2023 Sec 3 IP Physics ANSWERS (FOR STUDENTS)
Term 2 Weighted Assessment 2 (8 May 2023)
Topics:
(1) Total Internal Reflection
(2) Lenses
(3) Kinematics

30

Penalise 1 m from total for any s.f. error

Answers to Section A (MCQ)

1	2	3	4	5	6
A	C	D	C	A	B

Section B (24 marks)
Answer all questions.

7 Fig. 7.1 (not drawn to scale) shows rays of light travelling in material G from a light source, L. Ray Y is incomplete.

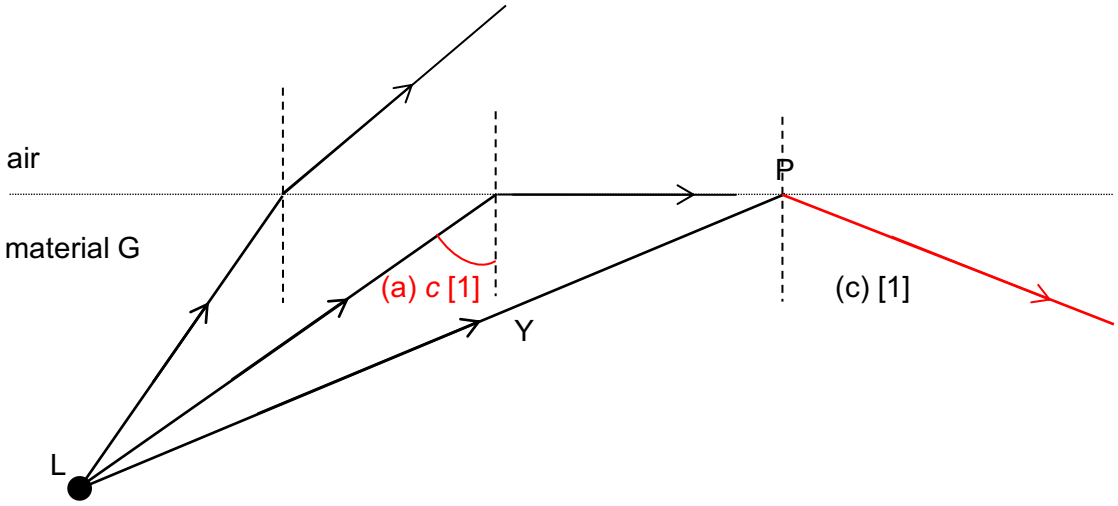


Fig. 7.1

(a) Mark the critical angle in Fig. 7.1 and label it *c*. [1]
Normal must be drawn and angle must be labelled for mark to be awarded.

(b) Material G has a refractive index of 1.54. Calculate the critical angle of light in material G.

1.54 = 1/sin *c* [1] *c* = 40.5° or 40° [1]

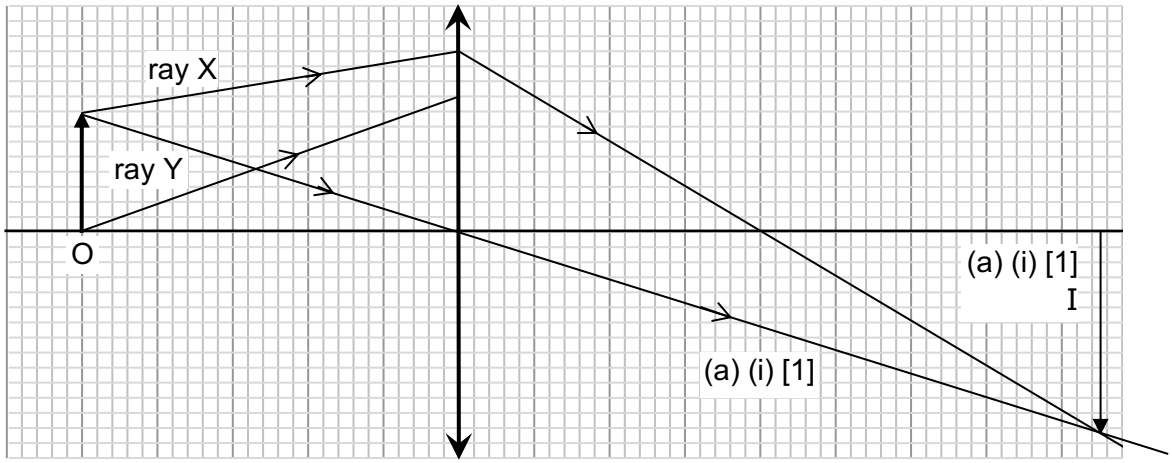
(c) Draw the path for ray Y after it hits the boundary between air and material G at point P. [1]
Angles of incidence and reflection must be approximately equal (within 5 degrees).
Ray direction must be marked with arrow.

8 Fig. 8 shows an object O placed in front of a converging lens, L. The path of ray X from the top of the object O is shown as it passes through the lens. Another ray Y from the foot of the object is shown.

(a) Draw necessary ray(s) on the diagram above to

(i) locate the image of object O. Draw and label the image as I. [2]

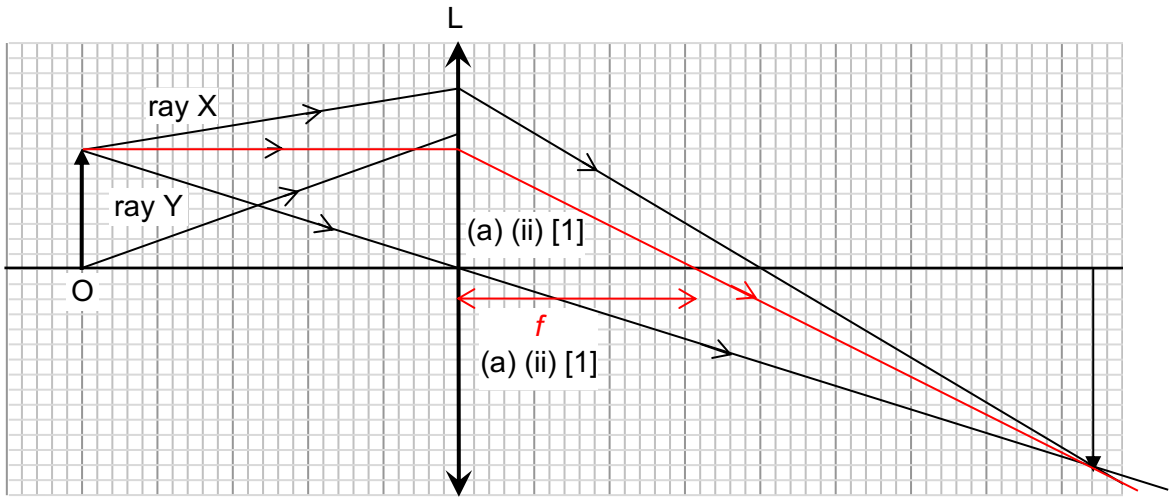
Award 1 for a ray through centre of lens undeviated
Award 1 for extending ray X or using parallel rays to locate image (must label I and image must be drawn with solid lines)
Accept alternative methods if valid.



(ii) determine the focal length. Mark the focal length on the diagram and label it as *f*.

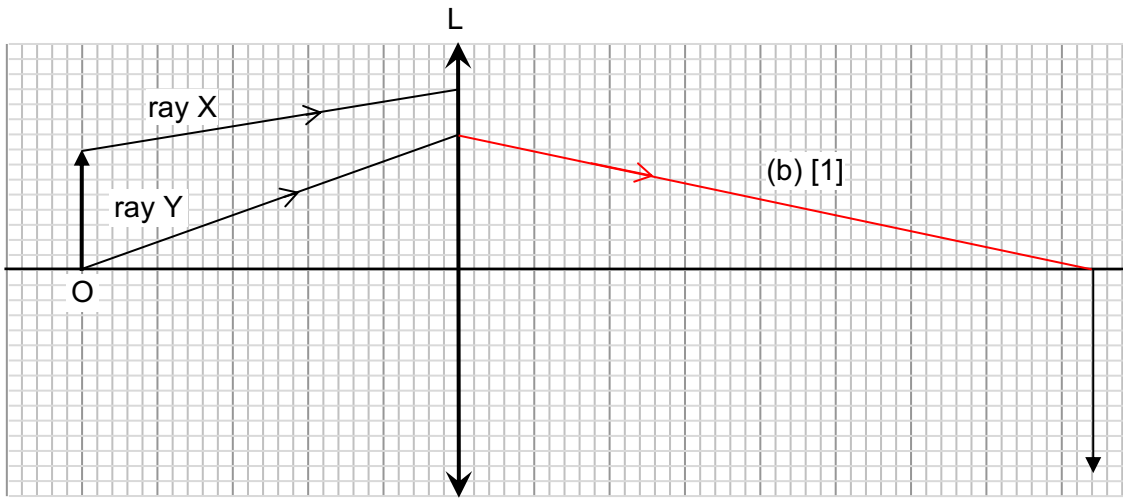
Award *1 for a ray parallel to the principal axis passing through the principal focus.*
Award 1 for indicating and labelling f correctly
Note: Many students labelled the Principal Focal point rather the focal length.

[2]



(b) Draw necessary ray(s) on the diagram to complete the path of ray Y after it passes through the converging lens L. [1]

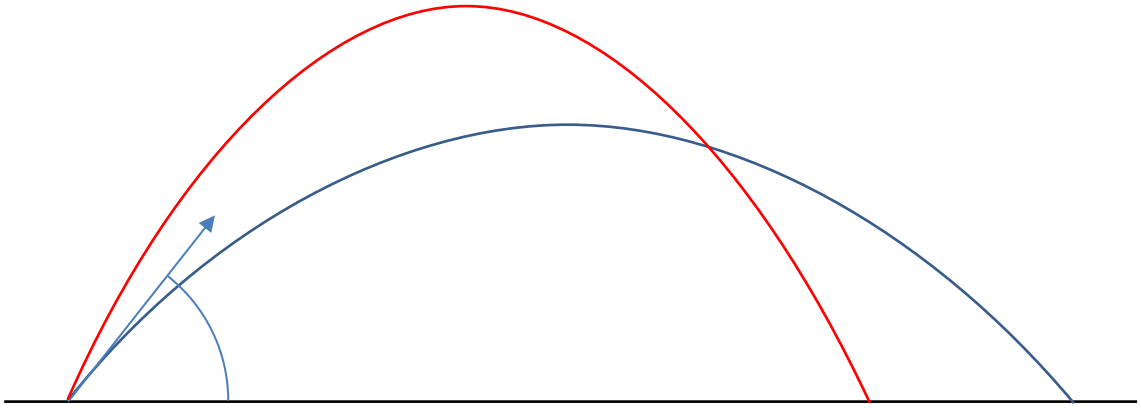
Award 1 as long as the ray is extended to meet the base of the image (even if the image is wrong). The ray must extend all the way to the image.



(c) State the characteristics of the image formed.

real, inverted, magnified [1]

9 Fig. 9.1 shows the path of a ball thrown up from X at an angle of 45º to the ground. Assume air resistance is negligible.



(a) Given that the time from the ball being thrown to the ball hitting the ground was 4.5s, calculate the maximum height reached by the ball.

considering only the vertical component of motion

s = ?
t = 4.5 ÷ 2 = 2.25 s
a = -10 m/s^2
v = 0 m/s
u = 22.5 m/s [1]

s = ut + ½at²
= 22.5 × 2.25 + ½(-10)(2.25)²
s = 25.3 m (3 s.f) [1]

(b) Draw on Fig 9.1 the path of another ball thrown from X with same initial speed but at a launch angle of more than 45º (but less than 90º).

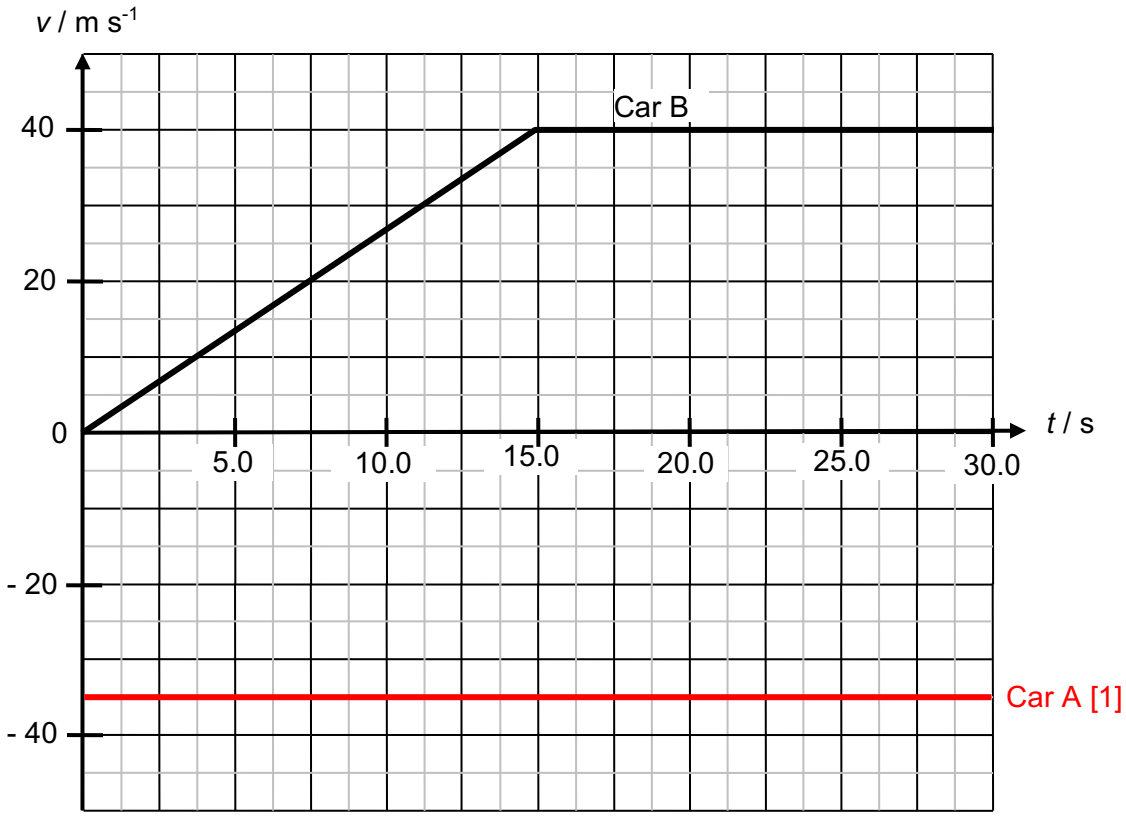
[2]

Maximum height is greater than the original graph. [1]

Range is less than original [1]

Deduct one mark if curve is not smooth or not close to parabolic

10



(a) Based on Fig. 10.2, state the sign convention used for the direction from station J towards station K.

Negative [1]

Also accepted "leftwards is positive" or "rightwards is negative"

(b) **(i)** Define *acceleration*.

Acceleration is the rate of change of velocity. [1]

(ii) Calculate the acceleration of car B at t = 10.0 s.

$a = 40 \text{ m s}^{-1} / 15.0 \text{ s}$ [1]

$a = 2.7 \text{ m s}^{-2}$ [1]

(c) When car A is 700 m from station J, it passes car B.

(i) Calculate the distance of car B from station K.

distance = 1200 m – 700 m = 500 m [1]

(ii) Determine the time when car A passes car B.

$\frac{1}{2}[t + (t-15.0 \text{ s})] \times 40 \text{ m s}^{-1} = 500 \text{ m}$ [1]

t = 20 s [1]

Note: cannot use one of the 4-equations-of-motion here as car B does not have just one motion. It undergoes an acceleration followed by constant velocity.

(iii) Calculate the speed of car A.

s = v x t

700 m = v x 20 s [1]

v = 700 m / 20 s

= 35 m s^{-1} [1]

(iv) Hence, sketch the *v*–*t* graph of car A from *t* = 0.0 s to *t* = 30.0 s on Fig. 10.2.
*Allow e.c.f. from (iii) – any **negative** horizontal line at the calculated speed. Label not needed.*