G.C.E. (Advanced Level) Examination - August 2007

PHYSICS - I

Provisional Scheme of Marking

2007 - Answers

Q	1	2	3	4	5
01		X			
02			X		
03					X
04		X			
05			X		
06		X			
07				X	
08	X				
09		X			
10	X				
11				X	
12			X		
13			X		
14		X			
15	X				
16			X		
17	X				
18				X	
19		X			
20				X	
21			X		
22					X
23				X	
24					X
25			X		
26					X
27					X
28			X		
29					X
30			X	X	
31			X		X
32					X
33			X		
34		X			
35			X		
36	X				
37		X			
38	X				
39	X	X	X	X	X
40					X
41	X				
42			X		
43	X				
44	X	X	X	X	X
45			X		
46		X			
47				X	
48					X
49				X	
50			X		
51	X				
52	X				
53			X		
54				X	
55	X				
56					X
57			X		
58					X
59			X		
60		X			

G.C.E. (Advanced Level) Examination - August 2007

PHYSICS - II

Provisional Scheme of Marking

A - PART

01. (a) Chemical balance. 01

(b) (1) Meter Ruler / Half meter ruler 01

(2) Meter Ruler / Half Meter ruler 01

(3) Micrometer Screw Gauge 01

(c) $d = \frac{m}{lwt}$ 01

(d) Thickness may not be uniform OR

Thickness may not have the same value everywhere.

Thickness can be different at various places 01

(e) (i) (1) l = 30.0 cm $\quad \frac{1}{300}\left(\text{or } \frac{0.1}{30} \text{ or } \frac{0.05}{30}\right)$

(2) t = 0.15 mm $\quad \frac{1}{15}\left(\text{or } \frac{0.01}{0.15} \text{ or } \frac{0.005}{0.15}\right)$

(ii) 20

(f) $\frac{m}{lW \times 10^{-4}}$ or $\frac{m \times 10^{4}}{lW}$

02. (a) Triple beam balance/ chemical balance / four beam balance OR electronic balance. 01

(b) Heat lost to the surrounding can be neglected OR
No heat exchange with the surrounding OR
Heat loss to the surrounding is minimized 01

(c) 1. Mass of calorimeter with the stirrer
2. Mass of calorimeter, stirrer and water
3. Initial temperature of water
4. Maximum temperature of the water
5. Mass of calorimeter, stirrer, water and metal balls.
or mass of calorimeter and the mixture. 02
(All 02 any correct three 01)

(d) (i) Water may not cover the metal balls completely OR
Water may vaporize (evaporate) due to high temperature it gains.
OR metal balls will not mix properly with water.
OR Heat in metal balls will not completely absorbed by water.
OR Heat loss to the surrounding will be higher. 01

(ii) Water may spill over when stirring
OR water may spill over when balls are transferred
Increase in temperature may be too small
Increase in temperature of water may not be deflectable.

(e) Heat lost by metel balls = 0.3 x S x 64
Heat lost by metal balls = heat gained by calorimeter, stirrer and water

0.3 x S x 64 = 2400 01

S = $125 Jkg^{-1}\,^{\circ}C^{-1}$ 01

(f) Water will be added to the mixture along with the metel balls.
Dry balls can not be obtained from this method
Temperature of metel balls will be reduced when water is wiped off from the balls.
Heat lost to the surroundings will be high while transferring the balls. any correct 01

(g) No

(1) Metel power may float in water

(2) Metel power may stick on to the wall of the calorimeter.

(3) During the transfer of metel powder of the calorimeter amount of heat lost from the powder is high because of its high surface area. OR

Temperature of metel powder will be less than 100°C when it is transferred to the calorimeter because of higher cooling rate due to large surface area.

Any correct two 01

03. (a) $V = f\lambda$ and $\lambda = 2l$

$V = 2fl$ 01

(b) $l = \frac{V}{2f}$

$l = \left(\frac{V}{2}\right)\frac{1}{f}$ 01

$y = l$

$x = \frac{1}{f}$

(c) (i) first use the tuning fork with the lowest frequency and check the resonance length.

reason :- To make sure that the wire is long enough to get the resonance lengths for all frequencies.

(ii) Start taking data with the tuning fork with highest frequency

Reason :- To make sure that the fundamental mode of resonance is taken in increasing the resonance length for successively decreasing frequencies.
Correct Answer and reason 01

(d) The smallest tuning fork (Shortest tuning fork) 01

(e) Vibration amplitude is highest at the fundamental mode01

(f) (i) Y axis - l cm

X axis - $\frac{1}{f}$ (H_z^{-1}) or S 01

(ii) (Selecting the two point in graph) 01

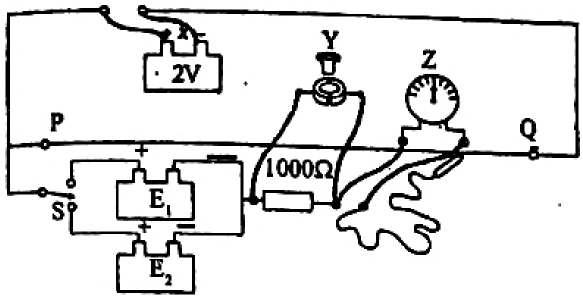
$$m = \frac{0.39 - 0.21}{0.0038 - 0.0021} = \frac{0.18\ ms^{-1}}{0.0017} = 105.88\ ms^{-1}$$

$V = 211.76\ ms^{-1}$

$(210 - 213\ ms^{-1})$

(g) Repeat obtaining the resonance state several times by adjusting the peg and estimate Δl_2
OR by slowly moving the position of the peg within the resonance region and detecting its limits. 01

04.



(a) Connection of the 2V accumulator as shown 01
Connection of the key (Y) and Galvanometer Z 01

(b) E_1 and E_2 < e.m.f x
OR Magnitude of the e.m.f. of x must be greater than E_1 and E_2 OR 2V > E_1 and E_2

(c) No
Reasons :- Wire does not come to stady state OR voltage across the wire can not be kept constant OR Temperature of the wire will vary
Any reason 01

(d) Accumulater will be discharged rapidly OR
E.m.f of the accumulater can not be maintained at 2V OR the potential drop per unit length of the wire will vary OR wire will be heated up excessively.
Any reason 01

(e) (i) Momentarily touch the wire with the jockey and find the approximate balance - point 01
(ii) close the switch y and take the exact balance point 01

(f) $E_1 = kl_1$

$E_2 = kl_2$

$\frac{E_1}{E_2} = \frac{l_1}{l_2}$ 01

(g) Add a resistance box in series with the poteitiometer wire 01

(h) Replace the 2V accumulator with another accumulator (battery) having a larger e.m.f. OR
Connect another accumulator is series with the accumulater.
OR connect another 2V accumulater is series with the first

PART B

01. (i) If x is the displacemant of each brake pad then
$1 \times 0.6 = 2 \times 3 \times x$
$x = 0.1$ cm 01

(ii) (a) Let F be the force on the master piston
$G_A\ 10 \times 20 = F \times 5$
$F = 40N$ 01

(b) Pressure on the Master piston (P) = $F/_A$
$P = \frac{40}{10^{-4}}$
$P = 4 \times 10^5$ Pa 01

(c) Force on a Second piston = PA (F = PA)
$= 4 \times 10^5 \times 3 \times 10^{-4}$
= 120N

(d) Force exerted on the wheel due to a single brake pad.
$F = \mu R$ 01
$= 0.5 \times 120$
$F = 60N$ 01

(iii) Let α be the angular deceleration of the wheel
$\tau = I\alpha$ 01
$2 \times 60 \times 0.05 = 0.1\alpha$ 02
$\alpha = -60$ rads^{-2} 01

Initral angular velocity ω_0 of the wheel.
$\omega_0 = 2\pi f$
$\omega_0 = 2\pi \times \frac{600}{60}$ ($2\pi \times 10$ or 20π or 60π) 01

$\omega = \omega_0 + \alpha t$
$0 = 20\pi - 60t$
$60 + = 20 \times 3$
$t = 1$ S 01

Applying $\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ or $\omega^2 = \omega_0^2 + 2\alpha\theta$ or $\theta = \frac{(\omega + \omega_0)}{2}$
or $\tau\theta = \frac{1}{2} I\omega_0^2$

$\theta = 20\pi \times 1 - \frac{1}{2} \times 60 \times 1$ or $0 = (20\pi)^2 - 2 \times 60\theta$ or $\theta\ \frac{(20\pi \times 0)1}{2}$

OR $6 \times \theta = \frac{1}{2} \times 0.1 \times (60)^2$
$\theta = 30$ rad

Number of revolutions $= \frac{\theta}{2\pi}$
$= \frac{30}{2\pi}$
= 5 revolutions 01

[take $\pi = \frac{22}{7}$, t = 1.05s (1.04 , 1.05) 01

Nuber of revolutions = 5.24 rev
(5.23 - 5.25) 01

02. (i) (a) (1) When focused to infinity, the focal leagth mast be equal to the distance from the lens to the retina.
focal length = 2cm = 0.02m

$P = \frac{1}{f}$

$P = \frac{1}{0.02}$ 01

$P = 50$ D 01

$\frac{1}{V} - \frac{1}{u} = \frac{1}{f}$.

$\frac{-1}{0.02} - \frac{1}{\infty} = \frac{1}{f}$

$f = 0.02$m

$P = \frac{1}{f} = \frac{1}{0.02\,m}$ 01

$P = 50$ D 01

(2) focused to near point
using the lens formula

$\frac{1}{V} - \frac{1}{U} = \frac{1}{f}$ or
$\frac{-1}{0.02} - \frac{1}{0.25} = \frac{1}{f}$ } 10

$\frac{1}{f} = \frac{-27}{0.5}$

$\frac{1}{f} = \frac{-270}{5}$

$P = 54$ D 10

(b) The image is real and 01
inverted 01

(c) For thin lenses in contact $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ | $P = P_1 + P_2$ -01

$50 = 40 + P_2$

When focused to infinity $50 = 40 + \frac{1}{f_{Lens}}$ | $P_2 = 10D$ -01

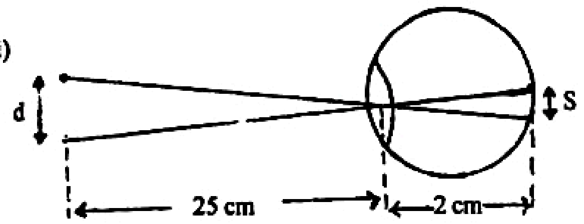
$\frac{1}{f_{Lens}} = 10D$

$P = 10D$

When focused to near point $54 = 40 + \frac{1}{f_{Lens}}$ | $54 = 40 + P_2$

The power of the lens $= 14D$ | $P_2 = 14D$

(ii)



(a) $\frac{S}{d} = \frac{2}{25}$

$S = \frac{2d}{25}$ $S = 0.08\,d$ 01

(b) When $d = 0.08$ mm $S = 0.08 \times 0.08 = 0.0064$ mm
$= 6.4\ \mu m$ 01

This value is lessthan 8μm. Therefore this separation is sufficient 01

(c) for 0.08 mm dot separation the image separation is 0.0064 mm. Using the lens, the image separation must be increased to 0.008mm. Therefore the required magnification is $\frac{0.008\ N}{0.0064}$

$= 1.25$ 01

Using lens formula

$\frac{1}{V} - \frac{1}{u} = -\frac{1}{f}$

$\frac{1}{D} - \frac{1}{u} = -\frac{1}{f}$

$\left(M = \frac{D}{u}\right) = 1 - \frac{D}{u} = \frac{D}{f}$

$M = 1 + \frac{D}{f}$

$125 = 1 + \frac{25}{f}$ 01

$\frac{25}{f} = 0.25$

$f = 100$ cm (1D) 01

03. (i) Compressional stress of the upper arm bone $= \frac{60 \times 10}{\pi(1-0.4^2)10^{-4}}$

young's modulus $= \frac{\text{stress}}{\text{strain}} = \frac{F/A}{e/l}$

Compressional strain $= \frac{600}{\pi(1-0.4^2)10^{-4}} \times \frac{1}{1-4 \times 10^{10}}$

$= 1.6 \times 10^{4}$ 01
(1.60 - 1.63)

Compressoinal strain $= \frac{e}{l}\left(\frac{\text{decrease in tength}}{\text{Intial length}}\right)$ 10

Compressional of the bone $= 1.6 \times 10^{-4} \times 0.3$
$= 4.8 \times 10^{-5}$ m 01
(4.80 - 4.90)

(ii) Elastic energy stored per unit length.

$= \frac{1}{2}$ Stress x strain 01

$= \frac{1}{2} \times \frac{600}{\pi(1-0.4^2)10^{-4}} \times 1.6 \times 10^{-4}$

$= 1.8 \times 10^{2}\ Jm^{-3}$ 01
(1.80 - 1.86)

Energy Stored $= \frac{1}{2}$ force x Compression 01

$= \frac{1}{2} \times 600 \times 4.8 \times 10^{-5}$

Energy sfored per unit volume $= \frac{1}{2} \times \frac{600 \times 4.8 \times 10^{-5}}{\pi(1-0.4^2)10^{-4} \times 0.3}$

$= 1.8 \times 10^{2}\ Jm^{-3}$ 01

(iii) (a) $V^2 = u^2 + 2as$
$V^2 = u^2 + 2gh$

Velocity of B when falls on to A $\left(\sqrt{2 \times 10 \times h} / \sqrt{20h} / 2\sqrt{5h} \text{ or } 4.47\sqrt{h}\right)$

$V^2 = 2gh$

$V = \sqrt{2gh}$

Change in momentum of B after falling on to A

$= \left(\sqrt{2 \times 10 \times h} - 0\right) \times 50$ $\left[\text{or } 100\sqrt{5h} / 223.5\sqrt{h}\right]$

$= 50\sqrt{20h}$ 01

(b) Average force $= \frac{\text{change in momentum}}{\text{time}}$

$F = \frac{\Delta mv}{t}$ or $25 \times 10^{2}\sqrt{20h}$

$= \frac{50\sqrt{20h}}{0.02}$ $\left(5 \times 10^{3}\sqrt{5h} \text{ or } 111.8 \times 10^{2}\sqrt{h}\right)$

(c) maximum stress $= 9 \times 10^{7}\ Nm^{-2}$

Total force on the upper arm bone $=$

$600 + 25 \times 10^{2}\sqrt{2 \times 10 \times h} + 500$ 01

$\left(600 + 5 \times 10^{3}\sqrt{5h}, \text{ or } 600 + 118.8 \times 10^{2}\sqrt{h}\right)$

If h_{max} is maimum height then

$\frac{500 + 600 + 25 \times 10^{2}\sqrt{2 \times 10 h_{max}}}{\pi \times \left(1 - 0.4^2\right)10^{4}} = 9 \times 10^{7}$ 01

$h_{max} = 4.3$ m 01
(4.10 - 4.53)

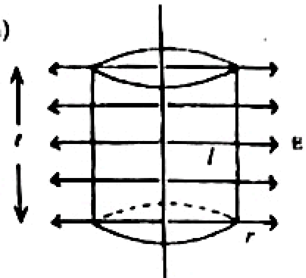
04. (i) Nuclear Medicine
Protein crystallography
Talking detectors in high energy physice
any one 01

(ii) Near the anode wire 01
(iii) Due to the acceleration in the electric field 01
(iv) Three (3) 01
(v) Near the anode wire 01
(vi) Speed of the positive ions is low.
Positive ions are heavier than electrons or lower acceleration.
Any one 01

Positive ions have to travel a longer distance weaker electric field away from the wires.
Any one 01

(vii) Gas used, anode voltage, separation between the cathode plates, separaton between wirrles, diameter or radius of wires.
Any one 01

(viii)



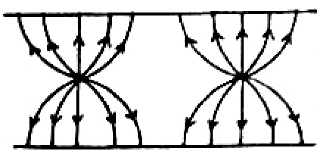
or Consider the cylindrical Gauss surface of length and radius r symmetrically 01

Applying Gouss law $2\pi r l E = \frac{\lambda l}{\varepsilon_0}$

$$E = \frac{\lambda}{2\pi\varepsilon_0 r}$$

(ix) Amplitude of the pulse increase.
reason : More secondary ionizations being produced
OR
More electrons would be collecled by the anode wire
OR stronger electric field closer to the wire. 01

(x)



Correct Shape 01
line perpendicular to the Cathode plate 01
Correct direction of the field with arrows 01

(xi) Energy of outgoing particle $= 100 - \frac{100 \times 30}{1000}$
$= 97 \times 10^3$ or 97keV 01

05. (A) (i) $F = BIl$

$F = \frac{BEl}{R}$ $(I = E/R)$

direction of the force right or ⟶ 01

(ii) (a) $E = Blv$
the back emf $= Blv$ 01
(b) Current through the bar; $i = \frac{E - BlV}{R}$ $(v = E - Blv)$ 01

$F = BIl$
Force on the Bar $= \frac{Bl(E - Blv)}{R}$ 01

Power delivered by the battery (w) $= VI$
$= E\left(\frac{(E - BlV)}{R}\right)$
$= \frac{E^2}{R} - \frac{EBlV}{R}$ 01

(c) Due to the force F, the bar is accelerated, Then because E is constant, the force is decreases. The speed v does not increase after the force becomes Zero OR current becomes Zero
Therefore the maximum speed is reached when
$E = Bvl$

$V = \frac{E}{Bl}$ correct orgument 01

When the speed in maximum current through the bar is Zero 01

(iii) When is S is open and S_2 is closed the only emf present in the system is the induced emf due to the motion of the bar. This emf produces a current which creates a force that opposes the motion of the bar. Therefore, the bar is decelorated. 01

The kinetic energy is converted to heat the induced current flows through the resistance of the bar OR through I^2R type heating OR through Joule heating. 01

(iv) (a) Maximum speed is given by $v = \frac{E}{Bl}$ $(E = Blv)$

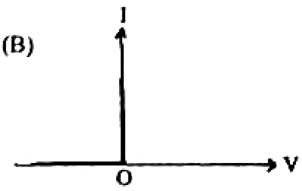
required E is given by $= 2 \times 10 \times 100$ $(E = Blv)$
$= 2000V$ 01

(b) The initial acceleation $= \frac{BlE}{mR}$

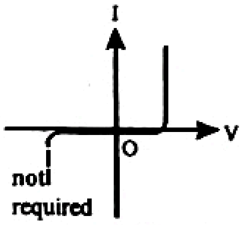
$$\begin{bmatrix} F & = ma \\ BIl & = ma \\ a & = \frac{BEl}{R} \end{bmatrix} \quad a = \frac{BEl}{mR} \quad a = \frac{2 \times 10 \times 2000}{20000 \times 10}$$ 01

$a = 0.02\ ms^{-2}$ 01

05. (B)



01



01

not labled in both diagrams deduct 1 mark

(i) When forward biased
Peak currend (i_D)
V $= IR$
$10 - 0.7 = 1 \times 10^3 I_D$

$I_D = \frac{9.3}{10^3}$ 01

$I_D = 9.3 \times 10^{-3}$ A (9.3mA) 01

When reverse biased peark current of $I_D = 0$ 01

(ii)

V_A (V)	V_B (V)	V_o (V)	logic level
0	0	0	0
0	5	4.3	1
5	0	4.3	1
5	5	4.3	1

Correct V_o column 01
Correct logic level Column 01

(iii) $V_A = 5V$ and $V_B = 3V$

$$I_{R_L} = \frac{5 - 0.7}{1 \times 10^3}$$

$= 4.3\ A\ (4.3 \times 10^{-3}A)$ 01

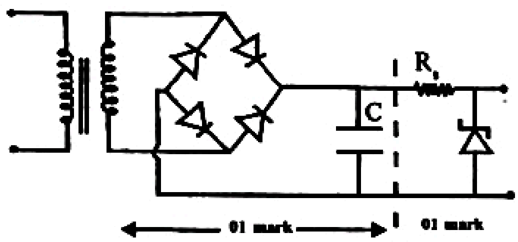
(iv) (1) (a) When ac power is present upperdiode is forward based and its cathode will be at 14.3 v which makes lower diode reverse biased 01
Clock will have 14.3V at its supply input and function normally 01

(b) When ac power fails, lower diode becomes forward biased and upper diode becomes reversed biased. 01

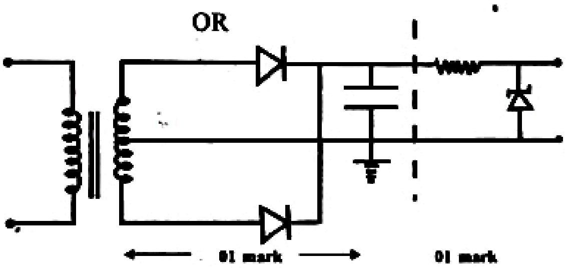
∴ Clock will bave 11.3v at its supply input and continue to function normally 01

(2) When ac power is present the lower diode is reverse biased and therefore current drawn from the 12v supply is zero. 01

(v)



OR



06. (A) (i) At the steady state, rate of heat how through the upper plate $= 50w$ 01

Applying $\overset{\circ}{Q} = kA\ \frac{(\theta_1 - \theta_2)}{d}$ 01

$$50 = \frac{k \times 2 \times 10^{-4} \times (100 - 98)}{2 \times 10^{-3}}$$

$K = 250 Wm^{-1}k^{-1}$ 02
(Corret unit 01 mark)

(ii) (a) $\overset{\circ}{Q} = KA\ (\theta_1 - \theta_2 / d)$

$50 = \frac{250 \times 2 \times 10^{-4} \times (40 - \theta)}{2 \times 10^{-3}}$ 01

$\theta = 38\ ^\circ C$ 01

(b) From Newton's low of cooling rate of heat loss

$\overset{\circ}{Q}\ \alpha\ A (\theta - \theta_R)$ 01
$50\ \alpha\ A \times (38 - 30)$ Ⓐ 01
$50\ \alpha\ 2 \times 10^{-4} (98 - 30)$ Ⓑ 02
From the above proportionalities

Ⓐ/Ⓑ $1 = \frac{A \times 8}{2 \times 10^{-4} \times 68}$

$A = \frac{2 \times 10^{-4} \times 68}{8}$ 01

$A = 17 \times 10^{-4}\ m^2$ 01

(c) Rate of heat absorbed by water $= ms\theta = m \times s \times (35 - 30)$

$50 = m \times 4.2 \times 10^3 \times 5$ 01

$m = 2.3 \times 10^{-3}\ kgs^{-1}$ 01

$= (2.3 - 2.4)$

06. (B) (i) Energy of the incident x - ray photon $= \frac{hc}{\lambda}$

Energy of the incident x - ray photon $= \phi_1$

$$\phi_1 = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{2.2 \times 10^{-10}}$$

$\phi_1 = 9 \times 10^{-16} J$ 01

(ii) (a) Apply the photo - electric equation

$\phi_1 - \phi_2 = E_k$

$9 \times 10^{-16} - \phi_2 = 6 \times 10^{-16}$ 01

$\phi_2 = 3 \times 10^{-16} J$ 01

(b) $\phi_2 = \frac{hc}{\lambda}$

$\lambda = \frac{hc}{\phi_2}$

$\lambda = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{6 \times 10^{-16}}$

$\lambda = 6.6 \times 10^{-10} m\ (6.6\ ^\circ A)$ 01

(iii) $\phi_1 - \phi_2 = 9 \times 10^{-16} - 3 \times 10^{-16}$ 01
(Award the mark for taking the difference)

$\lambda = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{6 \times 10^{-16}}$

$\lambda = 3.3 \times 10^{-10} m\ (3.3\ ^\circ A)$ 01

(iv) (a) $P = E/C = \frac{9 \times 10^{-16}}{3 \times 10^8}$

$= 3 \times 10^{-24}\ kgms^{-1}\ (Jms^{-1})$
(01 mark for the unit)

(b) Let V be the Speed of the recoiling atom then

$P = mV$

$3 \times 10^{-24} = 6 \times 10^{-26}\ V$ 01

$V = 50 ms^{-1}$ 01

(c) Kinetic energy of the atom $= \frac{1}{2} mV^2$

$= \frac{1}{2} \times 6 \times 10^{-26} \times 50^2$

$= 7.5 \times 10^{-23}\ J$ 01

(d) Kinetic energy as a fraction $= \frac{7.5 \times 10^{-23}}{9 \times 10^{-16}}$

$= 8.3 \times 10^{-8}\ (8.0 - 8 - 4)$ or

indicatmg that 10^{-23} is very small compared to 10^{-16} 01

∴ the kinetic energy of the recoiling atom is negligibly small compared to the energy of the incident X - ray photon.