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Mark Scheme (Results)
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GCE O Level

GCE O level Physics (7540/02)

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Notes on the mark schemes

Abbreviations used in the scheme

UP	unit penalty
TE	transmits the error
OWTTE	or words to that effect
SF	significant figures
SFP	significant figure penalty
MAX	maximium
dop	dependent on previous

7540 Paper 02

1.	(a)(i)	**momentum**	5.0 x 6.2	**1**
			= 31 kg m/s or Ns **UP**	**1**
			accept the following units : $kgms^{-1}$ Ns correct answer with unit but no working scores both marks	
	(ii)	**g.p.e.**	5.0 x 10 x 3.2 or 5.0 x 9.81 x 3.2	**1**
			= 160 J or 0.160 kJ **UP** or 156.96 J (160Nm/16000 ncm 156.96 Nm) correct answer with unit but no working scores both marks	**1**
	(iii)	**kinetic energy**	= ½ x 5.0 x $(6.2)^2$	**1**
			= 96.1 J /96 J **UP**	**1**
			accept the following units where appropriate in (ii) and (iii) : j kj Kj KJ Nm Ncm nm ncm correct answer with unit but no working scores both marks	
				6 marks
	(b)(i)	**CoG**	point /position/ place at which/where (all) the weight/pull of	**1**
			gravity/mass (appears to) act(s) Independent marks	**1**
	(ii)		backwards	**1**
			downwards/ towards the legs/lower independent marks	**1**
				4 marks

(c)(i)	**labelled diagram showing**	two trolleys (on line or something) pin and cork/magnets/Velcro balance light gates/ticker tape timer and tape (at least one label) (friction compensated) runway / ramp / downwards plane **apply scheme strictly for recoil** **1 mark each for any 3 correct**	**(1)** **(1)** **(1)** **(1)** **(1)** **max 3 marks**
(ii)	**measurement**	1 mass of trolley 1 2 mass of trolley 2 /mass of both trolleys mass of each trolley scores both mass marks 3 speed/velocity /appropriate distance before collision 4 speed/velocity /appropriate distance after **1 mark each for any 3 correct points**	**1** **1** **1** **1** **max 3 marks**
(iii)	**method**	(Tilt runway to) compensate for friction Move first trolley at constant speed/short push start ticker timer collide with second stationary trolley connects/sticks to second trolley **1 mark each for any 3 correct**	**1** **1** **1** **1** **max 3 marks**
(iv)	**calculation**	$(mv)_{\text{before}} = (mv)_{\text{after}}$ or $m_1v_1=m_2v_2$ or mass of trolley 1 before x velocity before = mass of combined trolleys x velocity after Accept $m_1u_1 + m_2u_2 = (m_{1+}m_{2)}v_{(2)}$ or $m_1u_1 + m_2u_2 = m_1 v_{(2)+}m_2 v_{(2)}$ but not $m_1u_1 + m_2u_2 = m_1 v_{(1)+}m_2 v_{(2)}$ ie speed after must be the same Do not accept $m^1u^1 + m^2u^2 = (m^1{}_+ m^2{}_)v(^2)$ ie powers anywhere OR momentum before = momentum after	**1 mark**

(Total 20 marks)

2.	(a)(i)	**water**	decreases from -20ºC	**(1)**
			increases at 0ºC	**(1)**
			increases to 4ºC (dependent on mark 1)	**(1)**
			decreases from 4ºC to 100ºC	**(1)**
			decreases at 100ºC	**(1)**
			1 mark each for any 3 correct	**max 3**
			If no mention of temperature allow 1 mark for Decrease then increase then decrease	
	(ii)	**Liquid A**	The mark is for a description of a line which decreases, qualified by a word or phrase which clearly indicates that it is a straight line graph	
			decreases continuously decreases steadily decreases uniformly decreases constantly decreases as a straight diagonal line decreases proportional(y) (to temperature)	**1**
			do not accept decreases gradually or inversely proportional	
				4 marks
	(b)(i)	**atmospheric pressure**	Y <u>and</u> Z both required in either order	**1**
	(ii)	**pressure**	= 0.2 x 1000 x 10 or 0.2 x 1000 x 9.8	**1**
			= 2000 Pa / 2000 N/m^2 2kPa 2 kN/m^2 **UP** (1960 or 1962 for 9.8 or 9.81)	**1**
	(iii)	**pressure at X**	100 000 – 2 000 apply **ecf if working is shown eg 100 000 – candidates value**	**1** **1**
			= 98 000 Pa or N/m^2 or 98 kPa or kN/m^2	
	(iv)	**mass**	V = 0.20 x 0.00005	**1**
			= 0.00001	**1**
			mass = density x V = 1000 x 0.00001	**1**
			= 0.01 kg **UP**	**1**
			OR allow	
			Force = 2000 x 0.00005	**1**
			= 0.1 (N) (**UP** if 0.1 kg given as final answer)	**1**
			mass = 0.1 / 10	**1**
			= 0.01 kg **UP**	**1**
				9 marks

(c)(i) **explain**

$h_A > h_{water}$ Or $h_{water} < h_A$ **1**

$(h\rho g)_{water} = (h\rho g)_A$ or same pressure on both **1**

hence $\rho_{water} > \rho_A$ **or** $\rho_A < \rho_{water}$ **dop** **1**

(ii) **value**

use measurements from diagram **1**

h_W = 12.5 to 13.5 mm h_A = 16.5 to 17.5 mm

value within acceptable range 714 to 818 kg/m^3 NO **UP**

	H_A	H_A	H_A
H_W	16.5	17	17.5
12.5	758	735	714
13	788	765	743
13.5	818	794	771

1

(iii) **difficult**

water has meniscus/curved surface/shorter length/ liquid A has flat surface **1**

(iv) **temperature**

density varies/changes with temperature **1**

7 marks

(Total 20 marks)

3 (a) (i) Candidates may give :

speed/velocity changes or decreases gains 1 mark **1**
speed/velocity <u>increases</u> (in air) gains both marks **2**

max 2 marks

(ii)
Candidates may give :

1.35 = sin (angle)/sin 45 **1**
sin (angle) = 1.35 x .707 **1**
angle = 72.6679^0/72.668^0/72.67^0/72.7^0/ 73^0 **1**
allow 72.64 if working shown

(Correctly rounded number from list without working scores all three marks. Award marks if ^{0} is omitted)

max 3 marks

5 marks

(b) (i) Candidates may give one point from:

light incident/hits/falls normally (to surface) or
perpendicular (to surface) or
at right angles (to surface)

1

max one mark

(ii)
Candidates may give one point from:

speed/velocity changes or
speed/velocity decreases or
wavelength changes or
wavelength decreases

max one mark **1**

(iii)
Candidates may give :

1. (light) reflected
2. angle (of incidence) is greater than critical (angle)
3. Total internal reflection (full phrase scores two marks on its own but watch for total internal refraction which does not score)

One mark for each of points 1 and 2; max 2 marks

(iv)
Candidates may draw :

a ray reflected at angle of 45^0 (by eye or marked 45^0) **1**

the ray then passing through the curved face without change of direction. **1**

Max 2 marks

(v)
Candidates may give :

sin (C) = 1/1.6 or 1.6 = 1/sin(C) or 1.6 = Sin 90/sin(C) **1**
accept 1.6 = sin 89/sin C **1**
(Sin (C))= 0.625 **1**
C(ritical angle) = 39^0/38.7^0 /38.68^0/38.682^0

(Correctly rounded number from list on its own without working scores all three marks. Award marks if ^{0} is omitted)

(vi)
Candidates may give :

$1.6 = 3 \times 10^8$/ speed in glass **1**
speed in glass = $3 \times 10^8/1.6$ **1**
= 1.9×10^8/1.88×10^8/1.875×10^8 m/s unit required **1**
or 190 000 000m/s or 188 000 000m/s or 187 500 000 m/s
(please check for correct number of zeroes)
(Correctly rounded number from list on its own without working scores all three marks. Do not award final mark if unit is omitted)

12 marks

(c)
Candidates may give :

1. speed of light in water less than air/ more than glass
2. Refractive index of water is > refractive index of air
3. change of speed smaller
4. critical angle larger (than 45)/angle of incidence less than critical angle

One mark for each point max 3

(Total 20 marks)

4 (a)(i) (a) Candidates may give :

1. when an object is forced/made/caused to vibrate **1**
2. (by another object vibrating) at its <u>natural frequency</u> dependent on mark 1 **1**

max 2 marks

(iii)
Candidates may give :

(membrane vibrates with a) large(r)/great(er) amplitude/displacement **1**

large amplitude/displacement gives loud(er) sound/amplitude is proportional to loudness/depends on amplitude **1**

max 2 marks

4 marks

(b) (i) Candidates may draw a graph with:

1. the correct orientation and scale 2cm=5mm on x axis and 2cm =10mm on y axis **1**
2. labels and units (Minimum wavelength /mm and length/mm) **1**
3. points plotted to within 1 mm in each direction (deduct one mark for each incorrect plot or plot not visible) **2**
4. single, straight line though most points **1**

(linear scale with values placed on either axis at equal intervals scores mark 2 only)

max 5 marks

(ii) Candidates may give :

line across and/or down <u>on candidate's graph</u> (at 20mm) **1**

value given between 37.0 and 38.5 mm (unit required) **1**

max 2 marks

7 marks

(c) Candidates may give :

5.3 x 1000 (correct conversion from kHz to Hz)

=340/339/339.2 m/s
(Correctly rounded number from list on its own without working scores all three marks. Do not award final mark if unit is omitted)

0.340/0.339/0.3392 m/s scores marks 2 and 3
incorrect conversion eg 5.3/1000 x.064 scores second mark only

(d)

(i) Candidates may give :

same/equal/unchanged pitch **or** no effect on pitch **1**

larger/greater/longer wavelength **1**

(ii) Candidates may give :

pitch depends on /proportional to/varies with frequency **1**
frequency unchanged/same/ still 5300 Hz **1**

(give marks for either point independently)

use of wavelength= speed/frequency or speed = frequency x wavelength **1**
speed larger (this mark dependent on previous) **1**

max 4 marks

9 marks

(Total 20 marks)

5 (a) (i)

Candidates may give :

1. weight/ pull of gravity/ force of gravity/ pull of earth (not gravity)
2. upthrust
3. (oil) friction/fluid drag force/viscous force

one mark for each of any two points max 2

(ii) Candidates may give :

one axis labelled speed/velocity and (steep) line up at start

line curving or bending away from speed axis and becoming parallel to (other) time/distance/unlabelled axis by eye

4 marks

(b) (i) Candidates may give :

1. ruler/metre rule/ tape measure/centimetre scale/metre scale/distance measuring scale **1** **1**
2. stopclock/ stopwatch/ electronic timer/ light gates/multiflash camera **1**
3. balance /top pan balance /beam balance /spring balance /electronic balance /weighing scales/ newtonmeter/Newton scales
   do not accept weight measurer or weighing machine

max 3 marks

(ii) Candidates may give :

change size or diameter or radius or metal or density
accept different metal spheres
do not accept attaching weights or pushing down or just spheres of different weight or mass **1**

max one mark

(iii) Candidates may give :

1. Weigh/ find mass/weight of sphere
2. measure distance between marks
3. release/drop sphere
4. Start timer as sphere passes (upper) mark/start multiflash camera
5. stop timer as sphere passes (lower) mark or measure time (for sphere to fall between marks or from top to bottom)
6. Repeat once with a sphere of different mass/weight
7. Repeat with at least three/several masses/ at least a third mass
8. Use equation speed = distance/time

repeat with different masses scores marks 6 and 7

one mark for each of any six points max 6

marks 6, 7 and 8 could be in a table

(iv) Candidates may give :

1. repeat measurements for each mass/ repeat whole experiment
2. average (repeated) measurements for each (mass)

max 2 marks

(c) Candidates may give two responses from the following pairs:
temperature
higher temp will fall faster/lower will fall slower

or
thickness of oil/type of oil/ viscosity of oil/density of oil
thicker will fall slower/ thinner will fall faster

or
density of metal
denser will fall faster/ less dense will fall more slowly

or
size/area of sphere/diameter/radius
larger area falls slower

Any two pairs – 1 mark for a correct factor
1 mark for correct corresponding effect

(Total 20 marks)

TOTAL FOR PAPER 100 MARKS