Answers / Marking Scheme

Sec 4E Express Prelim 2021

Physics

Paper 1

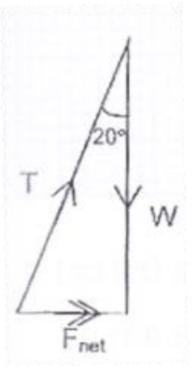
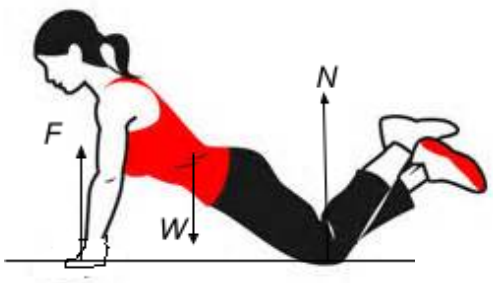
1	D
2	A
3	B
4	D
5	B
6	D
7	C
8	C
9	C
10	B

11	B
12	C
13	D
14	D
15	C
16	A
17	B
18	A
19	A
20	A

21	C
22	B
23	B
24	A
25	D
26	A
27	B
28	C
29	B
30	C

31	C
32	D
33	C
34	B
35	B
36	A
37	B
38	C
39	C
40	B

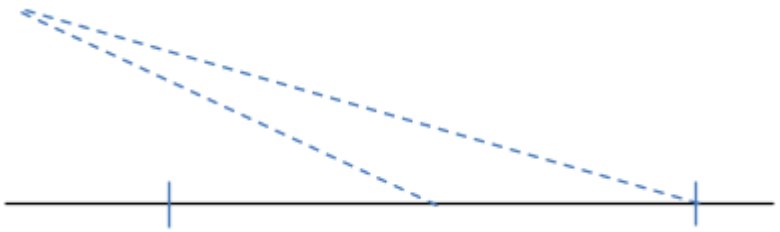
Paper 2
Section A

1		Scale  Correct vector diagram with arrows Net force = 2.4 to 2.6 N	1 1 1
			3m
2	**(a)(i)**	KE gained = ½ x 40 x1.5^2 – 0 J = 45 J	1
	(a)(ii)	WD = 30 x 6 = 180 J WD = gain in KE + WD against resistive force 180 – 45 = f x 6.0 m f = 22.5 N	1 1 1
	(b)	WD = Area under the graph = 30 x 6 + ½ x 30 x 4 = 240 J Average power= 240 ÷10.0 = 24 W	1 1
			6m
3	**(a)**	When randomly moving gas molecules hit the walls of the container at high speed, they exert a force on the wall. The force per unit area exerted on the walls of the container is the pressure.	1 1
	(b)(i)	As paint is used up, the volume of air in the can increases. Thus the number of gas particles per unit volume decreases. The frequency of collision between the gas particles and the walls decreases. Thus the force exerted per unit area decreases.	1 1
	(b)(ii)	The average kinetic energy of the remaining gas molecules inside the can decreases hence the temperature of the spray can decreases.	1
			5m
4	**(a)**	 	3
	(b)	For a body at equilibrium about a pivot, the principle of moments states that sum of clockwise moments about the pivot is equal to sum of anti-clockwise moments about the pivot.	1
	(c)	Taking moment about knee,	

		F(85) = 600(50) F =353 N	2 1
	(d)	Sum of upward forces = Sum of downward forces F + N = W 353 + N = 600 N = 247 N	 1
			8m
5	**(a)**	arrangement: Ice: in lattice / regular / arranged / orderly / fixed in place Water: random / irregular / not arranged / not orderly motion: Ice: vibrate Water: move (around) or slide over each other	 1 1
	(b)(i)	m = 1800 × 0.025 × 920 =41 000 kg	1 1
	(b)(ii)	$Q = mc\Delta\theta = 2.1 \times 10^3 \times 41\,000 \times 3.5$ $= 3.0 \times 10^8$ J	1 1
			6m
6	**(a)**	Microwaves microwave ovens / handphone signal transmission	1 1
	(b)	T = 1/f $= 1/(12 \times 10^9)$ $= 8.33 \times 10^{-11}$ s	 1 1
	(c)	v = f λ $3.0 \times 10^8 = (12 \times 10^9)(\lambda)$ λ = 0.025 m	 1 1
	(d)(i)	Any one of the following differences: ● Laser light is a transverse wave while ultrasound is a longitudinal wave. ● Laser light can travel in vacuum but ultrasound cannot travel in vacuum. ● Laser light travels at almost 3×10^8 m/s in air while ultrasound travels at about 340 m/s in air.	1
	(d)(ii)	Ultrasound cannot travel through space as there are no particles that enable transmission of ultrasound.	1
			8m
7	**(a)**	A (fixed)resistor B thermistor C L.E.D. OR light emitting diode (2 correct 1m; 3 correct 2m)	 2
	(b)	any four from six: ● if cold / hot resistance of thermistor high / low ● if cold / hot voltage (across) thermistor high / low ● if cold / hot voltage of input to LED high / low ● if cold / hot there is current / no current in LED ● if cold LED lights / brighter ● if hot LED does not light / dimmer	 4
			6m

8	**(a)**	When the current exceeds the fuse rating, the wire in the fuse melts (accept fuse blown) This opens the circuit and protects the circuit.	1 1
	(b)	operating current of fan = 1.25 A operating current of heater = 10.4 A Total I = 11.7 A Fuse will blow under normal operating condition. (only award if there is calculation)	 1 1
	(c)	Fuse is connected to the neutral wire. It should be connected to live wire. Earth wire is connected the heater coil, instead of the metal casing. Earth wire should be connected to metal casing of heater coil.	 1 1
	(d)	Total I drawn = 1.25 + 10.42 = 11.67 A Effective R = 240 / 11.67 = 20.6 Ω **OR** R coil = 23.04 Ω R lamp = 192 Ω R = (1/(240^2/2500) + 1/(240^2/300))^-1 = 20.6 Ω [1]	 1 1
			8m

Section B

9	**(a)(i)**	f = 1/[(1.5-1)(2/0.2)] = 0.2 m = 20 cm	1
	(a)(ii)	 1m for object within focal length 1m for virtual image on the same side as object 1m for light rays and arrows.	3
	(a)(iii)	The radii of curvature is directly proportional to the f.	1

	(b)(i)	Speed of light changes in different media.	1
	(b)(ii)	The higher the refractive index, the smaller the focal length.	1
	(b)(iii)	In a high refractive index material, the light bends more towards the normal/smaller angle of refraction. Light ray will converge towards each other in a shorter distance.	1 1
	(b)(iv)	A thinner/lighter lens can be used.	1
			10m
10	**(a)**	Speed is a scalar quantity while velocity is vector quantity (accept direction vs no direction)	1
	(b)	From t = 0 to 0.88s, **velocity decreases constantly** / constant negative acceleration /constant deceleration. At t = 0.88s, ball is momentarily **at rest.** From t = 0.88 to 1.8 s, ball **accelerates uniformly** in the **opposite direction.**	1 1 1
	(c) (i)	0.88s	1
	(c)(ii)	Distance = 0.5 x 8.8 x 0.88 = 3.87m	1
	(d)	The ball hits ground **or** short time for deceleration	1
	(e)	Kinetic energy of ball converted to thermal energy + sound energy	1
	(f)	Any 2: ● shorter time to drop to zero velocity ● line not straight **or** velocity does not change uniformly **or** gradient not constant ● smaller area under (first part of) graph **or** less distance travelled ● slower final velocity ● initial downward gradient steeper	2
			10m
11 E	**(a)(i)**	7.5 V	1
	(a)(ii)	R = V / I = 7.5 / 4.0 = 1.9 Ω	1 1
	(a)(iii)	P = VI = 6.5 × 4.0 P = 26 W	1 1
	(a)(iv)	resistance increases hence reading of ammeter decreases	1
	(b)	at least two lines on left and two lines on right of core and correct shape at least one arrow N to S (primarily upwards) and none wrong	1 1
	(c)	The cylinder is magnetised (by induction) with top (of cylinder) is induced with a South pole. Since unlike poles attract, the cylinder is attracted to the core	1 1
			10m
11 O	**(a)(i)**	An alternating current is where the flow of charge changes direction at regular intervals	1
	(a)(ii)	When the magnet rotates, there is **a change in the magnetic flux** within the coil. This induces an e.m.f. that produces an induced current.	1

		OR the magnetic field lines cut the coil	
	(a)(iii)	When the magnet **rotates towards** the coil, an i**nduced a current is produced in one direction, and** when it **rotates away f**rom the soft iron, an induced current is produced in the **opposite direction.**	1 1
	(a)(iv)	Any 1 way: Increase the speed of rotation of magnet Use a stronger permanent magnet Use a higher number of turn of the coil Decrease distance between the coil and magnet Use a lower resistance lamp	1
	(a)(v)	It helps to concentrate the magnetic flux through the coils.	1
	(b)(i)	Higher voltage reduces the current, and this **reduces power loss** in the transmission cables.	1
	(b)(ii)	P = I x V = 100 x 23 000 = 2 300 000 W or 2300 kW or 2.3 MW	 1
	(b)(iii)	Vp/Vs = Is/Ip 23 000 / 660 000 = Is / 100 Is = 3.48 A	 1 1
			10m