BLS 4E Phy Prelim 2021 P1 Answer

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

1

D

Time from X – Y is time for half a period. Time for 1 period = 75 s / 25 = 3.0 s Time for half a period = 3.0 s / 2 = 1.5 s

2 D



Area under V-T graph = distance travelled.

Graph only represents the time period when the cyclist is decelerating.



4

D

Order of movement of the car: stationary, increasing velocity, constant velocity and decreasing velocity in the same direction (so A is wrong as for the last part, the car moves in the opposite direction).

F

2

5



C Since $F_2 > F_1$, the object will move towards the right and friction acts toward the left. For the object to accelerate, the resultant force must be more than zero. $F_2 - F_1 - F > 0$ Only option C is possible.

$$= 200 cm^{3} - 60 cm^{3}$$
$$= 140 cm^{3}$$
mass = density×volume = 15 g/cm³ ×140 cm³
$$= 2100 g$$

7 C

The center of gravity is at position 5, the center of the beam. In order for the beam to be balanced, the pivot should be between position 5 and position 7 (where W_2 is). Only possible answer is C.

8 B

Taking moment about Z, taking clockwise to be positive. Resultant moment = $20 \times 3 - 10 \times 2 - 5 \times 2$ = 30 Nm clockwise

9

C In fig. 9.1,

pressure of trapped air = 75 cm Hg + 5 cm Hg

= 80 cm Hg

In Fig. 9.2,

Pressure of trapped air = 75 cm Hg - 5 cm Hg = 70 cm Hg

Compare the two situations, the product of pressure and volume should be the same. Since the tube used are the same, the cross sectional area will be the same.

 $P_1V_1 = P_2V_2$ $P_1L_1 = P_2L_2$ $80 \times 8 = 70 \times L_2$ $L_2 = 9.1 cm (2 s.f.)$

10 A

Pressure at X and Y are the same since they are at the same level.

$$P_{X} = P_{Y}$$

$$h_{X}p_{X}g = h_{Y}p_{Y}g$$

$$h_{Y} = h_{X}p_{X} \div p_{Y}$$

$$= 8 \text{ cm}$$

11 C

Useful work done = Work done on the box – work done against friction = Fd - Rd

12 C

Power is defined as the work done per unit time. P = WD ÷ t = F × d ÷ t = F × v (assuming the water move at constant speed, v = d ÷ t) = mg × v (force required is the weight of the water pumped out, W = mg) = 150 × 10 × 20 (for 1 second) = 30 000 W = 30 kW

13 D

Option A: Since more gas is added into the vessel, thus the number of particles per unit volume increases. The frequency of collision with the wall of the vessel increases thus pressure increases.

Option B: The intermolecular distance decreases due to the number of particles per unit volume increases.

- Option C: Since more gas is added, mass of the mass increases thus the weight increases.
- Option D: Average kinetic energy remains constant as it is proportional to the temperature of the gas. Since the temperature is kept constant, the average kinetic energy will not change.

14 C

Ceramic tile is a better heat conductor than the woolen carpet, thus heat transfer is slower through the woollen carpet as compared to the ceramic tile. Thus the woollen carpet will feel warmer than the ceramic tile.

15 D

Since radiation is the only method of heat transfer that is only to travel in vacuum, heat from the sun can only be transfer to earth through radiation.

16 B

The thermometer shows error in measuring temperature (constantly measured 1 °C lower) but if you are measuring the difference in temperature, the error will be eliminated.

Difference between melting ice and boiling water = 99 - (-1)

= 100 °C

17 C

$$\begin{split} \Theta &= (\mathsf{R}_{\theta} - \mathsf{R}_{0}) \div (\mathsf{R}_{100} - \mathsf{R}_{0}) \times 100 \\ 20 &= (\mathsf{R}_{\theta} - 2) \div (2.5 - 2) \times 100 \\ \mathsf{R}_{\theta} &= 2.1 \; \Omega \end{split}$$

18 B

Energy required to melt 8.0 g of ice cube = $\frac{8 g}{1000 g} \times 336 kJ / kg = 2688 J$ Time taken to melt the ice cube = $\frac{2688 J}{1.3 J/s} = 2070 s$

19 D

Energy gained by the 2 kg water = energy lost by the 4 kg water $M_2 c\Delta \Theta_2 = M_4 c\Delta \Theta_4$ $2 \times c \times (\Theta - 10) = 4 \times c \times (70 - \Theta)$ $\Theta - 10 = 140 - 2 \Theta$ $\Theta = 50 \ ^{\circ}C$

20 A



Since the wave move to the left, draw a second wave displace to the left, this represent how the wave will be like in the next instant. The particles will move from the first wave to the second wave with only up or down motion.

Particle P will move up and particle Q will move down.

21 B

Frequency is defined as the number of complete wave per unit time. 5 complete waves takes 6 second. Frequency = $5 \div 6$ = 0.83 Hz (2 s.f.)

22

А

When a light ray travels from within an optically denser medium to a medium that is optically less dense at the critical angle, the angle of refraction will be 90°, and it will

travel along the boundary.

23 C

Every second, the mirror will move a distance of 2 m, the image will be 4 m further away from the man. Thus the speed which the image is moving is 4 m/s.

24 D

Due to the high energy of ultraviolet radiation, it can be use to sterilize medical equipment.

25 C

The frequency of sound does not change as the wave travels from one medium to another.

Using v = $f\lambda$, $320 = f \times 0.5$ $f = 320 \div 0.5$ = 640 Hz

26 D

Loudness is proportional to amplitude, the amplitude of the new trace should be larger.

Frequency is proportional to pitch, the frequency of the new trace should be higher. This means that more waves can be seen with the same time.

27 B

Static shocks happen when a built up of electrons is discharged. Movement of protons, neutrons and cations involve moving the whole atom / molecules.

28 A

Since rod X and rod Y repels, X and Y have the same charge. Only option A and D are possible. Since rod X and rod Z attracts, X and Z have opposite charges or Z is neutral. Only option A is possible.

29 C

Lamp Q have the same brightness as the potential difference across Q is not affected by the jockey connection on XY.

When the jockey slides along X to Y, a short circuit is introduced in the circuit. The effective resistance along path with lamp P will decrease. The current in the path with lamp P will increase. The potential difference across lamp P will also increase due to the decrease in effective resistance of XY.

30 A

31

Effective resistance of parallel resistors = $(1 \div 3 + 1 \div 6)^{-1}$ = 2 Ω Potential difference across the parallel resistors = 12 ÷ 2 (Shared equally since resistance are equal) = 6 V Current through 6 Ω resistors = V ÷ R $= 6 \div 6$ = 1 A Using Q = It $= 1 \times 1$ = 1 C B Potential across 6 Ω resistor, V = IR $= 4 \times 6$ = 24 V Potential difference across 12 Ω resistor = Potential across 6 Ω resistor 5

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= 24 V
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Using V = IR, $24 = I \times 12$ I = 2 ACurrent through ammeter = 4 + 2 = 6 A

32

В

When the resistance of R increases, the effective resistor connected to voltmeter V_2 increases. Voltmeter V_2 will then register a high reading and the reading on voltmeter V_1 will decreased since the sum of V_1 and V_2 must remains constant.

33 B

Option A: Electrical energy = Pt = $(50 \div 1000) \times 2$ = 0.1 kWhOption B: Electrical energy = Pt = $(3000 \div 1000) \times (20 \div 60)$ = 1 kWhOption C: Electrical energy = $I^2 \text{Rt}$ = $(0.1)^2 \times 100 \times 10$ = 10 kWhOption D: Electrical energy = Pt = $(50 \div 1000) \times (30 \div 60) \times 2$ = 0.05 kWh

34 B

When live wire touches the case, due to the low resistance of the earth wire, current flow will increase. This will cause the fuse to melt and break the circuit.

35 B

Direction of magnetic field lines start from north pole pointing to south pole.

36 C

Direction of magnetic field lines start from north pole pointing to south pole. If compass A and B are correct, the end nearer to compass A is a south pole. The end nearer to compass D will be a north pole, which means compass D is pointed correctly.

37 B

Using Fleming's left hand rule, Index finger represent magnetic field pointing into the paper. The middle finger which represents the current (flow of positive charge) points toward the right. The thumb which represents force will be pointing up. The positive ion will experience an upwards force.

38 A

Unlike poles attract, thus magnet Y will attract magnet X. Since Z is soft iron, magnet Y will cause Z to become an induced magnet thus attracting Z.

39 B

Using the right-hand grip rule, the magnetic field of a wire flowing into the paper is clockwise.



Thus, the wires will move towards each other.

40

 $N_{S} \div N_{P} = V_{S} \div V_{P}$ $N_{S} = 12 \div 240 \times 1200$ = 60

The number of turns of coil in secondary coil is 60.

P2 Section A

1

 (a) scale: 1cm: 200N [1] Resultant force = 1732N +/- 40 N [1] Direction: Upwards [1] (No north) Correct drawing using parallelogram or tip to tail method with correct arrows [2] For Examiner

Use



2

3

Label W and indicate distance of 1.5 m. [1] (a) (b) Taking moments about X, Total clockwise moments = Total anticlockwise moments $(T_2 \times 2.3) + (20 \times 0.2) = (10 \times 1.3) + (40 \times 1.6)$ [1] $T_2 = 31.7 \text{ N}$ [1] Total Upwards Force = Total Downwards Force (C) $T_1 + 31.7 = 70$ [1] $T_1 = 38.3 N$ [1] Force = $10 \div 2.0 \times 2.8$ (a) = 14 N [1]

С

- (c) Any possible methods
 - Piston with smaller cross sectional area
 - Increase the force to compress the spring per unit length
- (d) When the gauge is attached, there is a slight increase in the overall volume of the tyre. [1]

The same number of molecules hit the larger walls of the tyres with the same force resulting in the fall in pressure. [1]

4 (a)

The arrangement of the atoms changes from one that is closely packed together in a regular arrangement to one which is closely packed but without any order. The atoms are now able to move about, sliding over each other from vibrating about a fixed position [1].

(b)

(i)

In conduction, heat is transfer through the substance through vibration of molecules and free electrons for metal. [1]

[1]

[1]

In convection, heat is transfer due to density changes of the particles. [1]

5 (a)

- energy = P x t = 200 x (4 x 60) = 48 000 J
- (ii) Heat loss by heater = heat gained by substance X $200 \times (6 \times 60) = 0.4 \times I_{f}$ $I_{f} = 72000/0.4$ $= 180\ 000\ J/kg$



Immerse the bulb of the thermometer into pure melting ice and ensure that the bulb of the thermometer is covered in ice. [1]

Wait for the liquid level in the thermometer to decrease to a constant length (height).

That level (or point) will be the lower fixed point. [1]



7

(a)

- time difference = 0.6 0.2(i) = 0.4 s speed = $2d \div t$ $1350 = 2d \div 0.4$ [1] $2d = 1350 \times 0.4$ $d = 540 \div 2$ = 270 m [1] (ii) $v = f\lambda$ $1350 = 4500 \times 10^9 \times \lambda$ [1] $\lambda = 3.00 \text{ x} 10^{-11} \text{ m}$ [1]
- (b) There might be a school of fishes or debris in the water. [1] Any other reasonable answer.
- (c) Checking of cracks in structures. [1] Any other possible answer.
- 8
- (a) Positively charged
- (b) The sphere oscillates between the 2 plates X and Y.

[1]

On touching X, the sphere lost its negative charges and becomes positively charged and the sphere repels from X as like charges repel. It swings towards and hits plate Y. [1] On hitting Y, the negative charges of Y flows to the sphere and the sphere becomes negatively charged. It then repels from Y and swings towards X. The motion repeats itself with its oscillatory motion. [1]

- (c) As the sphere swings and hits the plates X and Y, its electrical charge changes. The sphere transports electrons from plate Y to X. Current flows momentarily when the electrons are moved between the two plates. Thus the ammeter registers current periodically. [1]
- 9 (a) The magnetic field generated by the apparatus aligned the domains in the steel rod placed inside the coil with the swtich closed. [1]
 Steel is a hard magnetic material and retains magnetism well. [1]
 - (b)
- (i) Soft iron



all lines directly join from left to right and top line goes down and bottom line up [1]

no line inside the box and no lines cross



Section B [30 marks]

10

- (a) $ke = \frac{1}{2} mv^2$ $= 0.5 \times 0.025 \times 56^{2}$ [1] = 39.2 J [1]
- (b) a = (v-u)/t = (0 - 56)/0.02[1] $= -2800 \text{ m/s}^2$ Deceleration = 2800 m/s^2 [1]

- work done = F x d(C) = 70 x 0.12 [1] = 8.4 J [1]
- (d) By the Principle of Conservation of Energy KE = WD+ GPE 39.2 = 8.4 + GPE [1] GPE = 30.8 (Since GPE = mgh) 30.8 = mghh = (30.8) / (0.025 + 8.0)(10)= 0.384 m (theoretical value) [1]
- As the card falls, the light from torchlight is blocked by the card, the resistance 11 (a) of the LDR increases. [1]

When the light is not blocked by the card and reaches the LDR, the resistance of the LDR decreases. [1]

When the light is blocked by the card once again, the resistance of the LDR increases. [1]

When resistance of LDR increases, the potential difference across the LDR (b) also increases. [1]

Since the variable resistor is in series with the LDR, [1] when p.d. of LDR increases, the p.d. across the variable resistor will decrease two times, for the top and bottom of the card. [1]

10

(c) The time interval 1 is caused by the bottom of the card which reaches the LDR level first. [1]

When the top of the card reaches the LDR level, the speed of the card is faster, hence the shorter time interval 2. [1]

(d) Initial speed =
$$5.0 \div (0.1516 - 0.0490)$$

= 48.733 cm/s
Final speed = $5.0 \div (0.3003 - 0.2784)$
= 228.311 cm/s [1]
Time interval = $(0.3003 + 0.2784) \div 2 - (0.1516 + 0.0490) \div 2$
= 0.18905 s
Average acceleration = $(228.311 - 48.733) \div 0.18905$
= 949.9 cm/s^2
= 950 cm/s^2 (to 3 s.f.) [1]

12 Either

(a)

- (i) The needle deflects to the left. [1]
- (ii) Current moves from A to B. [1]
- (ii) There will be no deflection in the needle. As the wire AB is stationary, there will not be any rate of change of magnetic flux linkage with the magnet. [1]



(



(C)

Using the above set-up, keeping all other constant,[1] increase the number of loops in the coil. Observe the change in the voltmeter reading. If the voltmeter reading increases, the increase in the number of loops will mean that the magnitude of induced current increases. [1]

12 Or

- (a) Fuse and switch on live wire and correct symbols [1] Live and neutral wires connected correctly [1] Earth wire connected correctly [1]
- (b) 2000 J of electrical energy converted to heat energy per second. [1]
- (c) Wire A is connected to a switch. [1]
 When the switch is opened, the lamp will be disconnected from high voltage.
 [1]
- (d) The metal case is earthed. [1]

When the metal casing becomes live, a large current flows through the earth wire instead of the user because it has a lower resistance than the human body. [1]

This causes the fuse to melt. Thus, the metal case is disconnected from high voltage and the user does not get an electric shock. [1]

(e) The outer casing is made of plastic. Current cannot flow through it. [1]