question	answers	extra information	mark
(a)	<p>straight line from the tip of the object straight through the centre of the lens (1)</p> <p>parallel to the axis, then diverges from the lens as if from F (1)</p> <p>image drawn from where these lines intersect, vertically to the axis (1)</p>	<p>example</p> 	3
(b)	<p>any two from:</p> <ul style="list-style-type: none"> • smaller (than the object) • (both) upright • image is virtual / imaginary (whereas object is real) 	<p>no errors carried forward from the candidate's diagram</p> <p>mark first two points given</p>	2
total			5

Question 3			
question	answers	extra information	mark
(a)	<p>ray from the top of the object in a straight line to C (1)</p> <p>ray from the top of the object and parallel to the principal axis reflected from the mirror as if from F (1)</p> <p>where these lines intersect vertically to the axis (to form the image) (1)</p>	<p>example</p>  <p>note this mark depends on the first two marks being correct</p>	4

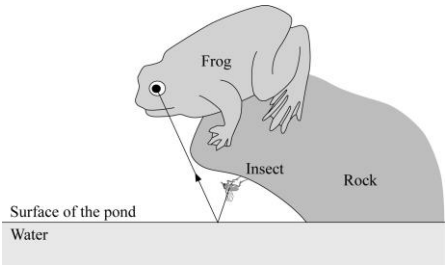
	direction of four <u>real</u> rays correctly shown (1)	two from the object towards the mirror two towards the student's eye note the rays only need to go towards the eye any arrows shown on 'rays' behind the mirror invalidate this mark	
(b)	image is formed by the intersection of virtual/ imaginary rays	or the construction lines only show where the image appears to be/where light seems to come from or the image is behind the mirror or (real) rays do not pass through the image or (real) rays do not cross ignore reference to a 'screen'	1

Question 4			
(a)(i)	answer in the range 3.0 ↔ 3.1 inclusive	accept for 1 3.6 ÷ 1.2 or 3.7 ÷ 1.2 or 36 ÷ 12 or 37 ÷ 12 or 18 ÷ 6 or 18.5 ÷ 6 or 10.2 ÷ 3.4 or 102 ÷ 34 or answer in the range but with a unit eg 3 cm	2
(a)(ii)	(principal) focus / focal (point(s)) / foci / focus	accept 'focusses' accept focals do not accept focal length	1
(a)(iii)	at the intersection of virtual / imaginary rays	or 'where virtual / imaginary rays cross' or the rays of (real) light do not cross or the image on the same side (of the lens) as the object or the image is drawn as a dotted line or the image is upright	1

		do not accept ‘cannot be put on a screen’ do not accept any response which refers to reflected rays	
(b)(i)	another correct observation about relationship between values of d (1) (but) not the same relationship between corresponding values for magnification (1)	example 15 is three times bigger than 5 but 2.0 is not three times bigger than 1.2	2
(b)(ii)	when the distance / d increases the magnification increases	or the converse accept ‘there is a (strong) <u>positive</u> correlation’ do not accept any response in terms of proportion / inverse proportion	1
(b)(iii)	(student has) no evidence (outside this range)	accept data / results / facts for ‘evidence’	1
Total			8

Question 5			
question	answers	extra information	mark
	any two from: <ul style="list-style-type: none"> • straight line from the top of object parallel to principal axis then reflected from the mirror and through F • straight line from the top of the object through F to the mirror then reflected parallel to the principal axis • straight line from the top of the object to the centre of the 	example of correct response  ignore direction of any arrow heads drawn on the lines	2

	<p>mirror reflected so that angle of incidence = angle of reflection</p> <p>real image shown from where their reflected rays intersect and perpendicular to the principal axis</p>	ignore image orientation if shown	1
Question 6			
(a)	<p>either</p> <p>(photographic) <u>film</u></p> <p>or</p> <p>CCD(s) (charge-coupled device(s)) / CMOS(s) (sensor(s)) / (active) pixel sensor(s)</p>	accept LDR(s) / light dependent resistor(s) not lux meter do not accept light sensor(s)	1
b(i)	converging	or convex	1
b(ii)	<p>either</p> <p>(0).35</p> <p>or</p> <p>(0).4(1)</p>	<p>do not give any credit for an answer greater than 1 or</p> <p>7 20 for 1 mark or</p> <p>clear evidence that appropriate measuring / counting, has been made for 1 mark</p>	2
(c)	<p>otherwise it will have no effect on the light detector or</p> <p>otherwise no (real) light will fall on the light detector</p>	<p>or a virtual / imaginary image will have no effect on the light detector</p> <p>allow error carried forwards for light detector allow so it can be formed on the film</p>	1
Question 7			
(a)(i)	plane	accept any unambiguous indication	1
5(a)(ii)	<p>upright</p> <p>virtual</p>	accept any unambiguous indication	<p>1</p> <p>1</p>

<p>(b)</p>	<p>reflection takes place at the surface of the pond and angle of incidence = angle of reflection</p> <p>reflected ray is a straight line to frog's eye through the air</p> <p>correct direction arrow either from insect or to frog's eye</p>	<p>as judged by eye</p> <p>only one arrow essential but do not accept if either arrow contradicted</p> <p>example of a fully correct response</p>  <p>The diagram illustrates a frog on a rock looking at an insect on the surface of a pond. A ray of light is shown reflecting off the surface of the pond from the insect to the frog's eye. Labels include 'Frog', 'Insect', 'Rock', 'Surface of the pond', and 'Water'.</p>	<p>1</p> <p>1</p> <p>1</p>
<p>Total</p>			<p>6</p>