Answers for 2023 Sec 4 IP Physics EOY Exams

Paper 1

1…….5	6……10	11…..15	16….20	21….25	26….30
AABCB	DCDBC	ADDDC	BABBA	BDABC	CCADA

Paper 2

Section A

1(a)(i) Velocity is a vector quantity whereas speed is a scalar quantity
Or
Velocity has magnitude and direction whereas speed has magnitude only.

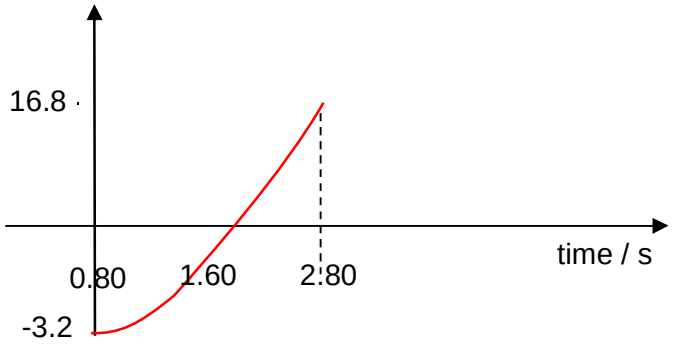
(a)(ii) Change in velocity = 20− (−8) = 28 m s^{-1}

(a)(iii) Change in speed = 20 − 8 = 12 m s^{-1}

(b)(i) At max height, v = 0 m s^{-1}
Displacement = area under the v-t graph (up to t = 0.80 s)
= ½ (0.80)(−8.0) = - 3.2 m

(b)(ii) Displacement = Area under the v-t graph = ½ (2.0)(20) – 3.2
= 16.8 m

(b)(iii)



- correct shape
- correct labels (allow e.c.f. for displacement values)

2(a) (i) A measure of the amount of substance in an object
(ii) The gravitational force on the object

(b) Taking pivot at B, applying Principle of moments,
Total clockwise moments = total anticlockwise moments
50 (0.30) + 25 (0.30 + 0.60) = F_A (0.80 – 0.30)
Evidence of $M = Fd$ applied correctly for either side of the equation F_A = 75 N

(c) Total upward forces = total downward forces
F_B = 75 N + 50 N + 25 N = 150 N

3(a) density = mass / volume = (66.45 – 52.00) / 17.0
= 0.85 g cm^{-3}

(b) $h_w \rho_w g = h\rho_X g$ ➔ (12.0 – 5.0) (1.0) = h (0.85)
h = 8.2 cm

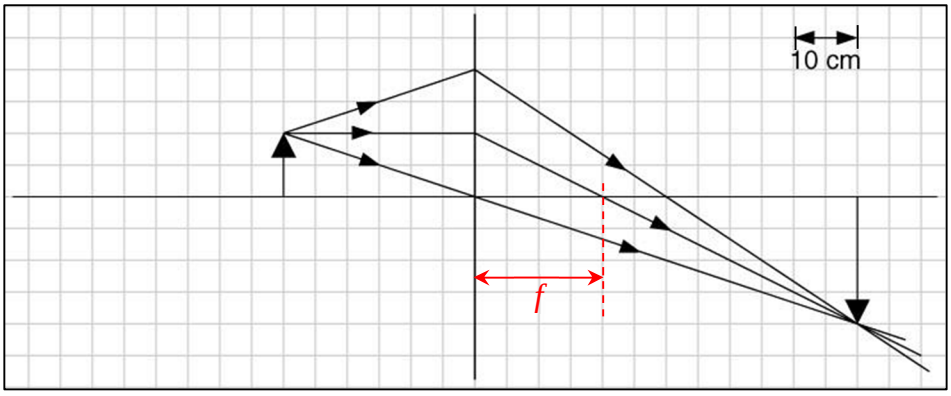
4(a) (i) radiation (ii) conduction

(b) the black surface is a good absorber of infrared radiation from the sun.

(c) Copper is a better thermal conductor to transfer thermal energy to the water

5 Let t be final temperature of coffee

loss of heat by steam + loss of heat by water to become water			=	heat gained by coffee
M L	+	M c Δθ	=	m c Δθ
$(0.025 \times 2.26 \times 10^6)$	+	$0.025 \times 4200 \times (100 - t)$	=	$0.15 \times 5800 \times (t - 20)$
5.65×10^4	+	$10500 - 105\ t$	=	$870\ t - 17400$
		t	=	$86.56 \approx 87$ °C



6(a) Draw an additional light ray through the optical centre to intersect original light ray to locate the image position.
Image distance = (12÷2) × 10 cm = 60 cm.

(b) Draw an additional light ray horizontally, then to meet the image.
Focal length f = (4÷2) × 10 cm = 20 cm.
OR calculation using $1/f = 1/u + 1/v$

7(a) A current flows through him from the car to earth to discharge the net charge on the car body.

OR his body is a conductor, so net charge on the car can be discharged by earthing.

(b) Use conducting / conductive material/ material which is a good electrical conductor / special conducting rubber with high carbon content
to make the car tyres so any excess charge on the car can be removed by earthing.

8(a) Area = $\pi r^2 = \pi \times (d/2)^2) = \pi \times (0.13/1000)^2 = 5.309 \times 10^{-8}$ m^2
$R = \rho L$ / Area = $1.7 \times 10^{-8}\ \Omega$m × 1.0 m / 5.309×10^{-8} m^2 = 0.32 Ω

(b) resistance of 1 strand of 5 m = 0.32 Ω × 5.0 = 1.6 Ω
24 strands are in parallel, resistance of cable = 1.6 Ω / 24 = 0.0667 ≈ 0.067 Ω

OR $R = \rho (5L) / (24A)$

9(a) rate of energy consumption = power dissipated by the oven = $\frac{V^2}{R} = \frac{220^2}{25}$

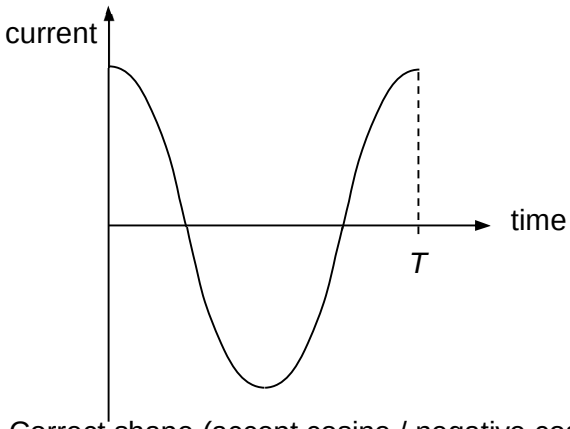
= 1 936 W ≈ 1900 W or 1.9 kW

(b) energy consumed by oven E = P × t = 1.936 kW × 2.5 h × 7 = 33.88 kWh
total cost = 33.88 kWh × $0.28 = $9.49

10 (a) 2 slip-rings (and carbon brushes)

(b) Arrow drawn from A towards B and labelled I

10(c)



- Correct shape (accept cosine / negative cosine curve)
- One complete cycle with approximately constant amplitude, *T* labelled

(d) Rate of cutting of magnetic field lines by the coil is halved (or rate of change of magnetic flux linked with the coil is halved). By Faraday's law, induced e.m.f. is halved, hence the amplitude of the current is halved.

Section B

11(a) The hand represents the focus /origin of earthquakes
The spring represents the ground/the crust/the Earth's surface.
(b) P (or Primary) waves / longitudinal waves
(c) amplitude
(d) crust
(e) $v = f\lambda$ ➔ $\lambda = v / f$
minimum λ = 6.0 km/s / 5.0 Hz = 1.2 km or 1200 m
maximum λ = 7.5 km/s / 5.0 Hz = 1.5 km or 1500 m
Its wavelength ranges from 1.2 km to 1.5 km.
(f) the P-wave velocity decreases rapidly from about 13 km/s to about 7.5 km/s.
(g) S waves cannot pass through molten rock, so they cannot enter the outer core which is made of liquid to reach the inner core.
(h) crust

12(ai) $F_{net} = ma$ ➔ $2400 - 1600 = 950\ a$
$a = 0.84\ m\ s^{-2}$

(aii)1. From *t* = 5 s to *t* = 20 s, the resultant force acting on the car decreases. By Newton's second law, the car is moving with decreasing acceleration.
The velocity (speed) increases at a decreasing rate.

(a)(ii)2. From *t* = 20 s to *t* = 30 s, the resultant force acting on the car is zero. By Newton's first law (OR by Newton's second law, acceleration is zero)
The car moves at constant velocity (constant speed).

(b)(i) P = work done / time = $F \times d / t$ (= $F\ v$) = 2700 (20) / 1
= 54 000 W

(b)(ii) gravitational potential energy of the car increases while kinetic energy remains constant
OR driving force needs to overcome the component of weight down the slope
OR There is also work done against gravitational force

therefore more work has to be done by the engine in the same time. Hence more power needed.

13 EITHER

13(a) e.m.f. is the work done per unit change by the cell to move the charge around a complete circuit.
(accept: work done by the cell to move a unit charge around a complete circuit)

(b)(i) $I = Q/t$ ➔ $Q = I\,t = (0.24\ A)(5 \times 60\ s)$
$= 72\ C$

(b)(ii) e.m.f. = work/Q = energy/Q ➔ energy = e.mf. × Q = 1.5V × 72C
= 108 J

alterative: *Energy* = *P t* = *V* I *t*

(c) Due to the heating effect on the resistor, its resistivity and hence its resistance increases.
Hence, ammeter reading decreases.

(d)(i) (*using potential divider concept for 2 resistors in series)*
V_1 / e.m.f. = $R_1 / (R_1 + R_2)$ ➔ $V_1 / 3.0 = 4000 / (4000 + 2000)$
$= 2.0\ V$

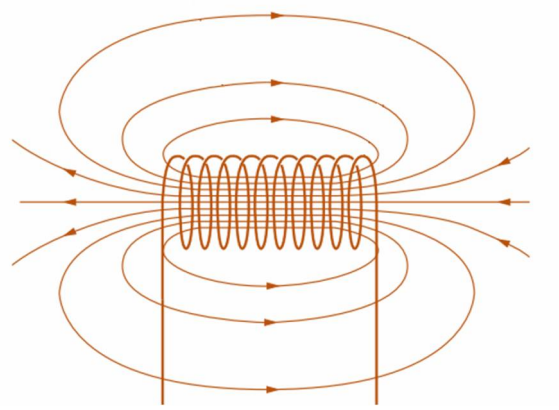
alternative: I = e.m.f. / $(R_1 + R_2) = 3.0 / (4000 + 2000) = 0.00050\ A$
$V = IR = 0.00050\ (4000)$
$= 2.0\ V$

(d)(ii) As the temperature rises above 0 °C, the resistance of the thermistor decreases, hence p.d. across the thermistor will also decrease
by the potential divider concept

OR since the ratio between the resistance of the thermistor and the effective resistance (or the fixed resistor) decreases

13 OR

13(ai) South pole
(a)(ii) lines should be drawn inside and around the solenoid.
(minimally 4 lines should be draw)
correct shape, approximately symmetrical
correct direction



(b) Since a South pole is produced at point P (from (ai)),
by Lenz's law, the current induced in the second coil will produce a South pole on its left to oppose the change in magnetic flux caused by P.

Applying the right hand grip rule, induced current flows from right to left through resistor R.

(ci) $N_s/N_p = V_s/V_p$ ➔ $N_s = (6.0/240) \times 2000$
$= 50$ turns

(cii) **1.** $P = 2 \times 18 = 36\ W$
2. $P_{in} = P_{out} = 36\ W$
$V_p I_p = 36$ ➔ $I_p = 36 / V_p = 36 / 240$
$= 0.15\ A$

Alternative for part 2:
Current flowing through each lamp = P/V = 18/6 = 3.0 A
$I_s = 3.0 \times 2 = 6.0\ A$
$I_p / I_s = N_s / N_p$
$I_p = (50/2000) \times 6.0$
$= 0.15\ A$