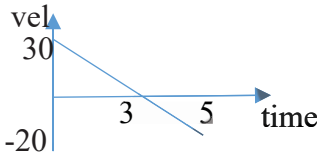
Answer for 2020 Sec 4Ex Pure Phy Prelim P1 Ans

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

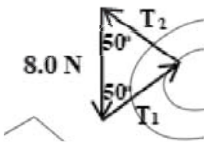
1	Addition of vectors must ensure resultant point from starting point of first force and end off at the ending point of last force	**C**
2	0.004 Gm = 4 x 10^6 m while 40 Mm = 4 x 10^7 m	**D**
3	Distance fall by X = ½ (3)(30) = 45 m Distance fall by Y = ½ (6)(60) = 180 m	**D**
4	Distance covered in the first 3 s = 45 m Distance covered in the next 2 s = 25 m Total distance covered = 65 m 	**B**
5	In the first 2 s, there's a net force of 2 N bringing about an acceleration of 2m/s^2 In the next 1 s, there's a net force of -2 N bringing about an acceleration of -2 m/s^2 In the last 2 s, there's net force of 6 N bringing about an acceleration of 6 m/s^2	**D**
6	Elephant has the largest mass thus highest inertia	**C**
7	Liquid with hydrometer floating the most is the highest density	**A**
8	Gravitational field attraction is acting towards the centre of the Earth	**C**
9	Let new pivot point be x cm 50 (x – 15) = 200 (45 – x) x = 39 cm	**A**
10	Force at B will create an anticlockwise moment equal to the clockwise moment created by F due to a shorter perpendicular distance from pivot point	**B**
11	Pressure at A = Pressure at B Density of A x g x (0.4) = Density of B x g x (0.3) Density of B = (4/3) Density of A	**A**
12	Marking at X -= 22 cm Marking over mercury level in barometer = 74 cm Height of mercury above X = 74 – 22 = 52 cm	**C**
13	Total work done = 200 x 15 = 3000 J Useful work = 500 (5) = 2500 J Efficiency = (2500/3000) 100% = 83.3 %	**A**
14	The velocity after 1 s = 10 m/s Gain in PE = Loss in KE = ½ (0.5)(20)^2 – ½ (0.5)(10)^2 = 75 J	**B**
15	As gas is in a rigid sealed container, there's no change in its volume thus the average distance remain the same.	**C**

16	Liquid has strong molecular bonding and they are free to move their position	**B**
17	Letter 'M' cool down the most as it has the largest surface area	**D**
18	Infra red radiation is used to transfer thermal energy	**D**
19	During melting, there is no change in its temperature and work is done to overcome forces of attraction and not break.	**B**
20	The relationship between ε and θ does not give a unique value	**C**
21	8 division rep 100°C 10 division rep (100/8) x 10 = 125°C	**D**
22	Heat gained by Q = Heat lost by R C_Q (45-20) = C_R (90- 45) C_Q / C_R = 9/5	**A**
23	The rise in temperature is the fastest for a material with low specific heat capacity	**B**
24	As wavefront enters into the deeper region, its speed increase and its wavelength increases. The direction of wave is bending away from normal.	**C**
25	Centre of rarefaction is the point with lowest pressure	**B**
26	Image of object is perpendicular distance away from the mirror (double reflection)	**C**
27	1.45 = sin(i) / sin (35) i = 56.3 change in direction = 56.3 – 35 = 21.3°	**D**
28	After locating the image of object, draw the ray P towards the tip of the image arrow	**B**
29	Gamma has the highest frequency with visible light having the longest wavelength.	**A**
30	$v = f \times \lambda$ $\lambda = (3 \times 10^8) / (6 \times 10^5 \times 10^9) = 5 \times 10^{-7}$ m	**C**
31	Loudness is proportional to amplitude Pitch is proportional to frequency Frequency is inversely proportional to wavelength	**B**
32	Metal is a good conductor of electricity. Once there's an excess charges, it will be discharged away easily. The other options will result in charging object by rubbing as they are non metal.	**A**
33	As the negative charge attracted to positive charge, there must be presence of positive charge at the top and thus the electric field is downwards. Do not use Fleming's Left Hand rule.	**C**
34	Q = It $I = (1 \times 10^{10} \times 1.6 \times 10^{-19}) / 4 \times 10^{-6} = 0.0004$ A V = IR = 0.0004 x 5 = 0.002 A	**A**
35	With switch P closed, the effective resistance of the 3 resistors will become lesser and thus the total resistance of the whole circuit will decrease leading to an overall increase in the current in the circuit. Thus the pd across lamp will increase.	**C**

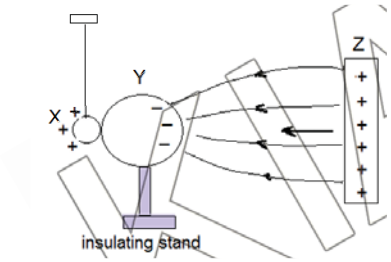
36	Electrical energy = 2 x 0.1 x 6 x 7 = 8.4 kWh in a week Total cost = 8.4 x 24 = 201.6 cents Total saving = 300 – 201.6 = 98.4 cents	**D**
37	The compass needed is not being influenced by the field strength of the permanent magnet.	**C**
38	Every half rotation, the current direction will be reversed in the coil	**B**
39	Using Fleming's Left Hand rule, the coil will move into the paper	**D**
40	Same directional current conductor will attract each other.	**A**

2020 Sec 4 Prelim Pure Physics Marker's report

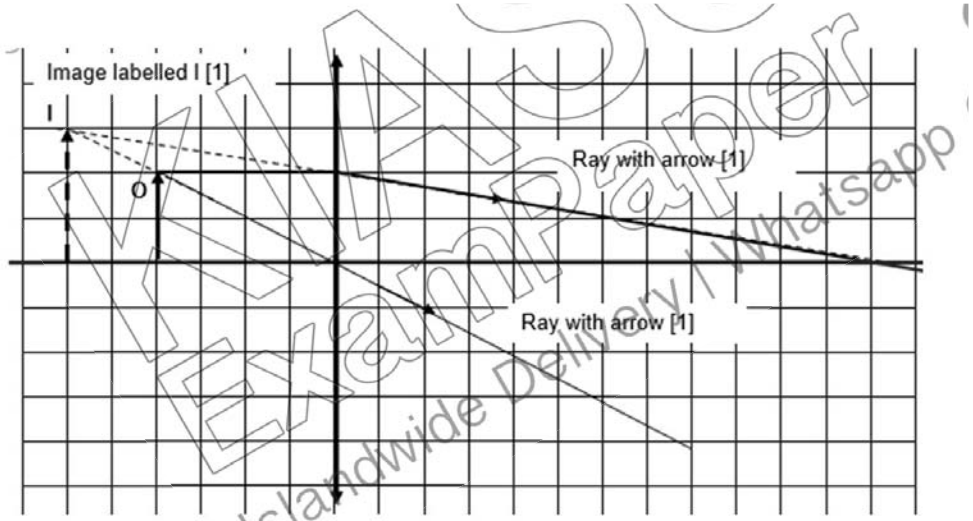
Que	Ans	Marks	Marker's Comments
1a	**10^{-8} to 10^{-7}** m	[1]	Most are not able to recall the size of virus
1bi	**micrometer screw gauge**	[1]	Most can do
1bii	**Check for zero error** to ensure that zero error is accounted for. Check for thickness of hair at **different portion of the hair** and obtain the **average** to get accurate reading	[1] [1]	Most can update about the zero error BUT not able to include read off at different part of the hair
2a	Displacement of 5 km meant that **5 km was travelled in a stated direction**	[1]	Most can stated the meaning well with some overlook the need to include the magnitude 5 km in the answer
2b	Alex would have covered a **total of 5 km in distance** and NOT displacement in order to complete the race As Alex travelled a total distance of 5 km in 20 mins, he is **having an average speed of 15 km/h and NOT velocity**	[1] [1]	Most can state the errors
2ci	Alex is running at greatest acceleration between **13 min and 16 min** The **change in velocity per unit time is the highest** during this duration **Gradient is the steepest** (also acceptable)	[1] [1]	Most can do it
2cii	Highest acceleration = (8 – 5) / 3(60) = 0.0167 m/s^2 F = ma ➔ 50 (0.0167) = **0.833 N** (Award 1 mark based on student's acceleration if correct mass is used in calculation)	[1] [1]	Most overlook that the unit used for time is minutes and thus calculated the resultant force wrongly

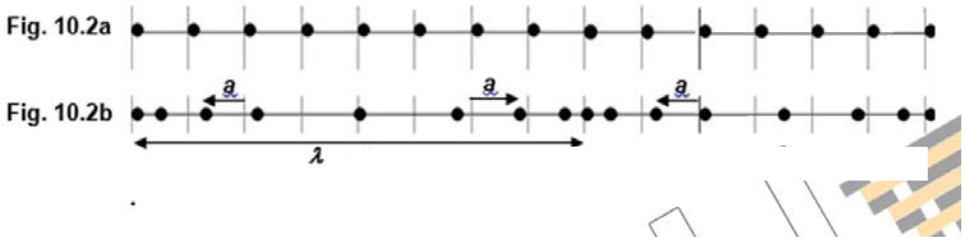
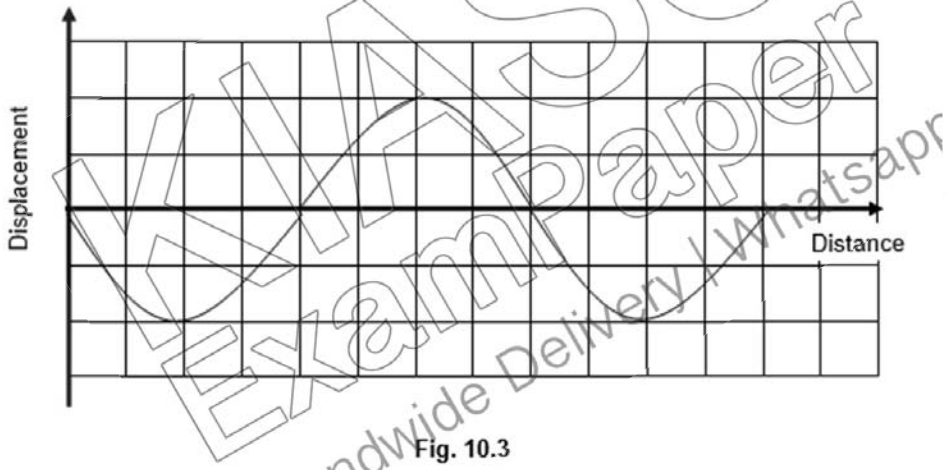
Que	Ans	Marks	Marker's Comments
3a	Mass is the measure of the **amount of matter in a body**. Weight is the measure of the amount of **gravitational force acting on an object**. Mass is a **scalar** quantity. Weight is a **vector** quantity Mass is measured in **kg** while weight is measured in **Newtons** Mass is measured by **electronic balance** while weight is measured by **spring balance** (Any two)	[1] [1]	Most can do it
3b	W = mg = 0.80 x 10 **= 8.00 N** (3 sig fig with correct unit)	[1] [1]	Most can do it
3c	1.0 cm : 1.0 N [1.0cm : 2.0N was not accepted] Scale too small 6.3 N [Accepted range: 6.2 N ~ 6.5 N]  Appropriate Scale Parallelogram or Tip-to Tail Correct arrows drawn Magnitude and unit for tension	[1] [1] [1] [1]	Most can do it
4a	Andres should push the door at a **further distance** away from the hinge to maximise the distance away from the hinge so as to bring about a lower force needed to produce the same moment. He could also push the door at **perpendicularly** so that the distance measured is the furthest from the hinge	[1] [1]	Most can state at a further distance from hinge but many did not mention about pushing at 90 deg to the door to have a higher perpendicular distance. Some overlook that efficiency means use a lesser force and mention about using a higher force to push
4b	Moment is the **turning effect** of force. It can be found by using **product of force applied and the perpendicular distance** from the **line of action of force to the pivot**.	[1] [1]	Most can do it

Que	Ans	Marks	Marker's Comments
4c	Moment is measured by the product of the **perpendicular** distance from the pivot point and the force applied. For measurement to be in Joule, it has to be the product of distance travelled **in the same direction** as the force applied. Moment is a **vector quantity** (in Nm) while work done is a **scalar quantity** (in J)	[1] [1]	Most could not state that moment is a vector while work done is a scalar
5a	Pressure of atmosphere is lower than gas pressure by 15 cm Hg Pressure gas = 76 + 15 = **91 cm Hg** Pressure = pgh = 13600 x 10 x 0.91 = 123 760 Pa = **124 000 Pa**	[1] [1]	Most can do it except for some who uses 15 cm instead of 0.15 m in the calculation
5b	Pressure difference = 0.15 x 10 x 13 600 With the new liquid X, the pressure difference still stays 0.15 x 10 x 13 600 = h x 10 x 6800 Therefore h = **0.30 m**	[1] [1]	Most can do it
5c	Since **liquid is incompressible**, the volume of liquid displaced at piston A has to be the **same volume** displaced at piston B. A **large cross sectional** at piston B will create **a small displacement** at piston B due to the displacement at piston A in order to obtain the same volume displaced. As the pressure created at piston A **is the same as** the pressure at piston B, piston B is of a larger cross sectional area than piston A, it will create **a larger force** at piston B Given that **work done = Force x distance** travelled in the direction of force. Work done at A = Force at A x distance travelled at A Work done at B = Force at B x distance travelled at B A **small force** at A with **large displacement** at A will create a **large force** at B with a **small displacement**. Thus the principle of conservation of energy is applicable in hydraulic system.	[1] [1] [1] [1]	Most are not able to explain fully when the principle of consevation of energy is valid in hydraulic system. Alot of points are missing in their explanation

Que	Ans	Marks	Marker's Comments
6a	GPE = mgh ➔ GPE = 0.2 (10) (0.05) = **0.1 J**	[1] [1]	Most can do it
6b	Loss in GPE = Gain in KE 0.1 = ½ (0.2) v^2 v = **1 m/s**	[1] [1]	Most can do it
6c	Energy is not being lost as the pendulum swings from B to A. All the gravitational potential energy lost is equal to the kinetic energy gained All gravitational potential energy is converted to kinetic energy	[1]	Most can do it
7a	An electric field is a **region in which a (unit positive) charge experiences an electric force**.	[1]	Most can do it
7b	X : **positive** Y : **negative**	[1]	Most can do it
7c		[1]	Most can do it
7d	As Z touches Y, **negative charges in Y will move to Z**. As Z is removed, both **X and Y will both be positively charged** and **X is repelled from Y** as like charges repel.	[1] [1] [1]	Some overlook and mention that the postive charges move and not electrons which is the wrong concept.
8a	Maximum reading = **20 V** Minimum reading = 200/600 x 20V = **6.67 V (to 3 sf)**	[1] [1]	Most can do it

Que	Ans	Marks	Marker's Comments
8b	I = V / R = 20 / (250 + 200) = **0.0444 A (to 3 sf)**	[1] [1]	Most can do it
8c	I through thermistor = V / R = 20 / (1 200 + 400) = 0.0125 A (to 3sf) Ammeter reading = 0.0444 A + 0.0125 A = 0.0569 A (to 2sf) Reading on V_2 = 400 / (400 + 1 200) x 20 = **5 V**	[1] [1]	Most can do it
Section B			
9a	Hair dryer produces **fast moving hot air molecules** which collide with the water molecules on the hair and transfer thermal energy to it. More water molecules **increase its KE** and they move more vigorously. There's an **increased in the number of fast moving surface water molecules that will successfully break the forces of attraction between the remaining molecules** and overcome atmospheric pressure to become gaseous state thus increases the rate of evaporation.	[1] [1] [1]	Most can explain with some overlooked that the hair dryer will produce fast moving air molecules used to heat up the water molecules
9bi	$P = V^2 / R = 230^2 / 25 = 2116$ W In 1 s, it will produce 2116 J of thermal energy. Energy produced by heater in 1 s = Energy gained by air in 1 s $2116 = m c \vartheta$ 2116 = 46 (c) (33 - 28) c = **9.20 J/g °C**	[1] [1]	Most are not able to use the resistance of heating element in the calculation and instead uses resistor R too! They overlooked that the whole circuit is a parallel circuit with the heating element getting the full emf instead of having to share with the resistor R

Que	Ans	Marks	Marker's Comments
9c	There will be **reduction to the temperature** of the air that is flowing out of the hairdryer. AND The flow **rate of air through the hairdryer increases** The flow rate increases due to a **lower resistance path** along the motor leading to a **higher current** flowing through the motor. As the flow rate of air increases and **power of heater stays unchanged** as it is still in parallel to the emf, the temperature of air flowing out of the body drops.	} [1] } [1] [1]	Most can explain that the temperature of air flowing out decreases but could not relate to the flow rate to explain
9d	A higher air flow rate will be when the switch is at K. E = 2.116 x (25/60) = 0.8817 kWh Cost of electricity = 0.8817 x unit cost = 28 cents Unit cost = **31.8 cents**	 [1] [1]	Most could not calculate as they were using resistor R in the calculation which is not needed if you need a higher flow rate of air
10ai		[3]	Most ended up drawing a real image wihich is 1.5 times instead of virtual ray and the whole ray diagram is wrong

Que	Ans	Marks	Marker's Comments
10aii	Distance of image from lens = **15 cm**	[1]	Poorly done
10bi		[1] for amplitude [1] for wavelength	Most can identfy the ampitude and wavelength correctly.
10bii	 Fig. 10.3	[1] A negative displacement must be drawn first [1] compression and rarefaction position must matches Fig. 10.2b Equal amplitude throughout	Most can identify the wavelength and the point with maximum displacement but could not recognise that the wavefrom must start with negative displacement first before drawing the positive displacement.

Que	Ans	Marks	Marker's Comments
10biii	There will be an **increase in amplitude** due to the loudness. The **wavelength will be shorter** as the higher pitch brings about higher frequency and thus shorter wavelength.	[1] [1]	Most stated the increase in the wavelength BUT overlook that the axis used in Fig. 10.3 is distance and NOT time.
E11ai	Total energy input by motor = P x t = 5000 x 30 = 150 000 J Energy input by motor = Gain in PE 150 000 = mgh = (200) (10) (h) h = **75 m**	[1] [1]	Most can do it
E11aii	Area under vel time graph = 75 m ½ (v)(t) = 75 ½ (10 t) (t) = 75 t = **3.87 s**	 [1] [1]	Most can do it
E11bi	The weight of falling weight = 0.02 x 10 = 0.2 N The magnetic force by the electromagnet B **must be more than 0.2 N** so that it can create a deceleration ie a **negative net force** so as to bring to an instant halt for the falling weight.	[1] [1]	Most did not realise that there is a need for the force to be higher than the weight in order to bring about a deceleration. IF it is the same as the weight the outcome is that the masss will fall with constant velocity instead of stopping
E11bii	**Increase the number of turns** coiling the electromagnet **Increase the current** flowing in the solenoid	[1] [1]	Most can do it
E11biii	There is **no need to increase/ change the strength** of the electromagnet B as the amount of force needed is still the same ie to overcome the weight	[1] [1]	Most did not realise that the force is the same as the weight is still the same despite falling from a higher height
O11ai	**South** polarity at Q	[1]	Most can do it

Que	Ans	Marks	Marker's Comments
011aii	The coil will rotate in a **clockwise** manner	[1]	Most can do it
011aiii	As the coil rotates past the vertical position, there is a **reverse in the direction of the current** flowing in the coil due to the presence of the split ring. This will allow the coil to rotate continuously as the **force acting on the left side of the coil is always up while the right side of coil is always down**.	[1] [1]	Most did not relate well the resason for continuously rotation but merely state there is presence of split ring
011bi	Both bulb J and K are **not ohmic conductors** as the **voltage is not directly proportional to current**	[1] [1]	Some overlooked the definition of ohms law and think that both are ohmic as it passes through the origin
011bii	At V = 0.2 V Bulb J current = 0.05 A thus resistance = V/I = 0.2/0.05 = **4 Ω** Bulb K current = 0.02 A thus resistance = V/**I = 0.2/ 0.02 = 10 Ω**	 [1] [1]	Most can do it
011biii	The **longer** the length of the wire used, the **higher the resistance** and the **thicker** the wire, the **lower the resistance**	[1] [1]	Most can do it