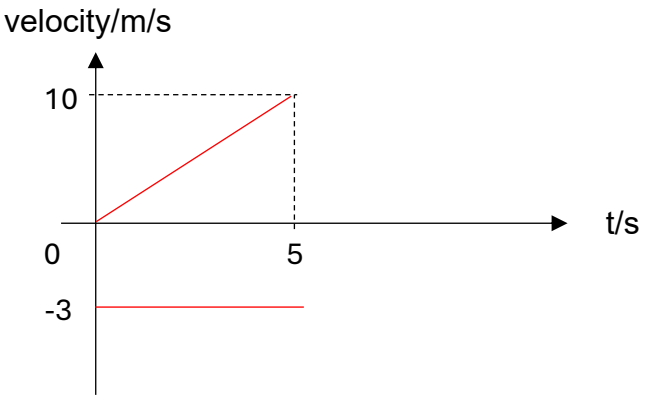
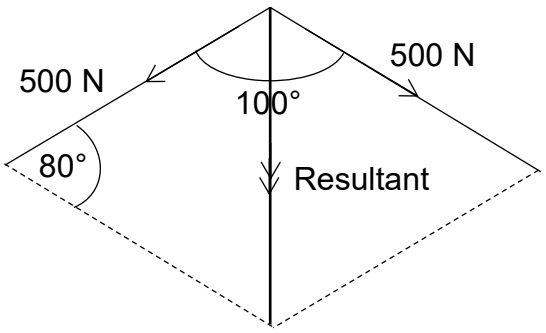
2024 Prelim Pure Physics 4 Exp Answer

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

1a	Speed increases uniformly by 2.0 m/s every second. OR For every 1s, the speed increases uniformly by 2.0 m/s. **Comments:** Responses are often not precise. Should not just repeat what's already given in the question e.g. rate of 2.0 m/s^2.	[1]
1b	 **Fig 2.1** Car A – Straight line starting from 0 with a constant gradient (+value) [1] Car B – Horizontal line (-value) [1] Relevant numerical values for both car A (10 m/s at 5 s mark) and B (at - 3.0 m/s) [1] **Comment:** Car B travels in the opposite direction of Car A, hence Car B's v-t graph will be negative.	[3]
1c	From v = u + at, v = 0 + 2t v = 2t Hence, distance = area under the v-t graph distance = ½ (t)(2.0t) t^2 = 1000 t = 31.6 s (no ecf) **Comment:** Only a few students managed to solve this question.	[1] [1]

2a	 Correct magnitude of tensions, and directions of tensions and resultant [1] Correct angle between tensions when arranged head to tail (80°) [1] Correct magnitude of resultant (accept 640 to 660 N), and there should be no doubt that the drawn vector is a resultant e.g. double arrows or labelled accordingly [1] **Comment:** There is a tendency for students to change the directions of the given vectors. Please note only the position of a vector can be shifted, its direction cannot be changed!	[3]
2b	Gravitational force of (by) balloon acting on the Earth. **Comment:** The type of force is often not stated.	[1]
3a	For a body in equilibrium, the sum of clockwise moments about a pivot is equal to the sum of anti-clockwise moment about the same pivot. (No mark if pivot is not mentioned)	[1]
3b	Taking moments point P, F x 0.1 = 1.8 x 0.02 F = 0.36 N	 [1] [1]
4a	Particles of liquids are held together by <u>relatively strong intermolecular force</u>, and are <u>slightly less closely packed than that of solids</u>. Thus, with small intermolecular distance, there is little space for liquids to be compressed. **Comment:** No credit if the arrangement of liquid particles is described as that for solids e.g. 'very' closely packed, 'orderly' arranged.	[1] [1]

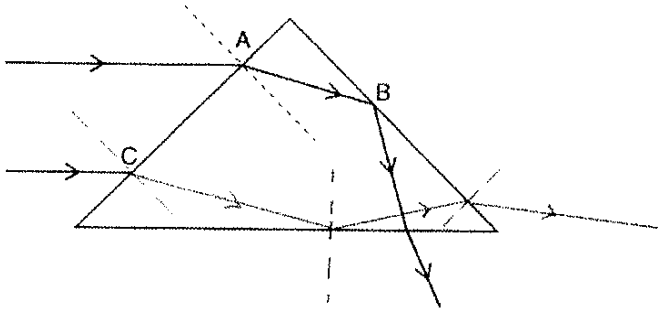
4b	Since pressure is transmitted equally, $\frac{F_A}{A_A} = \frac{F_B}{A_B}$ $\frac{30}{0.010} = \frac{F_B}{0.50}$ $F_B = \frac{30}{0.010} \times 0.50 = 1500\ N$	[1] [1]
4c	Since volume displaced is the same, 200 x 0.010 = *d* x 0.50 *d* = 4.0 mm OR by equating work done	[1]
5a	P_{atm} =(160 – 44 – 30 cm) = 86 cm Hg **Comment:** Not so well done. A few also didn't read the question carefully and gave answers in Pascal.	[1]
5b	P = hρg 86 cm Hg = (0.86 m)(13600)(10) = 116960 = 117000 Pa **Comment:** Common errors include not converting 86 cm to m, and not rounding the final answer to the appropriate s.f.	[1] [1]
5c	Atmospheric pressure decreases (with increase in altitude).	[1]
5d	Gas molecules move continuously and randomly, colliding with the walls of the container and the liquid surface of the mercury column. There is an average force exerted by the gas molecules per unit area / frequent collision of particles with liquid surface, causing a gas pressure to be exerted on the surface of mercury column, causing it to decrease in height. **Comment:** Students need to answer to the context of the question, i.e. using ideas about molecules.	[1] [1]

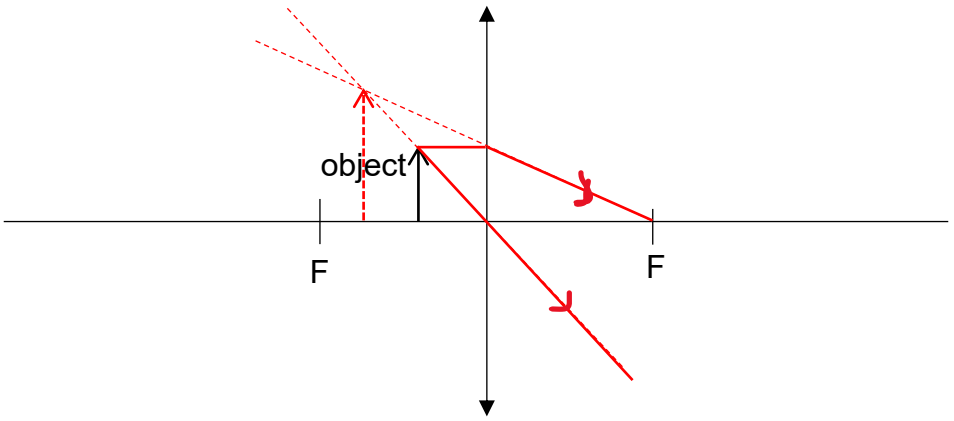
6a	Water that is heated by the heating element will expand, become less dense and rise up [1] Cooler water at the top will sink due to a higher density [1] so that it can gain heat from the heater. This is to set up convection currents to heat the water effectively [1]. **Comment:** Quite well done. Missing word "expand"	[3]
b	The layer of air trapped between the double walls reduces energy transfer via conduction since air is a poor thermal conductor.[1] The silvery surface of the double walls is a poor emitter of infrared radiation, reduces energy transfer through radiation.[1] **Comment:** Many still using the term "poor conductor of heat"	[2]
7 a	Electrons from the glass rod are transferred to the silk cloth, leaving the rod with excess positive charges. **Comment:** excess or more is acceptable.	1
b	Negative charges are attracted to the ball up the stem and away from the leaf. As the leaf and the stem now have the same positive charge, they repel each other and hence the leaf rises. **Comment:** Some are confused with set up stating that the leaf is attracted to the ball"	1 1
8 a	To disconnect the appliance from the high potential mains/supply when the switch is open **Comment:** Poorly done. Many have the idea that current flows and stops at open circuit.	1
b	The fuse melts and breaks/opens the circuit when the current passing through the appliance exceeds 5 A.	1
c	I = P/V I = 1500/240 = 6.25 A [1] Not suitable as appliance cannot be switched on without melting the fuse. [1] **Comment:** Using fuse higher than 6.25 A is not accepted.	2
9 a(i)	R = V / I = 3.0 / 0.4 = 7.5 Ω	1

	Comment: Well done with handful reading the wrong value	
(ii)	Resistance increases	1
b	A <u>significant percentage of the energy</u> provided to the filament lamp is transferred away in the <u>form of infrared radiation</u> instead of visible light due to its <u>high resistance</u>	1
10 a	The mains supply has an <u>alternating current</u> which induces a <u>changing magnetic field</u> in the core. [1] There is a <u>change in magnetic flux linking the secondary coil</u>. [1] According to <u>Faradays law</u> an alternating voltage is induced in the secondary coil. [1]	3
c	240/40 = Turns Ratio = 6.00 **Comment:** Wrong answers were given in ratio form or fraction which is not accepted. Many indicated wrong sf.	1

11a	Parallel line. Direction from south to north.	1
b		1
c	The nails are made out of <u>hard magnetic materials</u> which are <u>hard to demagnetize</u>. **Comment:** Steel is also accepted.	1
12a	It is a <u>random and spontaneous process</u> whereby <u>an unstable nucleus loses energy by emitting radiation</u>	1
b	$^{131}_{53}I \rightarrow {}^{131}_{54}Xe + {}^{0}_{-1}\beta$ 1 mark each per particle	2
c	1/16	1

13 a	[1] correct plotting of points (MUST PLOT ALL points in table) (Accept one missing plotted point but the value in the graph must still be correct) [1] melting at 40°C for **5 min** starting at **2.5 min** (horizontal line) [1] boiling at 70°C for **10 min** starting at time **10 min** (horizontal line) Did not mark down for inappropriate/odd scale but marked down for uneven scale	3
b	Heat gained by solid B = $mc\triangle\theta$ = 3kg x c x (40-30) ^oC Heat supplied by oven = P t = 150 W x (2.5 x 60) s **[1] either one of the above workings WITH formula**	3

	Heat gained = Heat supplied 3kg x c x (40-30) ^oC = 150 W x (2.5 x 60) s [1] c = 750 J/kg ^oC [1] **NO ECF based on graph as answer can be derived from actual question**	
c	Latent heat of vaporization = m l_v = 3 kg x 30.0 kJ/kg = 90 kJ	1
d	The amount of energy transferred per unit mass of a substance to change between the liquid to gas states, at a constant temperature	1
e	From the graph, it took a <u>longer period of time</u> for B to boil as compared to when it was melting. [1] **Ecf given based on students graph as qn stated refer to graph.** As <u>amount of energy provided per second is that same</u>, this means that <u>the total energy</u> transferred to B during boiling was <u>higher</u>. [1]	2
14 a (i)	$\eta = \frac{\sin i}{\sin r}$ $= \frac{\sin 45°}{\sin 29°}$ [1] = 1.46 (3sf)[1]	2
(ii)	Light is travelling from <u>optically denser medium (glass) to an optically less dense</u> medium (air) and the <u>angle of incidence the light ray makes at point B is greater than the critical angle</u> [1], **NO marks if the angle was no specified.** total internal reflection takes place [1].	2
(iii)	 Refraction at C with ray parallel to AB and TIR [1] Angle in TIR must be accurate (+- 1^o) refraction along side XY of prism[1]	2

	NO marks if refraction along any other side of prism	
14 b (i)	 1 mark for real light rays (with direction) **Did not mark down if direction no present as not specified in question** 1 mark for virtual light rays and virtual image	2
(ii)	Virtual, magnified, upright **NO ecf**	1
(iii)	Image height and distance from lens decreases. **Reject "It decrease" as no evidence that student recognized there were 2 variables.** **NO ecf**	1
15		
(a)	Energy cannot be created nor destroyed but can be transferred from one store to another. Total energy in an isolated system remains constant.	 [1]
(b)	Energy in chemical potential store in battery/cell of car transferred mechanically/electrically to the kinetic store and gravitational potential store of the car **(no marks if "Energy in kinetics store transferred to gravitational potential store)** and the internal store of the surrounding air/slope	[1] [1] [1]
(c)	KE at A = ½ mv_A^2 20 = ½ (1) v_A^2	

	v_A = 6.32 m/s KE at B = ½ mv_B^2 100 = ½ (1) v_B^2 v_B = 14.1 m/s gain in velocity = 14.1 – 6.32 = 7.78 m /s (OR 7.82 m/s if students used exact values in calculation)	[1] [1]
(d)	Gain in E_P = mgh = 1.0 (10) 6 = 60 J	[1]
(e)	Energy provided by battery of toy car = Pt = 80 (20) = 1600 J	[1]
(f)	Energy provided by motor of toy car = gain in E_P + gain in E_K + work done against resistive force 1600 = 60 + (100 – 20) + F (12) F = 122 N	[1] [1]
16		
(a) (i)	Ultrasound waves are sound waves with <u>frequency</u> of more than 20 KHz (OR above human audible range)	[1]
(ii)	Q is the deepest, as the echo from that point takes the <u>longest time</u> to return to the ship.	[1]
(iii)	"Mention that there is <u>energy transfer</u> OR the <u>collision</u> of water particles with their neighboring particles) AND mention that the <u>water particles vibrate parallel to the direction of wave motion</u> causing alternating regions of compressions and rarefactions. **NO marks if rarefaction has wrong spelling**	[1] [1]
(iv)	$s = \frac{2d}{f}$ $1500 = \frac{2d}{0.75}$ D = 563 m	[1] [1]
(b) (i)	10 cm 0.50 Hz.	[1] [1]
(b) (ii)	v = fλ = 0.50 x 5.0 = 2.5 m/s	[1] [1]

	ECF given based on (b)(i)	