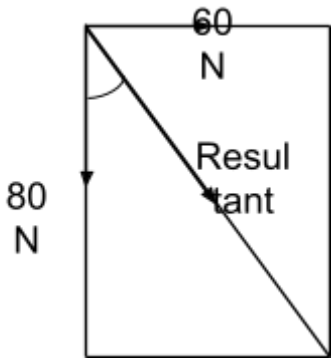
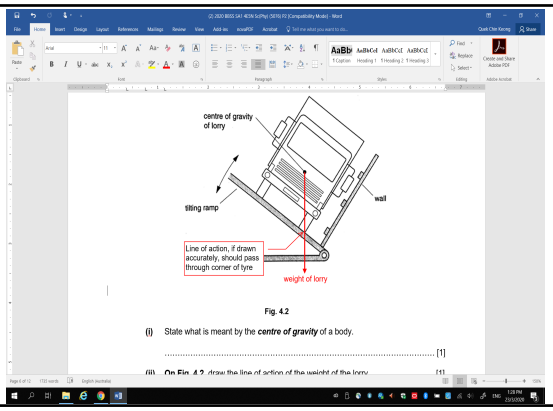
2020 BBSS SEC 4E5N SCIENCE (PHYSICS) (5076) O PRELIMINARY EXAM
MARK SCHEME (FOR TEACHERS ONLY)

PAPER 2: (W = working), (C/F = concept / formula), (A & U = answer & unit)

- **Penalize** 1 mark **per question** for no / wrong unit.
- **Penalize** 1 mark **per question** for failure to show concept / formula clearly **and explicitly** at the beginning of each mathematical working.
- Mark for 2 s.f. in Questions **4(b), 9(a)(ii) and 9(b)(iii) only**.

Q	Suggested Answer	Remarks
1a	Distance = area under v-t graph = ½(10 × 8.0) = **40 m**	[1]: C/F & W [1]: A
1b	Deceleration = change in velocity / time = (8.0 – 0) / 10 = **0.80 m/s²**	[1]: C/F & W [1]: A
1c	Retarding force = ma = (20)(0.80) = **16 N** ● Allow for ecf from part 1b	[1]: C/F & W [1]: A
1d	Work done = F.s = (16)(40) = **640 J**	[1]: C/F & W [1]: A
2a	● A to C: decreasing acceleration ● C to D: constant deceleration	[1] [1]
2b	● Weight of stone is constant. ● Air resistance against stone increases. ● Net force acting on stone decreases.	[1] [1] [1]
2c	No, because v-t graph of stone (between B and C) was never straight.	[1]
3a	 ● Appropriate scale: minimum of 1.0 cm to 5.0 N (reject 1.0 cm to **X** N where **X** > 5 because diagram will be too small) **and** either 60 N or 80 N force drawn correctly to stated scale. ● Magnitude of resultant force = **(100 ± 1.0) N** ● Angle θ: **(37 ± 1)°**	 [1] [1] [1]
3b	● Same magnitude as magnitude of net force found in 3(a) ● Ball held at equilibrium. Hence tension must be balanced (not equal) by resultant force in 3a (accept "equal in magnitude and opposite in direction" in lieu of "balanced").	[1] [1]
4a	Point where the weight of a body seems to act (regardless of the body's orientation)	[1]
4b(i)	● Line of action drawn vertically downwards (visual inspection suffices). ● If drawn correctly, the line of action should pass through the corner of the tyre as shown on the right. 	[1]
Q	**Suggested Answer**	**Remarks**

4b (ii)	● Line of action of lorry's weight acts outside lorry's base. ● **Clockwise** moment (due to lorry's weight) acts on lorry.	[1] [1]
4c (i)	Perpendicular distance between CG of metre rule and pivot = 20 cm Moment = F × d = (1.0)(20) = 20 Ncm	[1] [1]: C/F & W [1]: A
4c (ii)	Apply principle of moments about pivot (70-cm mark) (1.0)(20) = (**W**)(10) **W** = 2.0 N (reject "2N", "2.00N" – **mark for 2 s.f.**)	[1]: C/F & W [1]: A Mark for 2 s.f.
5a	Change in GPE = mgh = (80)(10)(60 – 4.0) = **44800 J**	[1]: C/F & W [1]: A
5b	½mv^2 = 23000 ½(80)v^2 = 23000 ⇒ v = **24 m/s** (to 2 s.f.)	[1]: C/F & W [1]: A
5c	Student's answer should contain the following points: ● Loss in gravitational potential energy (GPE) of man ● Loss in kinetic energy (KE) of man ● Gain in elastic potential energy (EPE) of rope	 [1] [1] [1]
6a	● Air molecules vibrate parallel to the direction of travel of sound waves ● Forming regions of compression and rarefaction	[1] [1]
6b	Sound travels faster through solids than through gases	[1]
6c (i)	Distance = speed × time = 300 × 0.100 = **30 m**.	[1]: C/F & W [1]: A
6c (ii)	Speed = distance / time = 30 / 0.020 = **1500 m/s**.	 [1]: C/F, W & A
7a	Electrons transferred from plastic ball to wool.	[1]
7b	● Electric field lines originate from positive and point into negative. ● Electric field lines more closely packed at regions closer to the charged bodies, and more spaced out elsewhere. ● Electric field lines do not cross / cut / merge with one another.	[1] [1] [1]
8a (i)	1 80 °C 2 Graph of water in B dropping more steeply initially, and Same final temperature of 22 °C	[1] [1] [1]
8a(ii)	Radio waves, microwaves (any one)	[1]
8b (i)	● Water above the heater (reject "at bottom of tank") heats up, expands and becomes less dense and rises. ● Cooler, denser water at top of tank sinks to take its place to get heated up. ● Above process repeats to form a convection current above the heater.	 [1] [1] [1]
8b (ii)	● Yes but slower. Thermal conduction through water is inefficient as water molecules **free to move** ● and **not as closely packed as particles in a solid**.	 [1] [1]
8b (iii)	More / entire tank of water will be heated up and not the entire volume / tank of water will be used. More time / energy will be wasted in the process.	 [1]
9a(i)	1 reflected ray: correct direction and correct angle (visual inspect) 2 refracted ray: correct direction and bends towards normal (visual inspect) 3 angle i: between incident ray & normal axis (student to draw themselves) 4 angle r: between refracted ray & normal axis (student to draw themselves)	All correct = [2] 1 mistake = [1] 2 or more mistakes = [0]
9a(ii)	Refractive index = sin i / sin r = sin 40 / sin 25 = 1.521… = **1.5** (to 2 s.f.)	[1]: C/F & W [1]: A
9a(iii)	Refractive index = c / v 1.5 = (3.0 × 10^8) / v ⇒ v = **2.0 × 10^8 m/s**	 [1]: C/F & W [1]: A
9b(i)	Light was travelling from an **optically** less dense medium to an **optically** denser medium.	 [1]
9b(ii)	Angle of incidence in the optically denser medium for which the corresponding angle of refraction in the optically less dense medium is 90°.	 [1]
9b(iii)	sin c = 1 / n = 1 / 1.5 c = sin^{-1} (1 / 1.5) = 41.81… = **42°** (to 2 s.f.)	 [1]: C/F & W [1]: A
Q	**Suggested Answer**	**Remarks**

10a	240 J of work is done in bringing unit charge around the whole circuit.	[1] [1]
10b	Potential difference across switch S = **240 V**.	[1]
10c(i)	I = V / R = 240 / (80 + 40) = **2.0 A**.	[1]: C/F & W [1]: A
10c(ii)	Potential difference across 80 Ω resistor = IR = (2.0)(80) = **160 V** (allow ecf from 10c(i))	[1]: C/F, W & A
10c(iii)	Power dissipated = VI = (240)(2.0) = **480 W**.	[1]: C/F & W [1]: A
10d(i)	80 Ω resistor still connected to high voltage (even though S is opened)	[1]
10d(ii)	X placed between 80 Ω resistor and positive terminal of power supply.	[1]

PAPER 1:

Q	A	Q	A
1	B	11	C
2	C	12	D
3	B	13	C
4	D	14	A
5	A	15	C
6	A	16	B
7	B	17	D
8	B	18	D
9	B	19	A
10	A	20	B