2022 4E Physics Prelim – ANSWERS

PAPER 1

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

PAPER 2

1 (a) A to B: moving upwards with constant acceleration
B to C: moving downwards with constant acceleration
C to D: coming to a stop after being in contact with the ground

[1] 2 correct
[2] all correct

Generally okay. Some students did not use the correct phrases. However, marks were awarded as long as description was correct. Some students mixed up the first two phrases.

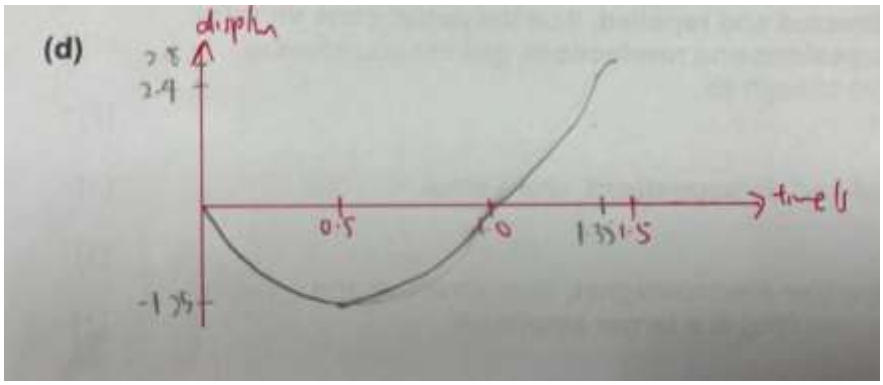
(b) 2.79 m [1]

Generally okay. Some students did not read the graph properly. Mark was given as long as the reading taken was only maximum one square away.

(c) 5.29 m [1]

Generally okay. Some students did not read the graph properly. Mark was given as long as the reading taken was only maximum one square away.

(d)



[1] for curve
[1] for horizontal part ecf

Badly done. Students made the following mistakes:
- Did not know how the shape would be like
- Did not see that the distance travelled from 0 – 0.5 s = distance travelled from 0.5 – 1.0 s

2 (a) height above B = 1.5cos20 [1]
GPE at A = KE at B
$m(10)(1.5 - 1.5\cos 20) = (1/2)mv^2$ [1],[1]
v = 1.35 m/s [1]

Badly done. Students made the following mistakes
- Did not understand that the concept asked was initial GPE = final KE
- Did not find the change in height, but may have found horizontal or diagonal distances

(b) decreasing acceleration [1]

Very badly done. Mark given if student indicated an increase in speed, for leniency.

(c) T = 2.4334 [1] for substitution

(2.4334)(7) + 2.4334/4 = 17.6 s [1]

Badly done. Students should visualise the entire movement of the pendulum to find out the number of periods.

3 **(a)** When a body is in equilibrium, the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot. [1]

Generally okay. All students are encouraged to get all definition questions correct.

(b) (12)(6) + (8)(10) = R(7) + (10)(10) [1],[1]

R = 7.43 N [1]

Generally okay. Students who got this wrong mainly mixed up the directions.

(c) There is a **resultant clockwise moment** about the pivot. [1]

The object will **rotate clockwise before coming to rest**, with the **center of gravity below the pivot**. [1]

Badly done. Mistakes made:
- Students were not clear enough in indicating when the object would come to a stop.
- Students missed out that weight would be a factor and produce a moment, thus thinking object would remain stationary.

4 **(a)** Reduce heat loss through conduction and convection [1]

As vacuum has no particles / no medium [1]

Not well done. Few students indicated both processes. Some students also did not explain that vacuum meant the absence of particles.

(b) Reduce heat loss through conduction as plastic is a poor conductor of heat [1]

Reduce heat loss through convection / evaporation as air is trapped [1]

Not well done. Few students indicated all processes.

(c) Reduce heat loss through radiation as silver is poor emitter of infrared radiation [1]

Not well done. Some students indicated that silver is a poor absorber or indicated that silver is a poor absorber and emitter, which does not fit the context of the question.

5 **(a)** Luggage scanning (accept other logical answers) [1]

Generally okay. X-ray machine not accepted unless accompanied by explanation on what an X-ray machine does

(b) $3 \times 10^8 = (10 \times 10^{-9})f$ [1]
$f = 3 \times 10^{16}$ Hz [1]

Generally okay. Some students got the powers wrong or forgot the speed of EM wave in vacuum.

(c) **(i)** kg m^2/s^2 [1]

(ii) $3 \times 10^8 = d / (21 \times 10^{-3})$ [1]
d = 6 300 000 m [1]

Not well done. Accept a range of 20×10^{-3} to 22×10^{-3}. Some students incorrectly thought that there was an echo.

6 **(a)** The a.c. power supply will cause the soft iron core to be magnetised in **opposite directions** periodically, [1]
causing the **magnet to be attracted and repelled**, thus the paper cone vibrates. [1]
This forms a **series of compressions and rarefactions** and the sound wave [1]
travels as a **longitudinal** wave through air. [1]
Max 3

Generally okay. Students could get the concepts right but missed out on key words.

(b) Soft iron is **easily magnetised and demagnetised**, unlike steel [1]

Generally okay. Some students missed out one of the scenarios.

(c) The sound will be **louder**. [1]
The soft iron core will be a **stronger electromagnet**, thus attracting and repelling the bar magnet more strongly, resulting in a **larger amplitude**. [1]

Generally okay. Some students missed out of the explanation. Some students thought that frequency would be affected.

(d) The sound will have a **higher pitch**.
The soft iron core will be magnetised and demagnetised twice as quickly, causing **frequency** of vibration of the cone to be **twice as fast**. [1]

Generally okay. Some students missed out the link between frequency and pitch.

7 **(a)** Weight = 40 N (Accept 38 – 42 N) [1] scale
Incline = 30° (Accept 29 – 31°) [1] vector diagram
[1] acceptable resultant force
[1] acceptable direction

8 **(a)**

$6.2 = \frac{R}{R+10}(12)$ [1]
R = 10.7 Ω [1]
Temperature = 24°C [1]

Generally well done. Accept 23.5 – 24.5°C.

(b)

The air molecules **gain kinetic energy** and speed up. [1]
They collide **more frequently and more forcefully** with the walls of the syringe and piston, causing the average force per unit area to increase and pressure to increase. [1]
Pressure in the syringe is greater than atmospheric pressure, resulting in a resultant force, causing **piston to move outwards**. [1]

Generally okay. Some students missed out key words.

9 **(a)**

The slip rings maintain constant electrical contact with the external output circuit as the coil turns. [1]

Not well done. A number of students gave the function of a split-ring commutator.

(b)

As the coil is rotated, there is a change in **magnetic flux linkage** between the magnetic field and the coil, producing an **e.m.f.** [1]
By Faraday's Law, there is an **induced current** produced to light the light bulb. [1]

10 **(a)**

$700 / (\pi(5)^2(10))$ [1]
$= 0.891$ g/cm^3 [1]

Generally okay.

(b)

$(891.26)(10)(0.1) + 1.01 \times 10^5$ [1] for pressure

$= 1.02 \times 10^5$ Pa [1]

Not well done. Some students did not change the unit of density. A number of students forgot to add atmospheric pressure.

(c)

(9000)(4) [1]
= 36 000 J [1]

Not well done. A number of students found specific latent heat of fusion.

(d)

(9000)(3) = (0.7)c(52)
c = 742 J kg^{-1} K^{-1} [1]

Not well done. A number of students did not know which part was liquid.

(e)

Lower. [1]
Not all the thermal energy from the liquid was transferred to the cooling source / Some energy may have been lost to surroundings. [1]

Not well done. Students have difficulty identifying if heat is lost or gained.

(f) The solid is the same temperature as its surroundings / cooling source. [1]

Not well done. Students think a phase change occurred.

11 (a) (i) A region where an electric charge experiences an electric force [1]

Generally okay. All students are encouraged to get all definition questions correct.

(ii) The **electrons** in the rod are **move towards** the positively charged plate as [1]
unlike charges attract, [1]
resulting in the left side of the rod being negatively charged.
The **rod will thus move towards the plate** as unlike charges attract. [1]

Not well done. A number of students did not explicitly state movement of electrons or movement of rod. Benefit of doubt was given. Maximum 2 marks will be awarded if positive charges getting repelled is mentioned.

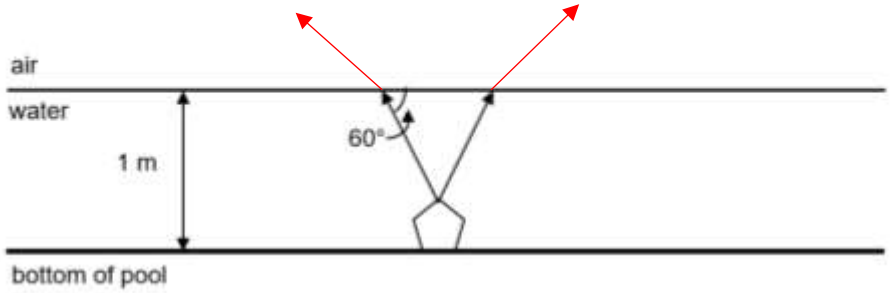
(b) (i) When the electrons moved towards the positively charged plate, the current resulted in a circular **magnetic field formed around the rod**. [1]
This magnetic field interacted with the external magnetic field, resulting in a upward force, causing the rod to levitate. [1]
When the electrons stopped flowing, current = 0, there was no circular magnetic field. Since there was no more interaction of magnetic fields, there was **no upward force** acting on the rod, causing it to rest on the table. [1]

Very badly done. Many students did not bring up magnetic field being generated when current passes through. Therefore, the second point about the interaction of magnetic field was also missed out on.

(ii) **Z** is the North pole. [1]
Using **Fleming's left-hand rule**, [1]
Since force (thumb) is pointing out of the page, current (middle finger) is pointing to the right, magnetic field (index finger) is pointing from Z to Y. [1]

Quite badly done. Students applied FLHR incorrectly as current was not taken to be in the opposite direction.

12 (a) (i) Draw light rays bent away from the normal [1]
E



(ii) By **extrapolating** the light rays, [1]
they **meet at a point above the object**, thus appearing to be closer to the surface than it actually is. [1]

Not well done. Students did not explain that extrapolation of lines was required.

(iii) 1 / 0.75 = sin r / sin30 [1]
r = 41.8° [1]

Not well done. Students did not apply Snell's Law correctly, as the 30 degree angle was not taken to be the angle of refraction in the optically denser medium.

(b) **(i)** When the angle of incidence is on the water-air boundary is too large, **total internal reflection occurs**. [1]
Therefore, the **light rays bend back into the water** and the light rays cannot be seen beyond a certain angle. Therefore, only a circle of light will be seen. [1]

Not well done. Students did not relate TIR to why light would not be seen.

(ii) sin c = 1 / 1.3333 [1]
c = 48.592°
tan(48.592) = opp / 1 [1]
opp = 1.1339
area = $\pi(1.1339)^2$
area = 4.04 m^2 [1]

Not well done. Some students could not clearly visualise how to calculate the area of the circle of light.

12 **(a)** **(i)** Correct rays [1]
O Correctly drawn image [1]

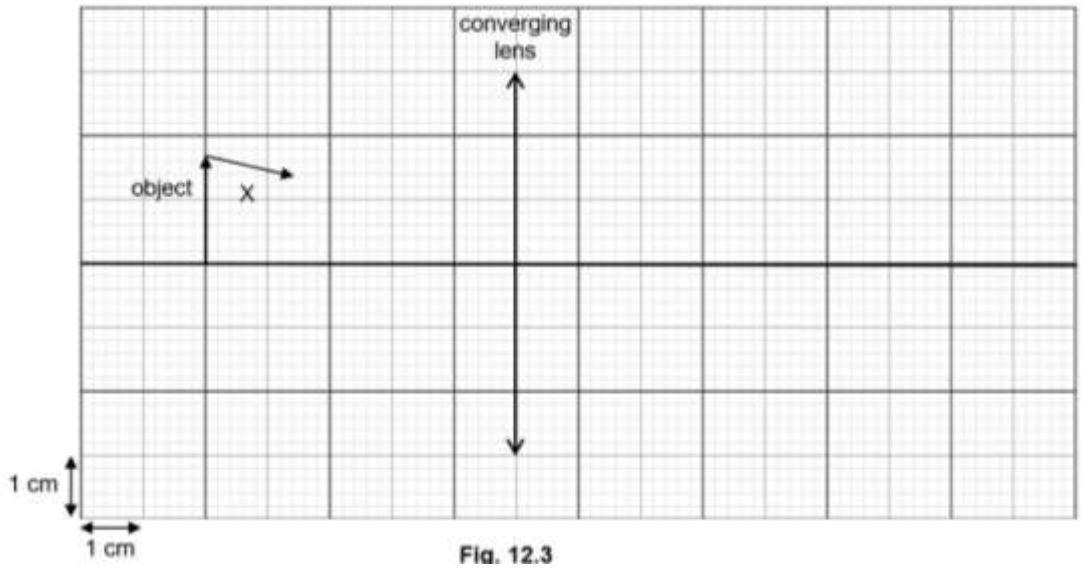


Fig. 12.3

Generally okay. Some students missed out on arrowheads. A number of students did not know how to draw ray X.

(ii) Correctly drawn ray [1]

(b) Eye/camera [1]

Generally okay.

(c) Dimmer image [1]

Not well done. Some students thought that only half the image would appear.

(d) 5 cm ≥ object distance (u)s > 4 cm: image is real, inverted and diminished. Image increases in size as it moves closer to the lens. [1]
u = 4 cm: image is real, inverted and same size. [1]
4 cm > u > 2 cm: image is real, inverted and magnified. Image increases in size as it moves closer to the lens. [1]
u = 2 cm: image flips to the same side as object. It is at infinity. It is virtual, upright and magnified. [1]
2 cm > u ≥ 1 cm: image is virtual, upright and magnified. Image decreases in size as it moves closer to the lens. [1]

Not well done. Students did not elaborate about the different scenarios.

(e) Thinner lens [1]

Some students did not change the set-up itself. Moving the object closer is part of the experiment itself.