Nanyang Girls' High School
2023 Sec 4 Physics Prelim Exam Markscheme

Paper 1

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

Paper 2

Section A

1(a) energy, weight, acceleration, speed, force [1]

(b) weight, acceleration, force [1]

(c) Force & Weight; N [1]
N

2(a) 4.0 s to 7.4 s (accept 7.0-7.4) [1]

(b) $a = (v - u)/t = (25 - 30) / (4-2)$ [1]
$= -2.5\ m/s^2$ [1]
Or deceleration = $2.5\ m/s^2$

(c) distance = area under graph $= ½ (30+25) (2.0)$ [1]
$= 55\ m$ [1]

(d) There is no net force on the car **OR** the forces on the car are balanced. [1]

hence the car moves with constant velocity [1]
OR constant speed in a straight line/same direction

Reject: Quoting Newton's first law correctly but didn't apply to the context

3(a) turning moment = 12 000 x 20 = 240 000 Nm [1]

(b) To produce an anti-clockwise moment about P to balance the clockwise moment caused by the load about P / to ensure no net moment [1]
OR to prevent the load and arm from toppling clockwise

(c) This allows the moment produced by the counterweight to be varied, so as to balance different loads on the arm of the crane. [1]
OR to balance the same load at different positions/distance from P

(d) Power = gain in gpe/time = mgh/t = 12 000 x 15 / (1.5 x 60) [1]
= 2000 W [1]

4(a) Polystyrene has pockets of air / is a poor thermal conductor / good insulator [1]

Keeps noodle hot / prevents cup from burning the hand [1]

(b) Shiny surface is a poor absorber of radiant heat / infrared radiation [1]
OR good reflector of radiant heat /infrared radiation

It will keep the noodle warm by reducing rate of heat loss by radiation. [1]

(c) Let the final temperature of the mixture be T.

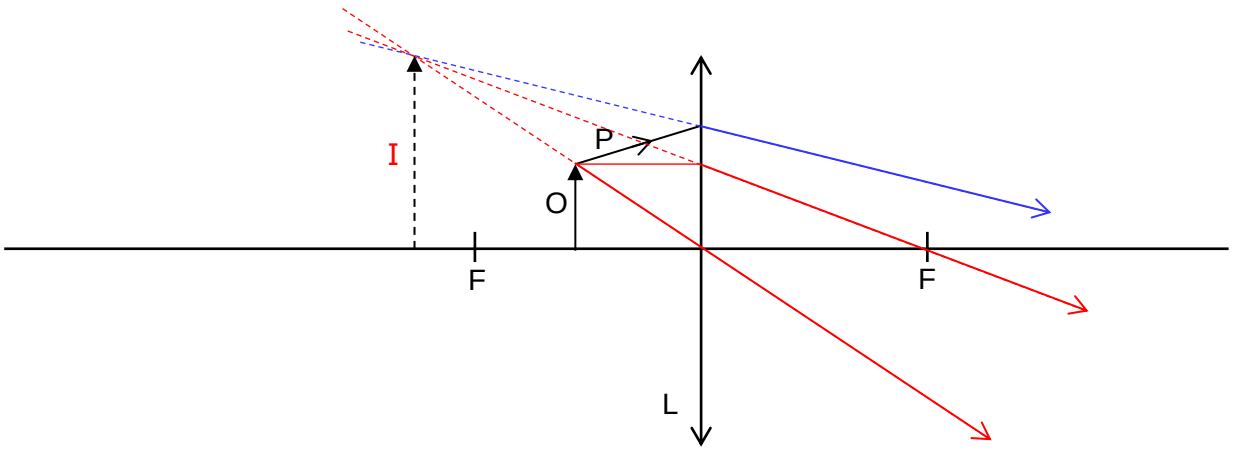
Heat gained by noodle = heat lost by water
(m c $\Delta\theta$) noodle = (m c $\Delta\theta$) water
(100/1000) × 2400 × (T – 26) = (400/1000) × 4200 × (90 – T)
[1] [1]

240 T – 6240 = 151 200 - 1680 T
T = 157440 / 1920 = 82 °C [1]

5(a) the incident ray is perpendicular to surface / parallel to normal [1]
OR angle of incidence is zero

(b) n = 1 / sin c = 1/sin 40° (c: critical angle, from normal) [1]
= 1.56 or 1.6 [1]

6(a) a ray through centre of lens & a horizontal ray then through F [1]
draw and label image I (with dashed line) [1]

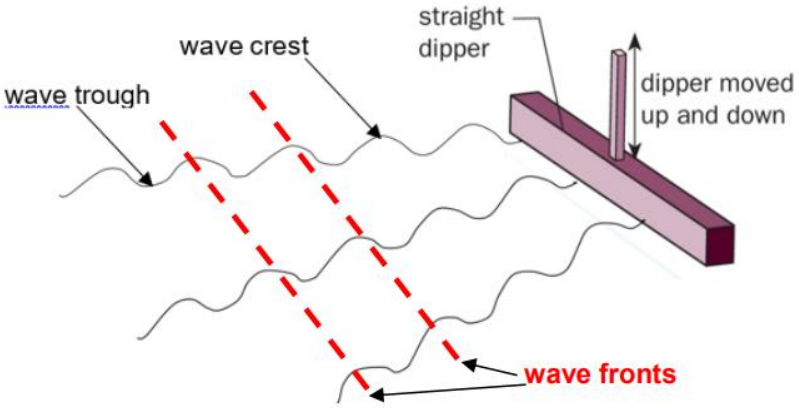


(b) correct path for P [1]

(c) image becomes smaller and closer to the lens [1]
/ image distance decreases

7(a)(i) A wavefront is an imaginary line on a wave that joins all adjacent points that are in phase. [1]

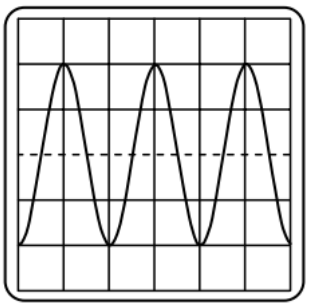
(a)(ii) *can draw curves* [1]



(b) frequency of the wave f = 5 cycles / 10 s = 0.5 Hz [1]
wavelength of the wave λ = 8.0 cm = 0.080 m
speed of the wave $v = f\lambda$ = (0.5)(0.080) = 0.040 m/s or 4.0 cm/s [1]

OR speed = d / t = (5 × 8.0cm) / 10s = 4.0 cm/s

8 trace has larger amplitude [1]
twice the number of waves (twice the frequency) [1]



9(a) the waste gases are warmer and less dense than surrounding air [1]
so they rise and carry the smoke with them

(b) negatively charged smoke particles are repelled by negative metal grid [1]
as like charges repel;
and attracted by the positive collecting plate as unlike charges attract [1]

10(a)(i) As the illuminance increases, resistance decreases (at a decreasing rate). [1]

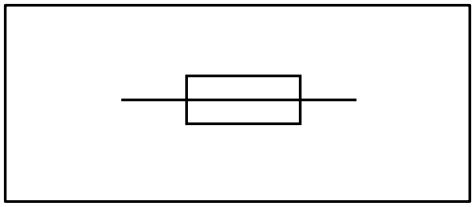
(a)(ii) R (at 10 lux) = 20 (kΩ) OR R (at 70 lux) = 5 ± 1 (kΩ) [1]
ΔR = |5 – 20| = 15 kΩ (± 1kΩ) OR 15 000 Ω ((± 1000 Ω) [1]

(b)(i) current I = V/R = 4.5V / 22 000Ω [1]
= 0.000 205 ≈ 0.000 21 A OR 2.1×10^{-4} A [1]

(b)(ii) p.d. V = IR = 0.000 205 A × 10 000 Ω = 2.05 ≈ 2.1 V [1]

(b)(iii) As illuminance increases, resistance *R* decreases & current increases [1]
p.d. across 10 kΩ resistor increases. [1]
OR
As illuminance increases, resistance *R* decreases & p.d. across *R* decreases
p.d. across 10 kΩ resistor increases.

11(a) live and neutral wires [1]

(b) fuse  [1]

12(a) A [1]

(b) A and B [1]

Section B

13(a) distance = 173 000 km × 1000 × 2 = 346 000 000 m ≈ 350 000 000 m [1]
= 3.5×10^8 m

(b)(i) the unit for speed should be km/h [1]

(b)(ii) speed = 28 000 km/h = 28000 × 1000 / 3600 [1]
= 7 777 ≈ 7800 m/s or 7.8×10^3 m/s [1]

(c)(i) volume V = $\frac{4}{3}\pi r^3$ = $\frac{4}{3}\pi(64 \div 2)^3$ [1]
= 137 258 ≈ 140 000 m^3 [1]

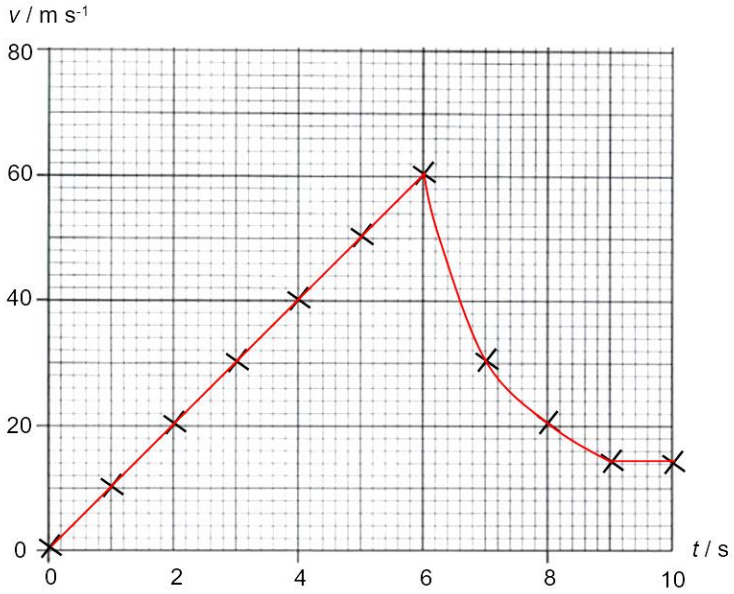
(c)(ii) mass = density x vol. = 2700 kg/m^3 × 137 258 m^3
= 370 597 000 ≈ 370 000 000 kg or 3.7×10^8 kg [1]

(c)(iii) kinetic energy = ½ mv^2 = ½ (370 597 000) $(7777)^2$ [1]
= $1.1207 \times 10^{16} \approx 1.1 \times 10^{16}$ J [1]

(d)(i) Asteroids may one day fall onto Earth surface/collide with Earth
to cause a disaster/deaths/disaster. [1]

(d)(ii) Astronomers would understand the behaviour/flight paths of the asteroids better and apply this knowledge to prevent any asteroid from falling onto Earth in the future.
change path of asteroid / evacuate people to safety / minimize death/destruction
[or any reasonable ideas] [1]

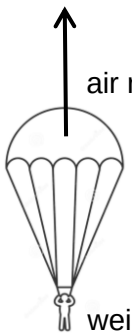
14(a)(i)



- All points plotted correctly [1]
- Straight line drawn correctly from (0,0) to (6, 60)
- A curve that transit to a horizontal line from (6, 60) to (10, 14) [1]

(a)(ii) 14 m/s [1]

(b) two forces in correct directions & labelled correctly [1]



(c) From t = 6.0 s, the <u>air resistance acting on the parachutist is larger than the combined weight</u> of parachutist and the parachute, she will <u>decelerate</u> / her velocity decreases / <u>the air resistance acting on her will decrease</u>. [1]

When the <u>air resistance eventually balances the weight</u>, [1]
/ there is <u>no resultant force</u> acting on the parachutist, thus she will not accelerate and reach terminal velocity.

(d)(i) GPE = mgh = (90×10×300) [1]
= 270 000 = 2.7×10^5 J [1]

(d)(ii) Energy lost = GPE – KE = 270 000 – 8820 = 261 180 ≈ 260 000 J [1]
or 2.6×10^5 J

15 EITHER

(a) $P = VI$ ➔ $I = P / V = 10\,500\ W / 230\ V = 45.7\ A$ or $46\ A$ [1]

(b) There is potential difference (p.d.) across the wires due to their resistance. [1]
230 V is the sum of the p.d. across the wires and across the heater unit. [1]

(c)(i) $V = 230 - 225 = 5\ V$ [1]
$R = V/I = 5 / 40 = 0.125\ \Omega$ [1]

(c)(ii) $R = \rho L / Area$ ➔ $Area = \rho L / R = 0.125 = (1.8 \times 10^{-8} \times 16 \times 2) / 0.125$ [1]
$= 4.6 \times 10^{-6}\ m^2$ [1]

(d) These wires with small cross sectional area have high resistance [1]
which may lead to overheating and cause an electrical fire [1]

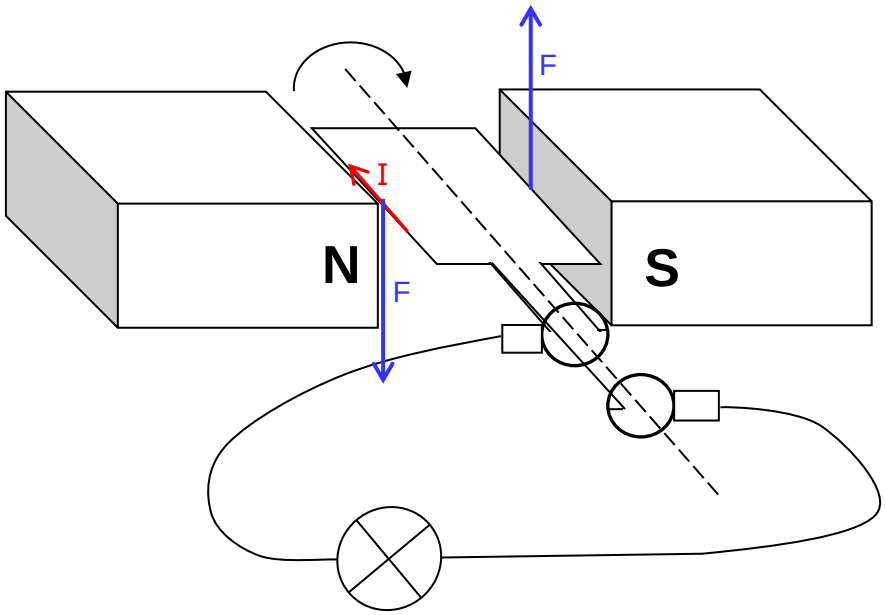
Note: The heater unit has high current I for heating purpose.
Power dissipation in these wires = I^2R is high

(e) Connect a fuse in series with the switch [1]
Connect the earth wire to the metal casing

15 OR

(a) The coil <u>continuously cuts the magnetic field lines</u> [1]
By <u>Faraday's law</u>, an induced e.m.f. is produced in the coil. [1]
OR As the coil rotates, the <u>magnetic flux linked to the coil changes continuously</u>,
By <u>Faraday's law</u>, an induced e.m.f. is produced in the coil.

(b) To provide <u>good contact between the coil and the carbon brushes/external circuit</u> [1]
OR To allow <u>freedom of rotation of the coil</u> (without twisting the wires of the coil)



(c) (i) current I marked in correct direction (clockwise around coil) [1]
- *Apply Fleming's right hand rule*

(ii) forces F marked in correct direction [1]
(downward force on left side of coil, upwards on right)
- *Apply Fleming's left hand rule*

(d) Bulb removed gives open circuit so <u>no current can flow in the coil</u> and there will be <u>no forces on the coil</u>. [1]

(e) *Any 2 of these:* [2]
- increase the number of turns in the coil / use a stronger magnet
- rotate the coil with a faster speed / insert a soft iron core within the coil

(f) *frequency increases by 3/2 = 1.5 times*
amplitude increases by 1.5 times: from 2 to <u>3 squares</u> [1]
period decreases by 1.5 times (12/1.5) from 12 to <u>8 squares</u> [1]