

2024 AHS S4 Physics Prelim Exam

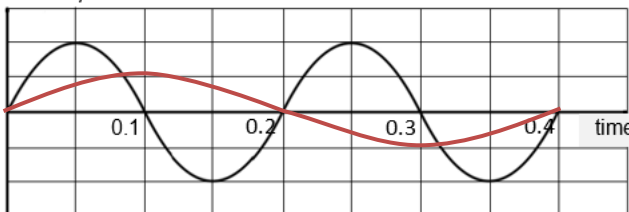
Paper 1 Answers

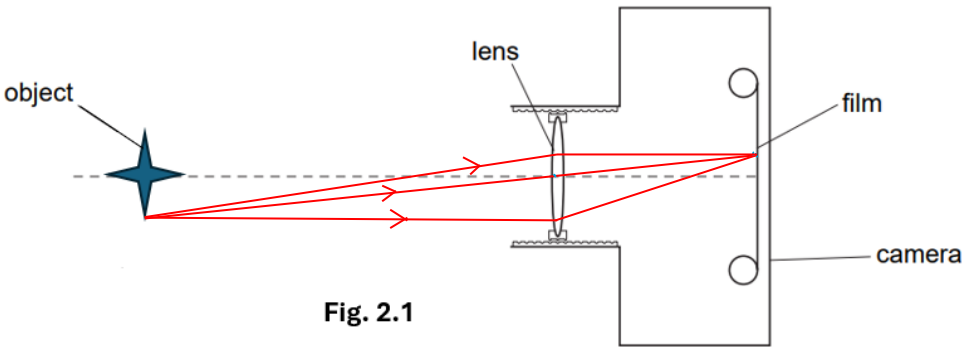
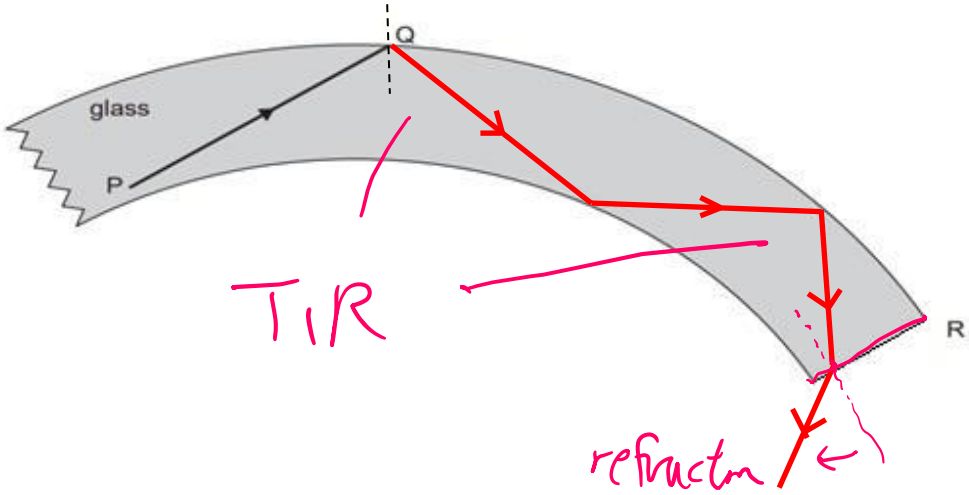
1	2	3	4	5	6	7	8	9	10
C	A	D	B	D	C	D	B	B	C
11	12	13	14	15	16	17	18	19	20
A	B	A	C	D	A	D	C	C	D
21	22	23	24	25	26	27	28	29	30
A	D	D	D	C	B	A	C	C	D
31	32	33	34	35	36	37	38	39	40
C	A	B	B	B	A	B	A	C	B

Paper 2 Answers

1(a)	Speed is a physical quantity with only <u>magnitude</u> but velocity is a physical quantity with both <u>magnitude and direction</u> . OR Speed is a <u>scalar</u> quantity. Velocity is a <u>vector</u> quantity.	1
(bi)	change in speed = $25 - 22 = 3.0 \text{ m / s}$	1
(bii)	change in velocity = $25 - (-22) = 47 \text{ m / s}$ or $-22 - 25 = -47 \text{ m / s}$	1
(ci)	average acceleration = change in velocity / time $= 47 / 0.0013 = 36200 \text{ m / s}^2$ (3 s.f.) or $36\,000 \text{ m / s}^2$ (2 s.f.) [accept ECF from (b)]	1
(cii)	average force = mass x acceleration OR $= 0.16 \times 36\,000$ $= 5760 \text{ N}$ (3 s.f.) or 5800 N (2 s.f.) accept ECF from (ci)]	1 1
2(a)	Force acting on each cylinder $F = 800 / 4 = 200 \text{ N}$ Pressure increase = F / A OR $= 200 / 0.0035$ or $800 / (4 \times 0.0035)$ $= 57100 \text{ Pa}$ (3 s.f.) or 57000 Pa (2 s.f.) [Award 1m for method even if area is converted wrongly / Eg. 35 cm^2 is wrongly converted to 0.35 m^2]	1 1
(b)	The continuous <u>bombardment</u> / <u>collision</u> of air molecules on the cylinder wall <u>exerts a force</u> (per unit area) on the cylinder wall.	1
(c)	The gas molecules <u>gain kinetic energy</u> / <u>move faster</u> . This causes the molecules to bombard on the cylinder wall <u>more frequently</u> with and <u>more forcefully</u> and hence there is a <u>greater (average) force per unit area</u> on the cylinder wall. Therefore, the gas pressure increases. 4 points – 2 marks, 1-3 points – 1 mark, otherwise 0 mark	2

3(a)	Work done is the <u>product of force and distance</u> moved by the object <u>in the direction of the force</u> .	1 1
(bi)	Gain in GPE = mgh OR $= 0.15 \times 10 \times (10 - 2.0)$ $= 12 \text{ J}$	1 1
(bii)	Show understanding that $E_k = \frac{1}{2} mv^2$ Total energy at B = $12 + 170 = 182 \text{ J}$ Total energy at A = KE of the ball = total energy at B $\frac{1}{2} mv^2 = 182$ $v = \sqrt{\frac{182 \times 2}{0.15}}$ $= 49.3 \text{ m / s (3 s.f.) or } 49 \text{ m / s (2 s.f.)}$	1 1
(c)	Mechanically	1

4(a)	The (wall) <u>molecules / particles</u> (reject air / sound molecules) <u>vibrate about their equilibrium (fixed) positions / oscillates</u> and <u>collide / pass on their (kinetic) energy</u> to their neighbouring molecules. (3 points – 2m, 1 to 2 points – 1m, Otherwise 0)	
(bi)	wavelength = 100 cm	1
(bii)	period $T = 0.2 \text{ ms}$ frequency $f = 1 / T$ $= 1 / 0.2 \times 10^{-3}$ $= 5000 \text{ Hz}$	1
(biii)	$v = f\lambda = 5000 \times 1.0 = 5000 \text{ m / s}$ OR: $v = \lambda / T = 1.0 / 0.2 \times 10^{-3} = 5000 \text{ m / s}$ (allow ecf)	1
(c)	displacement / cm  time / ms. Fig. 4.2 [1m for correct amplitude / 1m for correct period]	2

5(ai)	 Fig. 2.1 Any two of the three rays. [1m for each ray / minus 1m for no arrow and <u>not from bottom</u>]	
(aii)	move lens towards object / to left / away from the film / (forward)	1
(bi)	 Can be just one or two TIR (at least one with $i = r$ approximately) Correct refracted ray from end R - bends away from the normal [1] [minus 1 m for no arrow, must draw at least one arrow]	1 1
(bii)	Total internal reflection is the <u>complete / total reflection</u> of a light ray in an <u>optically denser medium</u> at the boundary with an <u>optically less dense medium</u> .	1
(biii)	$\sin c = 1 / n$ OR $n = 1 / \sin 42^\circ$ $= 1.5$ $c / v = 1.5$ $v = 3.0 \times 10^8 / 1.5 = 2.0 \times 10^8 \text{ m / s}$	1 1
6(a)	<u>Negative charges are induced</u> on the gate / <u>electrons</u> (from the ground) <u>are attracted</u> to the paint particles Since <u>unlike charges attract</u> , the positively charged droplets are attracted to the gate.	1 1
(b)	More even coating	1 1

	since the droplets are positively charged, they <u>repel each other/like charges repel</u>. OR less wastage since the droplets and the gate are oppositely charged and <u>unlike charges attract</u>. OR The entire gate will be coated with paint Since the entire gate will be induced with negative charges and <u>unlike charges attract</u>. Reject: paint will stick better / longer paint or will not peel off because of attraction of opposite charges.	1 1
(c)	Non-conductive materials <u>do not induce charges / induction cannot occur</u> as they have <u>no free electrons/electrons cannot flow freely</u>. So the positively-charged droplets will not be able to attract to the non-conductive materials.	1 1

7(a)	 Fig. 7.1 - correct positions of switches - parallel connection - correct symbols for lamp - correct symbol for switch 4 correct = 2 m, 2 to 3 correct = 1 m, otherwise = 0)	2
(bi)	Current $I = 1.4 + 1.4 = 2.8 \text{ A}$	1
(bii)	P.d. $V = 240 \text{ V}$	1
(biii)	Fuse rating = 3A, 4A or 5A	1
(c)	Because the <u>p.d. across each lamp remains constant</u> when connected in parallel.	1

8(a)	<u>Describe</u> - coil/cone moves left to right / back and forth / oscillates/vibrates / in and out. <u>Explain</u>	1
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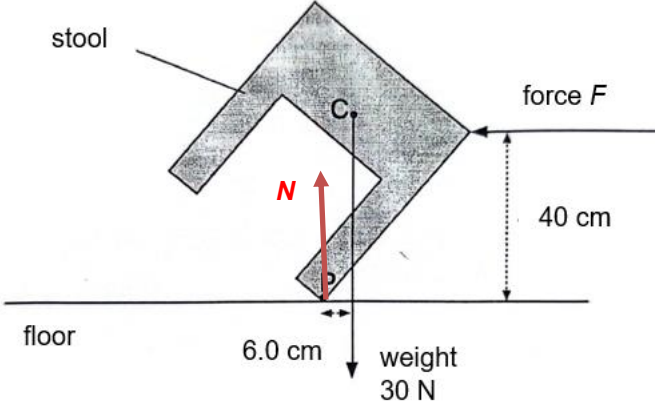
	- current in the coil produces magnetic field / current in magnetic field produces force/Like poles repel and unlike poles attract/ by right hand grip rule - poles of the coil change when current changes direction - force exerted by magnet oscillates/alternates/ attractive and repulsive. [Any two out of three]	2
(b)	- volume decreases/quieter/less sound [1]. - resistance between S and C decreases. p.d. across loudspeaker reduces. (give one mark if student interpreted as 'moved to C'.)	1 1

9(a)	<i>specific heat capacity</i> of a material is the <u>change of its internal energy per unit mass</u> for <u>each unit change in its temperature</u>. accept heat / thermal energy/energy instead of internal energy accept increase / decrease instead of change accept '1 kg or 1 g' instead of unit mass but reject if only mention 1 kg accept 1°C instead of unit change in temperature	1
(bi)	White surface is a <u>poor emitter of radiation</u>. (accept absorber) The insulation is a <u>thermal insulator</u> / <u>poor thermal conductor</u>. These reduce the <u>rate</u> of energy transfer from the <u>water to the surrounding</u>	1 1 1
(bii)	Energy transferred to water in heater B = 0.90 x energy transferred from heating element $Q = 0.90 \times Pt$ OR $= 0.90 \times 4000 \times 15 \times 60$ $= 3240000 \text{ J (3 s.f.) or } 3200000 \text{ J (2 s.f.)}$	1 1
(biii)	$Q = mc\Delta\theta$ OR $3240000 = 20 \times 4200 \times (T - 15) \quad \text{OR: } 3200000 = 20 \times 4200 \times (T - 15)$ $T = 53.6^\circ\text{C (3 s.f.) or } 54^\circ\text{C (2 s.f.)} \quad T = 53^\circ\text{C}$	1 1
(biv)	$Q = 3240000 / 0.70 \quad \text{OR } Q = 3200000 / 0.70$ $= 4630000 \text{ J (3 s.f.)} \quad = 4570000 \text{ J (3 s.f.)}$ $\text{or } 4600000 \text{ J (2 s.f.)} \quad \text{or } 4600000 \text{ J (2 s.f.)}$	1 1

10 (ai)	Nuclear decay is a random process by which an unstable atomic <u>nucleus</u> [1] loses its energy by <u>emission of electromagnetic radiation or particle(s) / nuclear radiation</u> [1].	2
(aii)	Background Radiation refers to nuclear radiation in an environment where <u>no radioactive source</u> has been deliberately introduced.	1
(aiii)	Number of half-lives = $12 / 6 = 2$ [1] Count rate due to source alone = $838 - 18 = 820$ $820 \times (1/2)^2 = 205$ counts / minute OR	1 1

	820 → 410 → 205 [1] [award method mark even if number of half-lives or initial count rate are calculated wrongly] (Reject Becquerel which is count/second.)	
(bi)	Proton number $X = 83 + 1$ $= 84$ ${}_{83}^{14}A \rightarrow {}_{-1}^0e + {}_{84}^{14}B$	1 1
(bii)	Alpha-particle Helium nucleus is emitted such that <u>2 protons and 2 neutrons</u> are emitted. Therefore nucleon number decreases by 4 and proton number decreases by 2.	1 1
(biii)	Atom A and C have <u>different proton numbers</u> . OR Atom A and C <u>do not have the same number of protons</u> .	1

11(a)	<table border="1"> <tr> <td>Visible light</td><td>Microwaves</td><td>Radio waves</td></tr> </table> - 1m for all correct components - 1m for correct order [Award 1m for correct order even though the components are named wrongly / Eg. Gamma ray / X-ray / ultraviolet]	Visible light	Microwaves	Radio waves	2
Visible light	Microwaves	Radio waves			
(b)	- Earth wire is connected to the metal casing. - If live wire touches case or case becomes live, earth wire will draw the large current. OR: A person touching the casing is protected from electric shock because earthing provides a lower resistance path for the current to flow. - Fuse will be blown due to the large current and disconnect the circuit and the person will not get electric shock.	1 1 1			
(ci)	$P = VI$ OR $= 230 \times 8.3$ $= 1910 \text{ W (3 s.f.) or } 1900 \text{ W (2 s.f.)}$	1 1			
(cii)	Cost = $1.91 \text{ kW} \times 20/60 \text{ h} \times \0.30 $= \$0.19$	1 1			
(ciii)	Voltage is halved. According to $P = V^2 / R$ [1], power <u>reduces by 4 times</u> [1] since resistance is a constant. OR Current is halved. According to $P = I^2 R$ [1], power <u>reduces by 4 times</u> [1] since resistance is a constant. OR $P = VI$, when V is halved, current is also halved. So <u>power is one quarter</u> of the original power.	2			

12(a)	The principle of moments states that when a body is in <u>equilibrium</u> , the <u>sum of the clockwise moments about a pivot</u> is equal to the <u>sum of the anticlockwise moments about the same pivot</u> .	1 1
(bi)	 (accept N as friction acting horizontally to the right)	1
(bii)	For equilibrium, anticlockwise moment = clockwise moment $F \times 40 = 30 \times 6.0$ $F = 4.5 \text{ N}$	1 1
(biii)	$N = 30 \text{ N}$ (or $N = F$ if N is friction)	1
(biv)	Any 2 of the 3 main points: - <i>Direction:</i> N is a <u>normal</u> force OR N is <u>perpendicular to the floor</u> surface / <u>opposite to the weight</u>. - <i>Objects involved:</i> It is the force exerted <u>by the floor on the stool</u>. - <i>Nature:</i> N is a <u>contact force</u>. ('same size as weight' - no credit as credit has already been given in (biii))	2
(c)	The <u>clockwise moment of the weight</u> about pivot P causes the stool to topple. OR: there is no more anticlockwise moment to balance the clockwise moment OR: clockwise moment greater than anticlockwise moment This is due to the <u>line of action of the weight acting on the right side of the pivot</u> <u>P</u>	1 1